

PROCEEDING:

2ND INTERNATIONAL SYMPOSIUM ON SOCIAL SCIENCES, BUSINESS, EDUCATION AND TECHNOLOGY 2026 (2ND ISBET 2026)





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PREFACE

On behalf of the organizing committee, it is my great pleasure to present the proceedings of the 2nd International Symposium on Social Sciences, Business, Education and Technology 2026 (ISBET 2026). This symposium serves as a dynamic platform that brings together academics, researchers, practitioners, and students from diverse disciplines to exchange ideas, share research findings, and foster meaningful collaborations.

ISBET 2026 reflects our collective commitment to advancing knowledge and addressing contemporary challenges across the fields of social sciences, business, education, and technology. The contributions compiled in this proceedings volume represent rigorous research efforts and innovative perspectives that are both relevant and impactful to the global academic and professional communities.

I would like to extend my sincere appreciation to all authors for their valuable contributions, as well as to the reviewers and editorial team for their dedication in ensuring the quality and integrity of the published papers through a thorough review process. My gratitude also goes to the organizing committee and Global Academic Excellence (M) Sdn Bhd for their continuous support and commitment in making this symposium a success.

It is my hope that this proceedings will serve as a useful reference and inspiration for future research, collaboration, and innovation.

Thank you.

Assoc. Prof. Ts. Dr. Muhamad Saufi Che Rusuli

Conference Chairman

2nd International Symposium on Social Sciences, Business,
Education and Technology 2026 (ISBET 2026)

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OCCUPATIONAL SAFETY IN THE TRANSPORTATION SECTOR: A BIBLIOMETRIC REVIEW

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Abstract: *These days, occupational safety is equally critical in the transportation sector, just as it is in other sectors, such as manufacturing and construction. A likely reason is that employees in the transportation sector are also exposed to a myriad of hazards that can adversely impact their health, well-being, and system performance. The primary objective of this study was to evaluate 1,361 publications indexed in Scopus and Web of Science (WoS) from 1990 to 2024 that were related to occupational safety in the transportation sector. This study identified global publication trends, influential institutions and countries, productive source titles, thematic concentration, and trending research using ScientoPy and VOSviewer. The bibliometric analysis results indicated that the number of publications has increased significantly since 2015, particularly during and after the COVID-19 pandemic. India and China are both actively publishing on this topic between 2023 and 2024, while the United States leads in terms of the number of publications. The thematic evolution has undergone a paradigm shift from the context of traditional concerns (ergonomics and accidents) to contemporary priorities, including sustainability, mental health, workplace violence, and Artificial Intelligence-based safety. This study contributes to the existing body of literature by incorporating insights into the current research trajectories that are driving trends in occupational safety research within the employment sector. The results of this study provide practitioners and policymakers with the most up-to-date information on this research. Future research should broaden the scope of occupational safety research in the transport sector to encompass multidisciplines, including digital hazards and the capacity of transport systems in diverse socio-economic contexts.*

Keywords: *Occupational Safety, Transportation, Workplace Violence*

Introduction

Occupational safety remains a pressing concern within the global transport sector, affecting workers in developed and emerging economies. Across various transport modes, employees are routinely exposed to complex and interrelated hazards, physical (Ito et al., 2023), ergonomic (Diniz et al., 2024), and psychosocial (Mościcka-Teske et al., 2024) that compromise their health, well-being, and productivity. From long-haul truck drivers and maritime seafarers to urban transit operators, the transport working circumstances is inherently hazardous (Sinclair et al., 2021), characterised by chronic fatigue, irregular schedules, exposure to vibration, violence, and extreme weather conditions (Peters et al., 2021). These risks contribute to persistently high rates of occupational injuries and fatalities worldwide (Lilley et al., 2021), particularly within road freight (Abdullah, 2021a) and maritime transport (Abdullah,

2021b), where operational demands and environmental uncertainties further heighten safety vulnerabilities.

The transport sector's diversity adds to the complexity of occupational safety management. Road, rail, maritime, and aviation subsectors present unique risks and systemic challenges. In road transport, long working hours, inadequate rest periods, and limited access to healthcare contribute to chronic physical strain and elevated accident risks (Rainey et al., 2019). Truck drivers, for instance, often endure prolonged sedentary work, disrupted circadian rhythms, and high mechanical vibration, factors closely linked to musculoskeletal disorders and fatigue-related crashes (Peters et al., 2021). Sleep deprivation is a particularly critical factor; drowsy driving alone accounts for 16.5% of fatal road crashes in the United States (Rainey et al., 2019).

Similarly, the maritime sector presents distinct occupational safety challenges. Working conditions aboard cargo vessels are especially strenuous, with crew members frequently subjected to high workloads and limited organisational support. Nævestad et al. (2018) observed that lower safety culture and inadequate leadership onboard cargo ships correlated with a higher incidence of accidents than passenger vessels, underlining the importance of organisational behaviour, communication, and safety training. In public transport systems, psychosocial risks such as harassment and fear of violence have become increasingly prominent, especially among female users and employees. Ceccato and Loukaitou-Sideris (2021) emphasised how gendered perceptions of safety affect transit usage, operational dynamics, and employee morale, suggesting a broader need for inclusive and psychologically safe transport environments.

Maritime and aviation sectors also contend with challenges of isolation, mechanical reliability, and environmental unpredictability. Regional cultural variations in safety perceptions and organisational practices further complicate these issues. For instance, Dui et al. (2021) developed a prioritisation framework for assessing the resilience of routes and ports during disruptive events in maritime logistics. Their study stressed the need for risk-informed infrastructure design and prioritised recovery planning to reduce operational and economic losses during crises. Likewise, implementing strategic planning and business optimisation in the aviation sector is essential to strengthening recovery processes, particularly when integrated with proactive risk mitigation and response strategies (Gorodnicka & Alomar, 2022). Based on these insights, targeted recommendations were formulated and presented to aviation management to enhance preparedness for future disruptions and ensure continuity of operations.

In rail transport, locomotive operations pose unique health and safety risks. Finochenko et al. (2021) documented the progressive deterioration of engine drivers' physical and cognitive health due to prolonged exposure to noise, vibration, and mental stressors. These factors, if unmanaged, may impair cognitive vigilance and elevate the likelihood of derailments or collisions. Consequently, the authors advocated for integrated risk management systems combining technical safety protocols with human interventions. Complementing this view, Umar et al. (2025) identified a critical oversight in current railway safety practices, underemphasising expert judgement's reliability. Given that expert evaluations often serve as

proxies for empirical data in safety assessments, failing to address their reliability could undermine the integrity of rail safety decision-making processes.

Technological advancement introduces both new opportunities and novel challenges in occupational safety. Artificial intelligence (AI), sensor networks, and data-driven systems are increasingly embedded in safety management strategies, offering capabilities such as real-time fatigue detection, hazard prediction, and automated emergency response (Abdullah & Sofyan, 2023). The Risk Evolution, Detection, Evaluation, and Control of Accidents (REDECA) framework provides a robust structure for assessing AI integration in occupational safety, with applications ranging from robotics in hazardous zones to wearable technologies for risk monitoring (Pishgar et al., 2021). The rise of autonomous vehicle systems and intelligent transport infrastructure also presents new safety paradigms. Jin et al. (2022), for example, systematically examined the resilience of autonomous vehicles under adverse weather and communication delays. Their findings indicated that sensor degradation under such conditions significantly compromises traffic safety, prompting a call for rigorous design standards and simulation-based validation across diverse operational scenarios.

Considering these developments, a growing body of research underscores the importance of advancing occupational safety in transport through technological innovation, improved regulatory frameworks (Fan & Yang, 2022), and a deeper understanding of health dynamics (Peters et al., 2021). Despite this growing interest, however, the research landscape remains fragmented. Many studies focus narrowly on subsectors such as sustainable transport (Bao et al., 2023), injury prevention (Alkhaleefah et al., 2021), or rail safety (Umar et al., 2025), without offering a holistic view of global research patterns pertinent to occupational safety. As a result, policymakers and scholars often struggle to identify critical knowledge gaps, under-researched populations, and emergent safety technologies. This lack of synthesis impedes coordinated international collaboration and delays the formulation of comprehensive safety policies.

To address this gap, the present study aims to conduct a bibliometric analysis of global research on occupational safety in the transport sector. Specifically, it seeks to map publication trends, identify leading contributors, and uncover thematic evolutions and emerging research frontiers. This study aspires to inform policy development, support cross-sectoral knowledge exchange, and stimulate deeper scholarly engagement in transport safety research by offering an integrated overview. The following research questions guide this investigation:

1. What are the global publication trends on occupational safety in the transportation sector?
2. Which institutions and countries are the most influential on occupational safety in the transportation sector?
3. What is the distribution of publications across source titles on occupational safety in the transportation sector?
4. What are the most frequently studied topics and emerging themes on occupational safety in the transportation sector?
5. Which articles are the most cited on occupational safety in the transportation sector?

Research Methodology

Data Collection and Ethical Considerations

Datasets used in the current study were retrieved in March 2025 from two leading bibliographic databases, Scopus and Web of Science (WoS). This procedure ensures comprehensive and high-quality coverage of scholarly literature. These databases were selected for their extensive indexing of peer-reviewed journals, robust citation tracking capabilities, and broad disciplinary scope (Abdullah & Sofyan, 2023). Scopus, managed by Elsevier, is recognised for its breadth of coverage across social sciences, engineering, and health-related fields (Sofyan & Abdullah, 2022), while WoS, curated by Clarivate Analytics, is esteemed for its high selectivity and depth, particularly in established and high-impact journals (Verma & Sharma, 2024). Thus, using both databases mitigates the risk of publication bias and enhances the validity of bibliometric analyses by enabling cross-validation of data sources.

The search strategy was carefully constructed to ensure the retrieval of publications that directly address the intersection of occupational safety and the transportation sector. To achieve this, the Boolean search string (“occupational safety” OR “workplace safety”) AND (“transportation” OR “logistics” OR “road transport” OR “freight”) was applied across both databases, targeting the Title, Abstract, and Keywords fields. This combination of safety-related and sector-specific terms enabled the capture of literature spanning various transport modes while maintaining relevance to occupational safety.

Restricting the search to these three metadata fields (Title, Abstract, and Keywords) ensured a balance between specificity and comprehensiveness, as these sections indicated a publication’s core content (Pottier et al., 2024). The use of synonyms and related terms (“occupational safety” and “workplace safety”) expanded the scope to include literature that might use discipline-specific or regional variations in terminology. Similarly, including terms such as “logistics” and “freight” alongside “transportation” ensured coverage of both macro-level systems and micro-level operations within the sector (Maiboroda et al., 2021). This strategy was intended to reduce false negatives (relevant studies being missed) while limiting false positives (irrelevant studies being retrieved), thereby enhancing the validity of the bibliometric dataset.

This study is based solely on secondary data derived from publicly accessible databases (Scopus and WoS) and does not involve human participants, animals, or sensitive personal data. As such, ethical approval was not required. The analysis and reporting were conducted in accordance with ethical academic research standards, ensuring accuracy, transparency, and the responsible use of bibliometric information.

Scope and Limitations

Although Scopus and WoS offer extensive coverage of peer-reviewed publications, the analysis may not include grey literature, preprints, or regionally indexed journals outside their scope. This limitation may exclude certain locally relevant studies or emerging research not yet captured by major databases. Nevertheless, using a dual-database strategy, combined with

the application of established bibliometric tools, enhances the study's findings' robustness, transparency, and replicability.

The current study on occupational safety in the transportation sector did not initially limit the publication year during the search process. This open-ended approach ensured a comprehensive retrieval of all relevant literature available in the selected databases. Yet, for analytical consistency and to reflect the meaningful evolution of the field, the analysis was confined to publications from 1990 to 2024. This timeframe was selected based on the observation that scholarly attention to transportation safety contexts began to gain momentum around the early 1990s (Hagenzieker et al., 2014). By setting 1990 as the starting point, the study captures the foundational developments, key thematic shifts, and emerging trends over three decades, providing a robust longitudinal view of the research landscape.

Bibliometric Tools and Analysis

To analyse the retrieved dataset systematically and visualise the intellectual structure of the research landscape, this study employed two widely recognised and complementary bibliometric software tools: ScientoPy and VOSviewer. Although numerous tools are available for conducting bibliometric analysis, such as Bibliometrix (Büyükkıdık, 2022), biblioMagika (Nour El Huda et al., 2023), and SciMAT (Abdullah et al., 2022), the selection of ScientoPy and VOSviewer in this study was guided by their alignment with the current research objective and the nature of the research questions. These tools were deemed suitable for providing performance analysis and science mapping, thereby supporting a comprehensive examination of publication trends, thematic structures, and scholarly influence within occupational safety in transportation.

ScientoPy was utilised primarily for performance analysis, providing descriptive statistics on the evolution of scientific output over time (Abdullah, 2023b). This included identifying annual publication trends, leading source titles, active countries and institutions, and high-frequency keywords. ScientoPy was selected for its ease of use, Python-based architecture, and ability to generate automated trend graphs and productivity metrics (Ruiz-Rosero et al., 2019). Its capacity to handle large datasets and perform keyword trend analysis over time made it particularly suitable for uncovering the dynamic thematic evolution within occupational safety in transportation research.

VOSviewer, on the other hand, was employed to perform science mapping through co-authorship, co-occurrence, citation, and co-citation analysis (Abdelwahab et al., 2023). This tool was selected due to its powerful graphical interface and ability to generate and cluster bibliometric networks, allowing for identifying thematic structures within the dataset (Van Eck & Waltman, 2014). The visualisation thresholds, such as the minimum number of keyword occurrences, citations, or co-authorship links, were determined based on the dataset's characteristics to facilitate accurate mapping. This approach ensures interpretability while preserving the integrity of meaningful network structures. Hence, VOSviewer was explicitly used to map co-occurring keywords to identify prominent and emerging research themes.

Data Cleaning and Preprocessing

Before analysing the measurable parameters, it is essential to conduct a preprocessing step on the downloaded dataset. This initial procedure involves merging all retrieved files into a single unified dataset and eliminating duplicate entries. Preprocessing also includes standardising the data by replacing commas in author names with semicolons, removing punctuation marks such as dots and commas, and correcting irregular characters or accents. Records containing identical author names and titles are also filtered out. These steps help improve the overall consistency and reliability of the dataset (Ruiz-Rosero et al., 2019).

Subsequent to initial processing, the data were consolidated into a singular dataset. Table 1 summarises the data preprocessing steps applied to the combined datasets retrieved from Scopus and WoS. A total of 1645 documents were initially loaded. After removing 64 records based on document type (retaining only articles, conference papers, proceedings, and review papers), 1581 valid records remained. Of these, 275 papers (17.40%) originated from WoS and 1306 (82.60%) from Scopus.

Table 1: Summary of Data Preprocessing

Information	Number	Percentage
Loaded papers from Scopus and WoS	1645	
Omitted papers by document type (only included article, conference paper, proceeding paper, and review paper)	64	3.90%
Total papers after omitted papers removed	1581	
Loaded papers from WoS	275	17.40%
Loaded papers from Scopus	1306	82.60%
Duplicated papers found	220	13.90%
Removed duplicated papers from WoS	0	0.00%
Removed duplicated papers from Scopus	220	16.80%
Duplicated documents with different cites by	141	64.10%
Total papers after removing duplicates	1361	
Papers from WoS	275	20.20%
Papers from Scopus	1086	79.80%

During the deduplication process, 220 duplicate records (13.90%) were identified, all of which were removed from the Scopus dataset. Notably, none of the duplicate entries were found in the WoS dataset. Among the duplicates, 64.10% represented the same documents cited differently across databases. After removing duplicates, the final dataset comprised 1361 unique records: 275 (20.20%) from WoS and 1086 (79.80%) from Scopus.

The final dataset comprised 1361 publications retained after rigorous data-cleaning procedures, including removing irrelevant document types and duplicate records. This sample size is considered sufficient and robust for conducting bibliometric analysis, particularly within a specialised research domain such as occupational safety in the transportation sector. According to prior studies, bibliometric analyses have been undertaken effectively using datasets of

comparable or even smaller sizes, provided that the data are representative and well-curated (Abdullah, 2023a; Donthu et al., 2021). The refined dataset offers adequate breadth to capture key publication trends, author and institutional productivity, thematic evolution, and citation patterns. Furthermore, including articles from both Scopus and WoS ensures high-quality scholarly content and enhances the generalisability of the findings across academic contexts.

Results and Discussion

Global Publication Trends in Occupational Safety and Transportation

Figure 1 illustrates the annual distribution of publications on occupational safety in the transportation sector, retrieved from Scopus and WoS databases between 1990 and 2024. The trend indicates a marked increase in research output over the past three decades, with Scopus consistently contributing a significantly higher number of publications than WoS across nearly all years. In the early 1990s, publication volume remained low and relatively stable, with both databases recording fewer than 15 articles per year. This limited output is reflected when occupational safety research was primarily focused on general industrial contexts, with transport-specific studies receiving comparatively less academic attention (Cunningham et al., 2020). However, beginning in the early 2000s, the volume of publications increased steadily, particularly in Scopus. This growth can be attributed to factors such as the expansion of transport and logistics infrastructure and the increasing accessibility of digital publication platforms (Serdyukova et al., 2020).

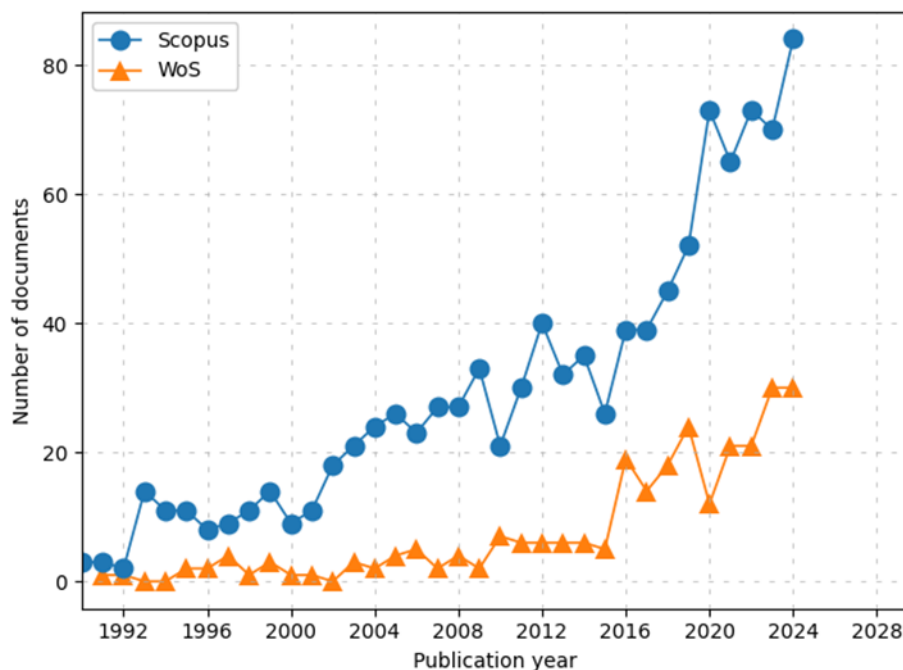


Figure 1: Global Publication Trends

A more substantial surge in publication activity is observed after 2015. Scopus recorded a sharp rise from 26 articles in 2015 to 84 in 2024, indicating a growing scholarly interest in occupational safety within the transportation sector. Similarly, WoS experienced noticeable

growth, albeit slower, rising from 5 articles in 2015 to 30 in 2024. The year 2020 marked a peak, with 73 publications in Scopus, possibly reflecting heightened concerns over occupational safety during the COVID-19 pandemic and its effects on global transport operations (Shan, 2022).

This upward trend aligns with global occupational health and transport safety policy developments, technological innovation, and interdisciplinary research efforts (Akyıldız, 2023). The consistent dominance of Scopus may be attributed to its broader coverage of applied and technical journals, especially in transportation, logistics, and engineering domains (Vengadesh et al., 2023). Meanwhile, the growing representation in WoS, particularly post-2016, suggests an expanding academic recognition of this research area within high-impact and discipline-specific journals.

The data suggest a sustained and growing global interest in occupational safety in transportation, with strong momentum in the past decade. This trajectory reflects the sector's evolving risks, the increasing complexity of logistics systems, and the emergence of new challenges such as automation, pandemic response, and climate-related hazards (Parsakia & Tabar, 2024), all of which have likely contributed to expanding academic output in this field.

Leading Countries and Institutions Contributing to the Field

Figure 2 highlights the top 10 countries contributing to research on occupational safety in the transportation sector and the percentage of documents published in the last two years (2023–2024). The United States leads significantly in total publications, contributing 445 documents, reflecting its long-standing academic investment in transport and safety research. However, only 11% of its output was published in the most recent two-year period, indicating a relatively steady but not accelerating trend.

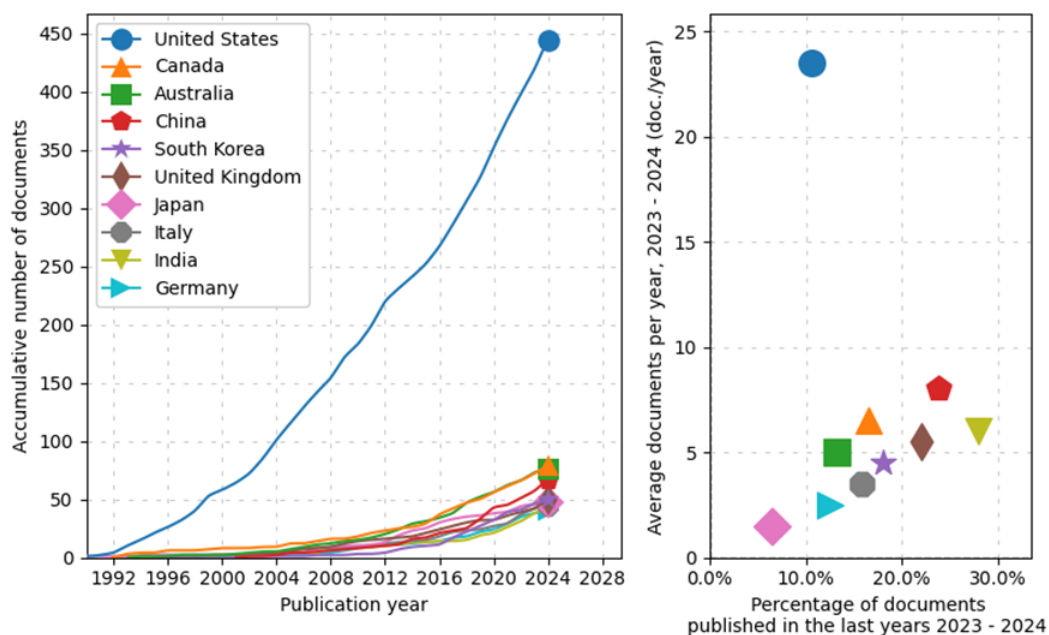


Figure 2: Leading Countries

In contrast, several countries with lower total outputs show notable recent research momentum. For instance, with 43 publications, India had 28% published from 2023 to 2024, the highest proportion among the top contributors. Similarly, China (24%), the United Kingdom (22%), and South Korea (18%) demonstrate significant recent engagement, suggesting a rapid acceleration in research activity in these regions. This may be attributed to increasing policy focus on worker safety, growing industrial and logistics sectors, and expanding academic capacity in occupational health and transportation systems.

Other countries such as Canada (17%), Italy (16%), and Germany (13%) also show stable but moderate recent contributions, indicating continued interest without sharp increases. Despite its established research infrastructure, Japan displays a relatively low recent output rate (6%) compared to its total, which may suggest either a plateau in academic focus or publication in non-indexed sources.

The data suggest a geographical shift and diversification in the research landscape, with emerging economies and traditionally underrepresented regions increasingly contributing to the global discourse on transport-related occupational safety (Ahuchogu et al., 2024). This reflects the globalisation of logistics networks, increased occupational risk awareness, and growing investment in research capacity within these nations.

Figure 3 presents the most active institutions contributing to scholarly research on occupational safety within the transportation sector. The analysis highlights a strong institutional presence from the United States, which dominates the top tier of contributors. The National Institute for Occupational Safety and Health (NIOSH), United States, leads by a wide margin, with 13 publications, underscoring its authoritative role in occupational safety research and policy development. NIOSH's emphasis on applied research and sector-specific interventions likely contributes to its prominence, particularly in transport-heavy logistics, aviation, and public transit industries.

A group of institutions tied at four publications each includes Baylor University (United States), the Centers for Disease Control and Prevention (CDC, United States), Michigan State University (United States), and the University of Kentucky (United States). These institutions and many public research universities with active programmes in public health, ergonomics, and industrial engineering play a pivotal role in advancing multidisciplinary approaches to safety.

Additional contributors include George Washington University (United States), Iowa State University (United States), and the University of Texas at Arlington (United States), each with three publications. Their participation reflects a broader trend of regional academic engagement in occupational health, often tied to collaborations with state-level safety authorities or transportation agencies.

Notably, Universiti Teknologi Malaysia (Malaysia) appears as the sole non-Western institution in this top group and contributes three publications. This inclusion signals a growing research presence from Southeast Asia, potentially driven by Malaysia's expanding transportation

infrastructure and its national emphasis on workplace safety through initiatives like OSH Master Plans (OSHMP) (Rahman et al., 2019).

This institutional distribution suggests that while the United States continues to lead in academic output, international representation is beginning to emerge, particularly from countries investing in transport infrastructure and safety governance. Encouraging collaboration between institutions from high-income countries and those from developing regions can help improve knowledge exchange, introduce diverse viewpoints, and support the development of safety research better suited to different local and regional transportation contexts.

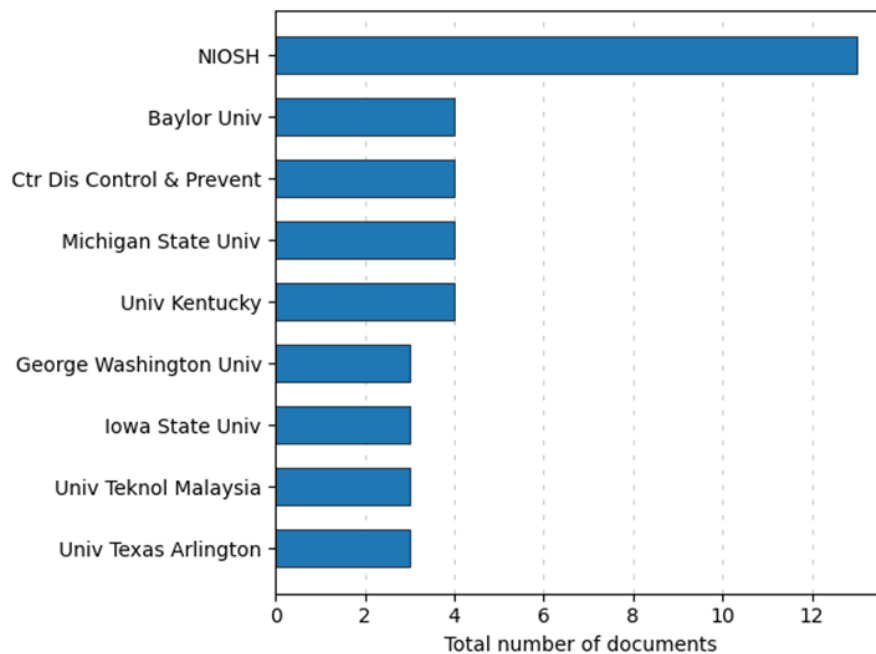


Figure 3: Leading Institutions

Source Title Distribution and Core Journals

Figure 4 presents the top ten source titles that have contributed the most to the literature on occupational safety within the transportation sector. Safety Science leads with 94 publications, confirming its status as the core journal in the field. As a high-impact, interdisciplinary journal focused on safety research, its dominant share (13% of its articles published in 2023–2024) indicates sustained relevance and ongoing engagement with contemporary occupational safety and transport issues.

Other prominent journals include the American Journal of Industrial Medicine (47 articles) and the International Journal of Environmental Research and Public Health (39 articles), the latter showing a strong recent contribution, with 15% of its articles published in the last two years. Journals such as the Journal of Occupational and Environmental Medicine (27 articles) and

PLOS ONE (23 articles, 13% recent output) also contribute significantly, demonstrating this research domain's interdisciplinary and public health-oriented nature.

Notably, Safety and Health at Work shows the highest recent activity, with 30% of its publications in this area appearing in 2023–2024. This suggests that the journal is emerging as a dynamic platform for new workplace and transport safety research. Similarly, BMC Public Health, although lower in overall volume (13 articles), demonstrates a remarkably high proportion of recent contributions (39%), reflecting its growing relevance in publishing transport-related occupational safety studies from a public health perspective. Conversely, journals like Industrial Health, Occupational Medicine, and the International Journal of Industrial Ergonomics, despite their historical focus on occupational issues, have not shown any recent publications in this field. This may indicate a shift in thematic focus or a decline in the coverage of transport-specific occupational safety topics in those outlets.

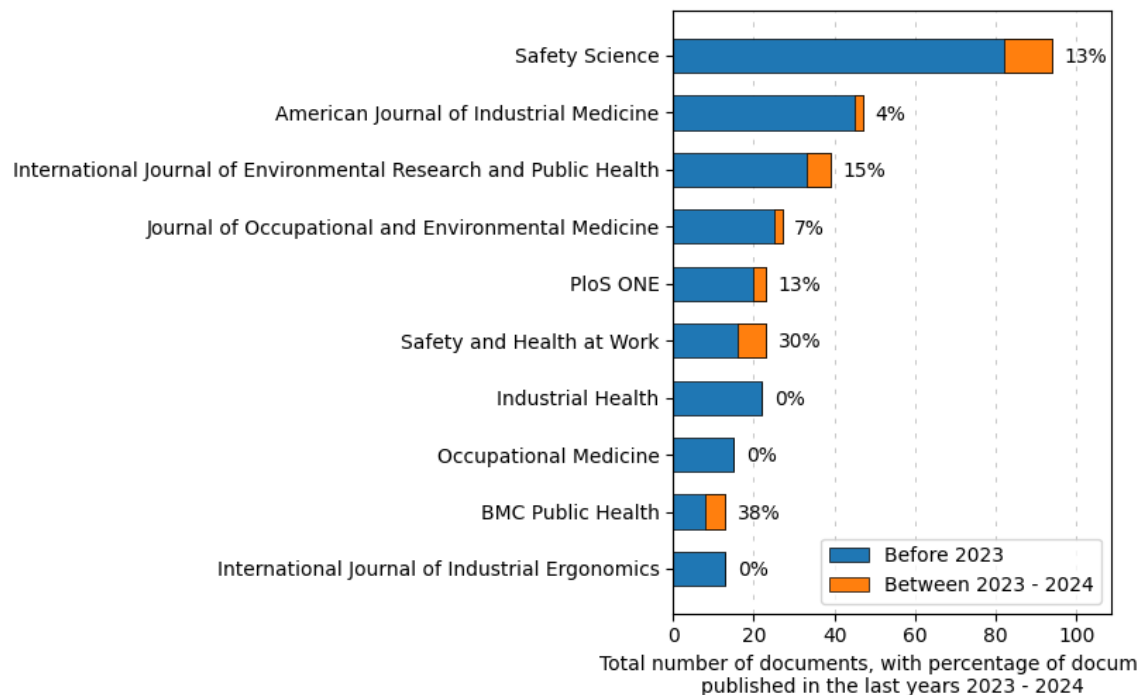


Figure 4: Source Titles and Recent Publication Activity

The source title analysis reflects the established scholarly anchors and emerging journals contributing to the development of this field. It also highlights the interdisciplinary nature of the topic, which spans safety science, occupational medicine, ergonomics, and public health. These insights are crucial for future researchers seeking suitable publication outlets and understanding how the academic conversation is evolving in response to emerging global safety challenges in transportation.

Thematic Foci and Emerging Research Areas

Figures 5 and 6 collectively illustrate the evolution of thematic foci and highlight emerging research areas in the field of occupational safety related to transportation. Based on ScientoPy keyword trend analysis (see Figure 5), a clear emphasis is seen on core themes such as occupational safety and health, risk assessment, workplace safety, epidemiology, fatigue, and occupational exposure. Among these, workplace safety demonstrates the highest recent activity, with 33% of publications appearing in 2023 to 2024, followed by occupational safety and health (28%) and risk assessment (21%). This pattern suggests a growing focus on integrated safety strategies and predictive risk frameworks in response to modern workplace challenges (Finochenko et al., 2021).

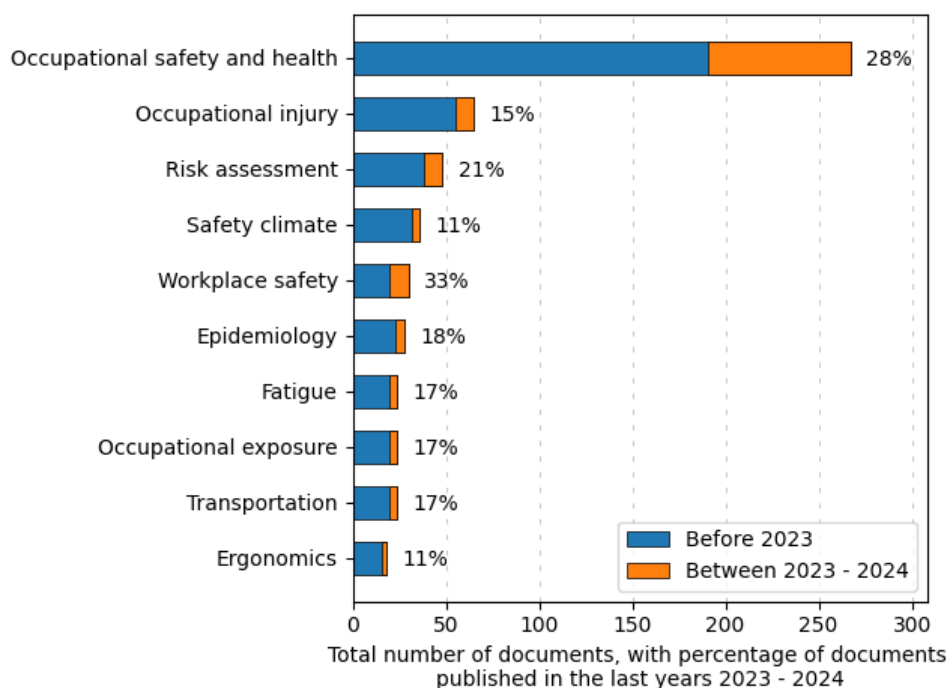


Figure 5: Keyword Analysis using ScientoPy

Other traditional topics such as ergonomics (11%), safety climate (11%), and occupational injury (15%) remain relevant but show more stable or moderate recent output. These results indicate that while foundational themes persist, there is a clear shift toward issues that reflect current industrial, technological, and psychosocial developments (Zemlyak et al., 2022).

The VOSviewer overlay visualisation (see Figure 6) reinforces these findings by mapping 34 author keywords with at least 10 occurrences and visualising their temporal emergence. Older topics such as injuries, accidents, ergonomics, and epidemiology, represented in purple hues, form the historical backbone of the field. These clusters were primarily active before 2016 and represent foundational research in occupational risk characterisation.

In contrast, keywords in yellow to orange, such as COVID-19, mental health, workplace violence, nurses, personal protective equipment, resilience, and automation, indicate recent and emerging themes that gained prominence post-2020. This temporal shift reflects an expanding

research agenda incorporating pandemic-related occupational health risks (Haghani et al., 2024), technological transformations in workplace safety (Ahuchogu et al., 2024), and mental health (Cendales et al., 2024), and gender-sensitive concerns (Hortelano et al., 2021), especially within frontline and transport-related occupations.

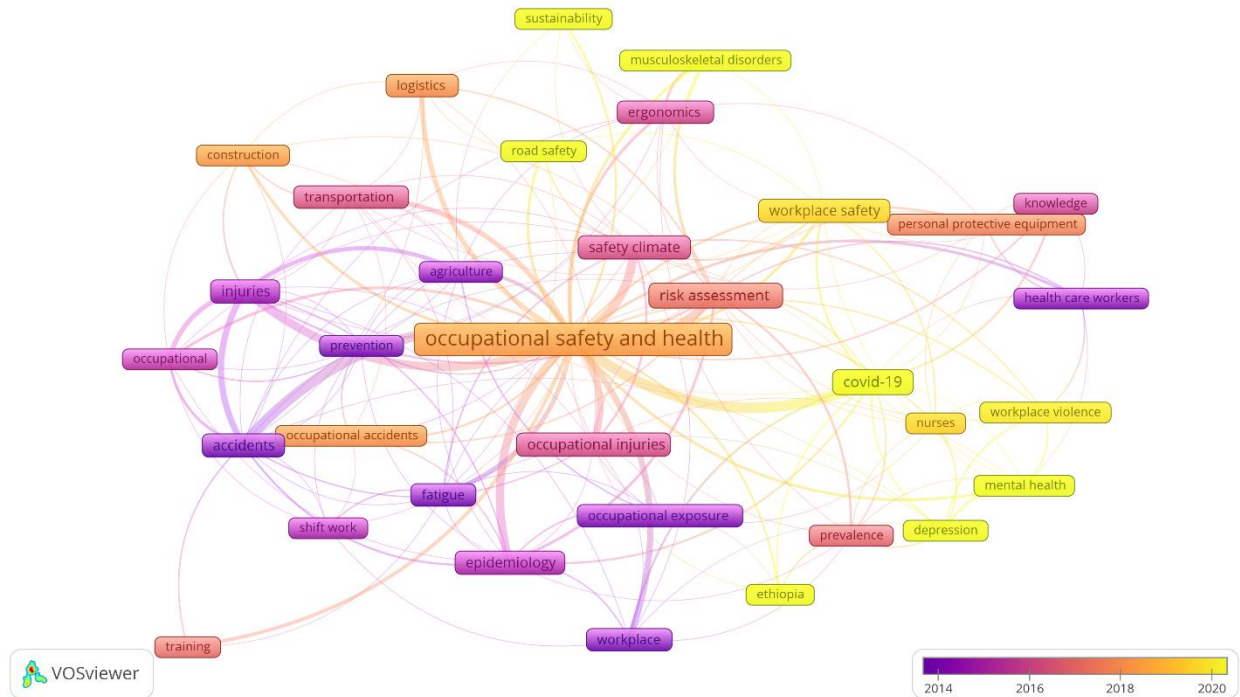


Figure 6: The Overlay Visualisation of Keywords

Additionally, the emergence of keywords such as sustainability, depression, training, and knowledge suggests a rising interest in long-term systems resilience, occupational well-being, and capacity-building strategies. This shift reflects a broader recognition of the need for holistic approaches that integrate mental health, continuous learning, and sustainable work environments as critical occupational safety components (Shahbaz & Sajjad, 2021).

Furthermore, the recent appearance of terms such as healthcare workers, logistics, road safety, and construction as keyword nodes indicates growing cross-sectoral integration in occupational safety research. This demonstrates that knowledge and best practices from other high-risk industries, such as healthcare and construction (Sidani et al., 2023), are now being applied to enhance safety practices within the transportation sector (Marji et al., 2023). This trend reflects a global shift toward interdisciplinary safety approaches and greater knowledge-sharing between sectors (Van Eerd, 2019).

These thematic patterns indicate a paradigm shift in occupational safety research from a narrow focus on physical hazards and incident prevention to a broader systems-based and person-centred approach. Future research directions are expected to explore increasingly:

1. The role of AI and wearable technologies in proactive safety management.
2. Mental health and psychosocial risks among transport workers.
3. Pandemic preparedness and biological hazard mitigation in mobile workforces.
4. Gender-based safety issues and harassment in public and commercial transport.
5. Policy and regulatory innovations that align with sustainable, resilient transport systems.

Highly Cited Publications and Influential Works

Table 2 presents the five most cited scholarly publications that have significantly influenced research on occupational safety in transportation. These high-impact works span diverse yet interconnected topics, ranging from safety climate and shift work to COVID-19 and cockpit procedures, highlighting the multidimensional nature of occupational safety in transport contexts.

The most cited work is a systematic review by Wagstaff and Lie (2011), published in the *Scandinavian Journal of Work, Environment and Health*, with 264 citations. This seminal paper synthesised evidence linking long working hours and shift work to safety risks, particularly within safety-critical industries like transportation. The review's epidemiological rigour and focus on transport and health sectors have made it a foundational reference for policy and empirical studies on work scheduling and accident prevention.

Following closely, Degani and Wiener's (1993) study on cockpit checklists, published in *Human Factors* and cited 223 times, explores human factors and standardisation practices in aviation. Though centred on aviation, the design principles and safety implications outlined are widely applicable across other high-risk transport sectors such as maritime, rail, and logistics—contributing to its enduring relevance.

Huang et al. (2016), in *Applied Ergonomics* (204 citations), expanded the scope of safety research by linking safety climate with broader organisational outcomes such as job satisfaction, engagement, and turnover, using truck drivers as a sample. This article bridges occupational psychology, human resource management, and transportation safety, illustrating how safety perceptions translate into behavioural and organisational consequences.

In response to the COVID-19 pandemic, Shen et al. (2020) published a high-impact review in *Environmental Pollution* (197 citations), documenting public transportation safety protocols and risk mitigation strategies from China. This study gained rapid scholarly attention, providing timely and practical insights into how transport systems can adapt to biohazard threats. This topic has redefined contemporary safety research priorities.

Table 2: Top Five Highly Cited Publications

Sources	Citation Count	Document Type	Database
Wagstaff & Lie (2011)	264	Review	Scopus
Degani & Wiener (1993)	223	Article	Scopus
Huang et al. (2016)	204	Article	Scopus

Shen et al. (2020)	197	Review	Scopus
Wallace et al. (2006)	160	Article	WoS

Lastly, Wallace et al. (2006) contributed a widely cited article in the Journal of Applied Psychology (160 citations) examining how organisational foundation climates predict safety climate and, in turn, accident rates in transportation. By using a large dataset of 9429 workers, the study offered robust group-level evidence supporting the mediating role of safety climate, a concept now central to transport safety discourse.

Collectively, these articles reflect the evolution of the field: from traditional focuses on ergonomics and scheduling to modern concerns with organisational culture, psychosocial dynamics, and global health crises. Their high citation counts underscore their foundational role in shaping the theoretical frameworks, methodological approaches, and practical interventions employed in occupational safety research across transportation domains.

Conclusion

This bibliometric analysis offers a timely and comprehensive examination of global research trends on occupational safety within the transportation sector. By analysing 1361 publications from Scopus and Web of Science spanning over three decades, this study highlights the field's rapid growth, shifting geographical and institutional landscapes, and the evolution of core research themes. The findings reveal a marked rise in academic output post-2015, with the COVID-19 pandemic, technological advancements, and heightened awareness of worker well-being catalysing a surge in transport safety scholarship. Notably, emerging economies such as India, China, and Malaysia are showing promising momentum, with Southeast Asia gaining scholarly visibility through contributions from institutions like Universiti Teknologi Malaysia.

The novelty of this study lies in its dual-database approach, its integration of performance and science mapping techniques, and its focus on thematic emergence, especially the convergence of occupational health with AI, sustainability, and mental health: an area underexplored in transport safety discourse. Furthermore, by identifying the most influential journals, institutions, and publications, this work is a navigational tool for future researchers, educators, and policymakers.

Additionally, these findings are highly relevant to current efforts to enhance technical and vocational education and training (TVET) for sustainable logistics and industry development. The study underscores the importance of preparing future graduates with domain-specific expertise and competencies in risk management, digital safety technologies, and data-driven decision-making. Such capabilities are essential for advancing inclusive and resilient transport systems and are closely aligned with the objectives of the Sustainable Development Goals, particularly SDG 3 (Good Health and Well-Being), SDG 8 (Decent Work and Economic Growth), and SDG 9 (Industry, Innovation and Infrastructure).

Contemplating the emerging themes uncovered in this analysis, future research directions may focus on the following areas:

1. Integrating artificial intelligence, Internet of Things (IoT), and wearable technology in transport worker safety.
2. Mental health interventions and psychosocial risk mitigation for frontline and logistics personnel.
3. Gender-based safety dynamics in urban mobility and freight systems.
4. Cross-sectoral learning from healthcare, construction, and logistics to inform transport safety standards.
5. TVET-based innovation in safety training programmes aligned with industry needs and digital transformation.,

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INSIGHTS OF SOCIAL WELLBEING DISPARITIES AMONG ASNAF UNIVERSITY STUDENTS: A DEMOGRAPHIC PERSPECTIVE

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Abstract: Social wellbeing issues such as financial difficulties, challenge in social interaction, stigma and social perception can lead to stress, family conflict, and psychological distress among asnaf students in Higher Education Institution (HEI). Taking into consideration the social wellbeing issues, this study examined the insight of social wellbeing disparities among asnaf students by examining their demographic profile as a main factor. Using a quantitative approach, data was collected through online survey from 120 asnaf students in a single IPTA in Northern Region of Malaysia. Independent t-test revealed significant relationships between male and female and their social wellbeing, but no significant relationship found for parental status. Meanwhile, ANOVA analysis found that asnaf's demographic profile such as age group, academic semester, number of siblings, and number of schooling siblings did not have significant influences on their social wellbeing. The significant influence of gender on social wellbeing suggests that male and female asnaf students often experience different social experiences, expectations, opportunities and social values in HEI and society. These differences show how they develop and build relationships with parents, colleagues, and society in their own ways including how they express emotions, love, and support. On the other hand, various aspects of asnaf's profile show no significant relationship with their social wellbeing because they are relatively homogeneous. For instance, same age group among them indicates that they have similar developmental stage and social experiences. Same goes to parental status, it may have limited impact on their social wellbeing because peer socialization and institutional support contribute more crucial roles in shaping their social domains. In a nutshell, this study managed to reinforce that gender-based norms shape asnaf students' social wellbeing, and education institutions should design students' social wellbeing programs that are matched to gender differences.

Keywords: social wellbeing, demographic profile, social experience development, Asnaf students, Higher Education Institution

Introduction

Social wellbeing challenges and issues among Asnaf students in Higher Education Institutions are varied, encompassing not only financial hardship, but it goes beyond social exclusion, social value and educational densities. Although they receive assistance from many agencies including Lembaga Zakat for providing them with financial support, a significant proportion of them continue to experience unhealthy levels of social wellbeing (Zakariya, Zin, Majid,

Ibrahim, & Bakar, 2025). Although there is a lack of studies on asnaf students' social wellbeing, previous research has highlighted issues that extend beyond financial burden. For instance, a study conducted at a single public university highlighted problems related to family relationships and psychological pressures (Zakariya et al., 2025). This study suggests that while asnaf students benefit from zakat assistance, their social wellbeing remains compromised by external and personal factors. On the other hand, previous studies have also revealed that most university students in Malaysia experience moderate to high levels of social support (Arifin, Sulaiman, & Zain, 2023). For instance, according to a study on undergraduate students in Kelantan, 55.3% of the students have high levels of social support, and 42% have moderate levels of social support (Arifin, Sulaiman & Zain, 2023). Despite having good social support, another study found that university students also experienced a high level of psychological distress such as anxiety and depression, with a study showing that more than 70% of students experience moderate to severe anxiety, depression and stress (Wong, Wong, Ng, Bostanudin & Tan, 2023).

Despite the mounting empirical evidence of the prevalence of anxiety, depression, and stress among Malaysian university students (Arifin, Abdullah, Omar, Mohamed, Yusop, & Hamdul Hadi, 2023; Ismail & Kahwa, 2020), there is a lack of empirical research on asnaf students, especially in terms of their demographic characteristics and social wellbeing relation. The existing research on asnaf students seems to focusing on their financial deficiency and occurrence of psychological distress, but ignoring demographic factors that may affect their social well-being, such as gender, age, family background, parental working status, family size, and educational level. Thus, this study aims to bridge this gap by examining the extent to which demographic characteristics explain the social wellbeing of asnaf university students in a public university.

Literature Review

Social Wellbeing Concept

Social wellbeing is defined as individual's own perception of his or her level of functioning and quality of life (Berkman et al., 2000; Helliwell & Putnam, 2004). Social wellbeing is underpinned in both positive psychology and social theory and focuses on the degree to which individual feel a sense of integration, acceptance, contribution, coherence, and actualization in society (Keyes, 1998). In similar vain, social wellbeing has been conceptualized as a likeness of the quality of an individual's relationships with others such as family, peers, community, and society (Berkman et al., 2000). It involves access to social networks and chances for participation, and perceptions of fairness and trustworthiness of social systems and institutions, (Helliwell & Putnam, 2004). Within an educational and socioeconomic framework, social wellbeing is often labelled as an outcome that is molded by both structural factors, such as poverty, social exclusion, and inequality, as well as individual factors, such as surviving emotional and social support (Dodge et al., 2012). Thus, social wellbeing is generally regarded as a key aspect of overall wellbeing, lengthways with mental and physical wellbeing, as it reflects how individuals rate their social experience and position within society.

Underpinning Theory

In this study, two related theories of social wellbeing are used to explain the social wellbeing norms of asnaf university students in relation to their demographic characteristics. Firstly, Keyes' Social Wellbeing Theory (Keyes, 1998). The theory postulates that social wellbeing can be measured along five dimensions such as social integration, social acceptance, social contribution, social coherence, and social actualization. The theory has relevance for understanding the social wellbeing of asnaf students because demographic factors derive students' social life experiences, responsibilities, and access to resources or facilities. For instance, the Zakat assistance has the potential for understabding their level of social acceptance and contribution through bursting participation in education and society. Secondly, Social Capital Theory (Bourdieu,1986). This theory demonstrates a few of dimensions such as social networks, norms, trust, and and reciprocity in embarking individual social wellbeing. For asnaf group of students, they may often face weak bonding social value because of social exclusion and marginalization. In this study, the reseachers can apply Bourdieu's thoery in relation to demographic characteristics by seeing demography as a foundation that outlines access to social networks, reources and support of asnaf.

Demography Characteristics and Social Wellbeing

Empirical research across various fields of study has shown that demographic variables are significant predictors of individuals' social wellbeing. Social wellbeing, defined as individuals' subjective experience of their social functioning, integration, and contribution to society, is affected by both personal and structural factors. Demographic variables such as gender, age, level of education, marital status, family background, and socioeconomic status have been extensively investigated as predictors of social and subjective wellbeing.

Significant evidence from empirical studies shows that there are gender differences in social wellbeing outcomes, although these may vary depending on the social context. Previous studies among university students and community samples have shown that females report lower social wellbeing due to their emotional vulnerability, caregiving, and social stress, while males report higher social contribution and autonomy (Keyes, 2005; Matud et al., 2019). On the contrary, there are studies that show females report higher social integration and relational support, which may act as a buffer against social isolation.

Age has also been recognized as an important demographic factor that affects social wellbeing. Empirical research has proven that social wellbeing may increase with age due to increased social coherence, emotion regulation, and social role acceptance (Blanchflower & Oswald, 2008). However, social wellbeing in younger populations, especially students, may experience challenges from transitional stress, identity formation, and economic insecurity. Empirical research conducted on higher education students showed that social wellbeing in younger populations may experience a decline in social integration and contribution due to a lack of social capital (Ryff, 2014)

Generally, education is positively correlated with social wellbeing. Research findings indicate that persons who have higher educational qualifications experience greater social inclusion, social network extension, and civic engagement than persons who do not have such qualifications (Helliwell & Putnam, 2004). Education increases social skills, self-esteem, and perceptions of social contribution, which are important factors in social wellbeing. For disadvantaged social groups, lack of access to educational opportunities has been implicated as a cause of social exclusion.

Variables such as marital status, as well as other family-related factors such as parental status, along with the number of siblings, have been explored as predictors of social wellbeing, especially for adults as well as students. Empirical research has found that married persons tend to experience higher social integration as well as emotional support in comparison to unmarried persons (Umberson & Karas, 2010). However, some research has found non-significant relationships between family structure-related factors as well as social wellbeing, especially for students.

On the whole, the empirical literature supports the importance of demographic factors as predictors of social wellbeing, although the relative importance may vary. In several studies, the focus is placed on economic or psychological outcomes, with less emphasis on the social wellbeing indicators. In addition, there is a scarcity of empirical studies among the marginalized population, such as the asnaf in the context of higher education. The studies emphasize the necessity for context-specific studies to examine the interplay between the support mechanisms provided by the institutions, such as the role of zakat, in predicting social wellbeing.

Research Method

Population and Sampling Technique

The population of this study consists of 2,143 Asnaf university students enrolled in both undergraduate and postgraduate academic programmes at a public university in Northern Region of Malaysia. As one of the population criteria, the students received zakat from the Kedah State Zakat Board (LZKN) in 2022 and 2023. The population list was provided by University's Jabatan Perancangan Perniagaan University and was used to select and determine the sample size. Based on Krejcie and Morgan's (1970) sample size table, a sample of 327 sample was required for the study. The sampling technique used was simple random sampling, as the researchers selected from the population list provided.

Measurement of Variables

Social wellbeing – In this study, social wellbeing is operationalised as asnaf students' assessment of their social relationships, condition and function in the social community including social integration, acceptance, contribution and actualization (Keyes & Shapiro, 2013). Social wellbeing was measured using a total of 19 items ranging from 1 (strongly disagree) to 5 (strongly agree) developed by Keyes and Shapiro (2004). Examples of these items include "If have something to say, I trust people in your community will listen to you", "I feel close to others in my community" and "I see my community as a source of comfort".

Demographic characteristics – Demographic profile includes age, gender, academic semester, parental status, and number of siblings.

Data Collection

The researcher identified the sample of Asnaf students using a systematic random sampling method. Each selected student was informed of the purpose of the study via email. The email also included information on access to the online survey (Google Form), the data collection period, and the researchers' contact details. Follow-up phone calls and reminder emails were sent to selected participants two to four weeks after the questionnaire was distributed. Based on the data collection procedure, a total of 327 questionnaires were distributed through an online platform. By the end of the data collection period, 138 responses were received; however, only 120 responses were deemed valid and included in the data analysis.

Research Findings

Gender and Social Wellbeing

A t-test (independent t-test) was performed to test whether there is a difference in social well-being between male and female asnaf students. Table 1 shows that there was a difference in social well-being ($t=-2.812$, $p=.006$) between male and female of asnaf students. This finding indicates that the gender play a vital role in developing the social wellbeing of asnaf students.

Table 1: Differences Between Genders and Social Well-Being

	Gender	N	Mean	Std. Deviation	Std. Error
KSSocial	Men	37	62.8649	14.04390	2.30880
	Female	83	70.1687	12.72392	1.39663

		Levene's Test for Equality of Variance		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
KSSocial	Equal variances assumed	.186	.667	-2.812	118	.006*	-7.30381	2.59758	-12.4472	-2.1599
	Equal variances not assumed			-2.707	63.438	.009	-7.30381	2.69836	-12.6953	-1.9122

*significance if less than .05 ($p<.05$)

Parental Status and Social Wellbeing

A t-test (independent t-test) was also conducted to test whether there is a difference in social well-being between asnaf students who still have a mother/father and those without a mother/father. Table 2 shows that there is no difference in social well-being ($t=-.348$, $p=.729$) between asnaf students who still have parents or none (deceased). This finding indicates that the parental status does not play a vital role in shaping the social wellbeing of asnaf students. Although it is assumed that parental status may influence their social dependence and emotional support within the household, the present result indicated that such differences are not enough to see any clear differences of social wellbeing among asnaf students in HEIs.

Table 2: Difference Between Parental Status and Social Well-Being

		Levene's Test for Equality of Variance		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Interval Difference Lower	Confidence of the Upper
KSSocial	Equal variances assumed	3,596	.060	-.348	118	.729	-1.49291	4.29199	-9.99222	7.00640
	Equal variances not assumed			-.257	10,983	.802	-1.49291	5.80135	-14.26400	11.27818

Age Group and Social Wellbeing

A one-way ANOVA test between groups with post-hoc comparisons was performed to test whether there were differences in social well-being between the three age groups of asnaf students. Before the ANOVA analysis was performed, the assumption of homogeneity between the groups was met, ie Levene's value was not significant ($p>.05$). This shows that the population variation in each age group is assumed to be the same. To determine if this test is significant, F-ratio (3.98), F-probability value and $p<.05$ are used. Based on Table 3 below, there is no significant difference between the age groups of asnaf students with social well-being ($f=1.260$, $p=.288$). This finding indicates that the age group does not play a crucial role in shaping the social wellbeing of asnaf students. They are relatively in similar age of group that exposed and experienced similar social interactions and emotional support, with often overlook age differences.

Table 3: Differences Between Age Groups and Social Well-Being

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
KSSocial	21-23	100	68.7900	14.07361	1.40736	65.9975	71.5825	31.00	95.00
	24-26	17	63.4706	9.75396	2.36568	58.4556	68.4856	49.00	83.00
	27-29	3	64.0000	8.71780	5.03322	42.3438	85.6562	54.00	70.00
	Total	120	67.9167	13.51661	1.23389	65.4734	70.3599	31.00	95.00

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
KSSocial	Between Groups	458.341	2	229.171	1,260	.288
	Within Groups	21282.825	117	181.904		
	Total	21741.167	119			

Number of Siblings and Social Wellbeing

A one-way ANOVA test between groups with post-hoc comparisons was also performed to test whether there was a difference social well-being between groups in the number of siblings of asnaf students. Before the ANOVA analysis was performed, the assumption of homogeneity between the groups was met, ie Levene's value was not significant ($p > .05$). This shows that the population variation in each group of the number of siblings of asnaf students is assumed to be the same. To determine if this test is significant, F-ratio (3.98), F-probability value and $p < .05$ are used. Based on Table 4 below, there is no significant difference between the number of siblings of asnaf students with social well-being ($f = 2.104$, $p = .103$). This finding indicates that the number of sibling does not play a vital role in colouring the social wellbeing of asnaf students. Although it is assumed that number of siblings may influence their social and interactions particularly due to lack of resources and financial survival within the household, the present result indicated that such differences are not partially enough to differentiate social wellbeing of asnaf students in HEIs.

Table 4: The Difference Between the Number of Siblings and Social Well-Being

						95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
		N	Mean	Std. Deviation	Std. Error				
KSSocial	1-3	35	63.5143	12.69639	2.14608	59.1529	67.8756	39.00	95.00
	4-6	69	69.4058	13.59965	1.63721	66.1388	72.6728	31.00	95.00
	7-10	15	70.4000	13.52669	3.49258	62.9092	77.8908	45.00	95.00
	11-13	1	82.0000	.	.	.	.	82.00	82.00
	Total	120	67.9167	13.51661	1.23389	65.4734	70.3599	31.00	95.00

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
KSSocial	Between Groups	1122.186	3	374.062	2.104	.103
	Within Groups	20618.981	116	177.750		
	Total	21741.167	119			

Number of Schooling Siblings and Social Wellbeing

Finally, a one-way ANOVA test between groups with post-hoc comparisons was also performed to test whether there was a difference in social well-being between the groups in the number of siblings attending school. Before the ANOVA analysis was performed, the assumption of homogeneity between the groups was met, ie Levene's value was not significant ($p > .05$). This shows that the variation of the population in each group of the number of siblings who attend school asnaf students is assumed to be the same. To determine if this test is significant, F-ratio (3.98), F-probability value and $p < .05$ are used. Based on Table 5 below, there is no significant difference between the number of siblings who attend school asnaf students with social well-being ($f = 1.006$, $p = .393$). This finding indicates that the number of siblings attending school does not play a crucial role in shaping the social wellbeing of asnaf students. Although it is assumed that this demographic characteristic may influence their social interactions and resources or financial sharing within the household, the present finding shows that such differences are not partially enough to unfluence asnaf's social wellbeing.

Table 5: The Difference Between the Number of Siblings Attending School and Social Well-Being

			Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
		Lower Bound				Upper Bound			
KSSocial	1-3	97	67.4742	13.71594	1.39264	64.7099	70.2386	31.00	95.00
	4-6	14	72.0000	14.08764	3.76508	63.8660	80.1340	53.00	95.00
	7-9	1	82.0000	.	.	.	.	82.00	82.00
	0	8	64.3750	8.86305	3.13356	56.9653	71.7847	48.00	74.00
	Total	120	67.9167	13.51661	1.23389	65.4734	70.3599	31.00	95.00

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
KSSocial	Between Groups	551.106	3	183.702	1.006	.393
	Within Groups	21190.061	116	182.673		
	Total	21741.167	119			

Discussion and Conclusion

Referring to the difference in social well-being between male and female students, this finding is consistent with some past researchers such as Arifin et al., (2023) and Matud, Curbelo and Fortes (2019). For example, Matud et al., (2019) found that men have a higher tendency compared to women in the aspects of self-acceptance and autonomy, while women have a higher attitude compared to men in personal growth and positive relationships with others. In the context of this study, the researchers think that this difference occurs because female students experience positive and negative emotions with a higher frequency and intensity compared to male students. For example, the researcher found that there were female students who openly expressed their emotions, feelings and complaints about their mental and social level without feeling any obstacles. Some of them shed tears talking about survival in the family, the experience of growing up in a family where their mother and father were separated, and the family's financial constraints that prevented them from learning. The opposite happened to male students who were seen not to be affected by anything that happened throughout their lives. Male students are relatively reluctant or open to sharing their mental and social well-being issues or problems, including aspects of family life, socializing with friends and financial constraints. Therefore, the difference that exists between male and female students may be influenced by the nature of the students themselves.

Meanwhile, other demographic characteristics such as gender, age, number of sibling and number of schooling sibling do not show differences in the social well-being of students. This

can be explained based on the almost identical age composition between students, and having the same quality of social network such as close friends, family members, neighbours, and the local community. A good social support may help them build a good quality of mental and social well-being, without being affected by differences in age, number of family members. Furthermore, the absence these relations across gender, age, number of siblings and number of schooling siblings indicates that asnaf's profile may be less important than other factors such as study environment, friendships, lecturer engagement, and student services and peer relationship. This is because most of them relatively are experienced and exposed to similar academic support system and social life which may reduce demographic-based variations in their social well-being. In a nutshell, the study shows that social well-being among asnaf students is not really influenced by their demographic attributes such as gender, age, number of siblings and number of schooling siblings.

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MOBILE AND DIGITAL BANKING ADOPTION, TECHNOLOGY INTEGRATION, AND PROJECT MANAGEMENT EFFICIENCY: A BIBLIOMETRIC ANALYSIS

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Abstract: *This research has been built upon a bibliometric analysis, which has explored the international research discourse of digital and mobile banking adoption, management efficiency and technology integration. The data collection is conducted through the Scopus database and the peer-reviewed journal articles published during 2015-2025 have been used for the analysis. We have also incorporated Biblioshiny and VOS viewers, important bibliometric tools, to identify citation networks, keyword co-occurrence, thematic clusters and co-authorship patterns. One of the findings is a strong research growth in this area, and a strong emphasis on topics such as digital transformation, organizational performance, and the adoption of fintech. Several frameworks that have been used to examine the adoption of new technologies have been largely adopted from highly cited works, while constructs such as green finance, project efficiency and sustainability have been gaining increased prominence. Inefficient collaboration patterns have been identified in research results, which recommended probabilities for significant manifold unification of finance, technology, to management areas. An advancement of academic debate on identification of leading authors, thematic trends and influential publications has been contributed by this research; which also offered practical outcomes for policymakers and practitioners. The research outcome has noted the strategic imperative to derive digital technologies respecting competitiveness and efficiency for practitioners. On the other hand, it underlined the significance to cultivate enabling frameworks for policymakers, to inform financial inclusion, sustainable development and innovation into the domain of digital finance.*

Keywords: *Mobile Banking, Digital Banking, Technology Integration, Project Management Efficiency, Bibliometric Analysis*

Introduction

The services given by financial institutions and banks is considered as the Mobile banking (M-banking), which occurred as the most notable strategic transformations in the retail banking sector in last 10 years (Al-Okaily et al., 2024; Al-Okaily et al., 2023). The financial sector has been able to offer customers with quick solutions, responding to their problems with the help of self-service technologies (Al-Bashayreh et al., 2022; Almajali et al., 2022; Abu-Salih et al., 2022) as technological interfaces has been transformed. Further, convenience are now offered to customers by these services, like remote financial services on mobile devices (tablets and smartphones) (Al-Qudah et al., 2024; Al-Adwan et al., 2022). M-banking unlike internet

banking, depends on the application that is developed and curated by the service provider itself. The digital transaction transition has however, transformed regular operations of financial institutions, especially for banks that need to offer quick resilience with concurrent needs to perform online operations (Al-Okaily et al., 2024). This new segment has been significant in concurrent scenario, respecting the service providers, providing benefits include new market penetration, operational scope extension beyond international borders, customer trust elevation, operational costs' notable reduction, enhanced performance levels, and widened delivery options.

Furthermore, customers benefit from a wide range of advantages with The m-banking featuring personalized, customized services and elevated convenience convey a dynamic advantages respecting customer benefit, given that savings on both time (Alsmadi et al., 2022). M-banking enable remote banking service access to customers, via wireless connectivity on mobile devices; serves as the latest service delivery model currently available in banks. Furthermore, the service procedure has been simplified for customers given the advancements, which track financial transaction details and supervise investment portfolios (Alsmadi et al., 2022). However, the m-banking services' noteworthy administration remained sparse. Meanwhile, the B2C mobile business model's implementations has also remained unsatisfactory, given that a large customer segment is still unaware with mobile commerce (Aws et al., 2021).

The growing recognition of digital finance has demonstrated an intersection between green innovation, environmental sustainability and digital finance, advocating a remote access to digital financial tools to produce cascading benefits for both economies and ecosystems. The spur growth of streamlining investments and low-carbon technologies in the renewable energy projects has enabled the digital finance platforms to leverage the implementation of green production methods; thus contributed into enhanced energy-environmental outcome (Cao et al., 2021; Lin & Ma, 2022). These platforms can support the small and medium-sized enterprises (SMEs) to adopt sustainable practices by alleviating the necessity to provide real-time financial information in the meantime reducing the massive capital investment requirement in the beginning; a factor that promotes energy-efficient provisions. The digital finance systems at the macro-level, between the crowd funding to remote payment systems in smartphones, subordinates the transaction costs, negotiates behavior and promotes greener consumption institution. As a product of these progressions, there is the creation of new sustainable employment aspect, starting with green financing of projects, to environmentally friendly start-ups. This had demonstrated an integrative expansion requirement without necessarily leading to loss of the environment (Geng & He, 2021). Since policymakers and investors have increasingly emphasized the need to focus on environmental, social, and governance (ESG) requirement, an effective digital financial system can become an essential channel, channelling the resources in sustainable business, to enhance a more sustainable and fair economic system globally (Yang et al., 2025).

Bibliometric analysis is able to utilise structural measure to identify gaps in knowledge, occurrence patterns and intellectual framework in the field as these constructs have increasingly gained practical and scholarly visibility. Research development, offering a perspective to research the seminal publications, authors, and the subsequent research has been central to the current research. This bibliometric review has added to a finer understanding of

the overlap between technology and banking, and provided useful advocacy to the policy makers, practitioners and researchers who wish to mobilize digital transition in respect of sustainable economic expansion. A systematic study on the development of the research in digital and mobile banking adoption, project management effectiveness and technology adoption has been the major focus in this review. The development of the interest of scholars over time has been placed in the perspective of visualizing the interaction of the themes and also identification of the sources of power and authors of the scholarly interest, through mapping out global patterns of publication of works in this area of interest. The analysis has also explored the fintech innovation and digital transformation contribution into project and operational efficiency for the banking field. The bibliometric approach has positioned this research to cultivate key research gaps, in particular sparse recognition given to project management aspects. It further outlined future research navigation into unification of project performance models into digital banking transformation.

Literature Review

Digital Transformation and Mobile Payment Adoption in Banking

New technological opportunities have been created by the growing penetration of mobile phone devices, which elevated global payment operations. The UTAUT2 framework has been extended in this research, to investigate Jordan-based mobile payment integration among public employees. The results using PLS-SEM have shown significant influence of social influence, price value, awareness, and trust and performance expectancy on decision-making, while facilitating conditions and effort expectancy remained insignificant. The impact of privacy and security has been mediated by trust, demonstrating contextual factors (Al-Okaily et al., 2024).

Recent research by (He et al., 2025) examined the influence of digital transformation on the rural commercial banks' profitability. The study using empirical data has exposed efficacy of digitalization to improve financial performance and operational efficiency. Strategic role of technology to offer resource allocation, profitability and competitiveness has been revealed in findings, specific to rural financial institutions governing digital transitions. Recent global trends featured m-banking use that enabled cashless transactions using smartphones. Their benefits over contemporary systems have been advocated by scholars, including speed, simplicity, flexibility and security. Remote transfers, bill payments and purchases are embedded in m-payments. M-payment adoption is raising continuously, with the significance to outperform traditional credit and cash-based systems (He et al., 2025).

(Eriqat et al., 2025), have explored the interaction between the money laundering risk and the digital payments, and expounded the role of the financial sector development as a moderator. The cross-country data results have indicated that in particular well-developed financial systems, implementation of digital payment can weaken the probability of money laundering. The study has shown the developmental and controlling importance of digital finance to facilitate transparency and resolution of illicit global financial activities. The digitalization has helped to promote structural changes in the banking sector of the emerging markets. The use of fintechs such as digital wallets, real-time payments and mobile banking have enhanced service delivery and revolutionized the financial intermediation. In modern settlements,

blockchain usage has provided the opportunity to tokenize assets and comply with KYC in order to enhance trust and efficiency. These technologies have interdependently influenced the performance of competitiveness and operations, particularly in the emerging economies(Ristanović et al., 2025).

Financial services have been under a massive change brought about by digitalization and m-banking services are a major focus. M-banking decrease dependence on physical infrastructure, increase financial inclusion and transactions simplification. Other than convenience, this promote a broader sustainability agenda, to customer loyalty, satisfaction and the sustainable practices consolidation in the modern banking practices (Balcioglu & Evranos, 2025). (Singh et al., 2025) have discussed the reasons and obstacles that have influenced the adoption of neo-banking based on Behavioural Reasoning Theory. The authors have unveiled convenience, technological efficiency and perceived benefits as the motivations to adoption, and regulatory concerns, security risks and lack of trust as the hindrances to adoption. The study has examined the lengthy understanding of consumer decision-making and transition to digital banking in the findings. Digital transformation, online platforms, automation and mobile applications are being used to transform the operations and enable the fast evolution of the retail banking sector. These developments have promoted access, personalization and efficiency, as well as responding to the increasing customer demands of on-demand and seamless services. Digitalization also enhances competitiveness and growth through better workflow and interaction. Regardless of this adoption was not even in the developing economies such as Uzbekistan; thus retail banks face not only challenges but also a great chance to implement effective digital banking solutions (Eshov et al., 2024). (A. K. Singh & Srinivasan, 2025).have analysed the perceptions of digital transformation amongst employees, customer satisfaction, financial risk and security in the Indian banking field. Their analysis has addressed the impact of digitalization on the structure of operations and services quality. In the findings, criticality of employee views to introduce customer-focused, secure digital banking practices is justified, which confirms and confirms flexibility and alignment of organizational strategies to the new financial and technological demands.

Digital Banking, FinTech, and Sustainable Financial Performance

(Wamba-Taguimdje & Kamdjoug, 2025) have conducted a systematic literature review on the topic of money technologies and mobile payments in sustainable development. The computer-assisted interpretive analysis study, revealed how operational efficiency, environmental sustainability and financial inclusion are adopted by the digital financial tactics. The results presented in favor of mobile payment adoption in favor of economic growth, and at the same time encourages sustainable activities and sheds light on the role of technology to expand the development agenda. The financial and banking industry, traditionally, has been leading in the implementation of new business models and technologies. The digital-only banking (DOB) is an important online banking framework which has proved to be effective in recent years, enable direct online interaction between their customers and the banks. These abundant technological innovations depend on a fine understanding of consumer behaviour in the quest to adopt new technologies and digital formats(Salmasi et al., 2024).

The routines, drivers and barriers influencing dynamic capabilities in digital banking evolution of Indonesia has been examined by (Abdurrahman et al., 2024), using the TOE model have explored the routines, drivers and barriers affecting dynamic capabilities in digital banking evolution of Indonesia. In this qualitative research, technological, environmental and organizational factors that determine digital adoption are observed. The findings are saturated with strategic fit, resource management and innovation processes that are critical towards effective execution of digital banking initiatives into developing economies. The effect of digital payment implementation for financial performance of HDFC Bank has been analyzed by (Agarwal et al., 2024). The review has documented integration of digital payment solutions increasing transaction speed, customer satisfaction and operational efficiency, which positively contribute into profitability. As a strategic enabler of competitive and financial performance, digitalization is embedded.

The banking sector has been transitioned by digital transformation, facilitated with technological innovation like cloud computing, AI, IoT and big data. Disruption from neo-banks, bigtech entrants and fintechs are faced by traditional banks, hindering legacy frameworks. Hence, incumbents shall go through a digital transformation journey (DTJ), steer strategies and phases unifying technology, operational innovation and customer expectations to remain competitive. Perceived usefulness, information and ease of use are the instrumental determinants respecting adoption and usage of mobile banking applications. These stages comprehension cater banks to enhance services, avoid commoditization and sustain relevance (Papathomas & Konteos, 2023). M-banking apps dominate electronic payment in Taiwan, with a penetration rate of 62.2% in 2019 and spurred adoption in 57-night markets. A 90% penetration rate by 2025 has been aimed by the government to inform a connected payment mechanism. Consumer habits are shifted since COVID-19, which created new demands. Firms are required to leverage technology, compete with digital actors and redesign services to sustain in evolving smart landscape, while being resilient to disruptions from emerging digital technologies (Ng et al., 2024).

Global banking has been transformed by Fintech, enhanced customer experience and performance. This adoption shall comply with local conditions and Shariah principles of Saudi Arabia. Reliability, empathy and responsiveness, key service qualities shape satisfaction, loyalty and trust. For leveraging fintech, awareness and digital transformation are imperative, shaping customer behavior and accelerating sustainable banking performance (Aldaarmi, 2024). Now, India has improved financial inclusion, with nearly 80% population reserving bank accounts. This expansion is supported by payment banks and FinTech firms to increase operational efficiency and undermine service costs for semi-urban and rural customers. For reaching to underbanked populations and offering stable landscape for inclusive financial services and fintech growth, continued efforts become imperative (Asif et al., 2023). Such commitment and technology advancement in e-commerce under Saudi Arabia's Vision 2030 has driven an area-based progression. Digital banking innovations, especially blockchain, open banking and fintech solutions has enabled this, which catered, efficiency, supply chain integration security and greater transparency; thus rapid growth confronted by the industry (Ezmigna et al., 2024).

Global Perspectives on Mobile and Digital Banking Transformation

Digital banking has created a sustainable financial environment that enhanced financial performance by SMEs. Transparency improvement, access and efficiency through digital platforms is reported in systematic literature reviews, which promote financial inclusion and operational robustness. Unification of sustainable practices through digital banking serves SMEs to optimise the amount of resources, reap long-term financial growth and enhance customer confidence (Amelia et al., 2024). The COVID-19 pandemic has boosted the use of digital payment systems, such as LinkAja, Gopay, and Ovo. The digital behavior, transaction trends and opportunities are the drivers of digital banking in Indonesia. This transformation has made possible notable potential benefits, including increased operational efficiency and financial accessibility to advocate the emergence of digital banking in high-potential markets (Perdini Fisabilillah et al., 2024). Banks will gain technological advancements in a congested digital environment, to lift operations and keep a competitive niche in the market. Digital platforms, such as social media banking, mobile banking, e-wallets and chatbots reduce expenses, enhance operational efficiency and improve service delivery. Banks will use analytics, to further recognize customer characteristics, process streamlining, improve contentedness and customization services. These technologies unification in Jordan promote cost savings, a high customer experience and operational excellence (Q. Bataineh et al., 2024). Tran et al. (2024) (Tran et al., 2024). have studied the impact of perceived safety on the adoption of digital banking services by customers in commercial banks of Vietnam. The improved data protection and security perceptions have been suggested by the stronger findings, which has considerably increased the usage intentions. Consequently, secure digital banking landscape has become a crucial thing to affirm in order to build customer trust; stimulate service adoption and promote engagement.

Digital banking drives market growth, cost savings, and increase in profits. A qualitative study based in Ghana reported user satisfaction and system usage due to system, quality of service and information in order to have a positive influence on net benefits. In findings (Owusu, 2024). adoption of the digital banking solutions which improve financial performance and operational efficiency in the emerging markets is proposed. Cashless banking is an important aspect that has been made possible by the diversity in mobile access and high rate of technological advancement, which has facilitated the expansion of banking services. Key aspects of service quality have been established using a 173-participant survey to be used in factor analysis. Particular elements revealed in reports, which have a strong influence on client satisfaction and offer feedback on how to optimize quality of cashless banking service (Gupta et al., 2024).

For the past few years, COVID-19 has accelerated the digital transformation and technological adoption. Online customer behaviour was altered as a result of rapid tuning into online channels, and online payment and online shopping options are extended to the businesses as well. Specifically, the technology of contactless payments became an attractive offer to customers, which m-banking became a standardized initiative in the emerging and emerged economies (Chetioui et al., 2023). The global financial sector's transformation facilitated by financial technology, which catered digital payment services and elevated financial inclusion in both emerging and developed markets. Mobile payments, internet banking and e-wallets are

the key solutions expanded accessibility, serving rural populations and reduce costs. Digital payment adoption is emphasized by policymakers, as instrumental to decrease cash reliance, boost competitiveness and improve efficiency, in specific rapidly evolving Asian markets (Azman Ong et al., 2023). The highly competitive and regulated banking sector is facing heightened competition among both banks and financial technology firms. Thus, banks have growingly adopted digital banking as a mean to maintain competitiveness. However, the Indonesia based Regional Development Banks (RDBs) have still not closed the competitive gap to reach customers using digital banking platforms (Thuda et al., 2023).

The influence of subjective norms on behavioral intention of customers to implement e-banking has been investigated by (Jermisittiparsert et al., 2023), illuminated the role of perceived usefulness as a mediator. The perceived benefits and social pressure significantly driving adoption decisions explained in this study. Advocating perception of usefulness to enhance customer acceptance is suggested in findings, which made subjective norms a vital determinant to extend banking-based digital transformation. The mobile banking benefit hinge upon its accessibility unlike traditional banking. Banking services can be accessed by customers at anywhere and anytime, with just an internet connection. The business landscape is transforming in Malaysia, as more population moving to the senior and mid-level management roles in their organizations. This has crafted increased demand for digital financial solutions (Al Tarawneh et al., 2023).

Internet or online banking is often termed as digital banking that refers financial transactions execution using digital platforms like ATMs, the internet and mobile phones. Such adoption has seen a rise in India, given the internet usage, the government's push for a cashless economy and smartphone penetration. Reserve Bank of India regulations supports this; thus banks have crafted user-friendly and secure platforms for the purpose of transfers, deposits, loans, bill payments, and relevant financial services (Singh et al., 2023). Irrespective of these benefits' recognition, customer awareness on m-banking adoption remained slow. 325 students of Tanzanian university used for a cross-sectional survey, to examine behavioral determinants shaping m-banking rise. The key motivators, driving the urgency to build context-specific models to increase customer adoption has been documented in findings (John, 2024). Technologies like electronic transfers, ATMs, mobile phones and internet banking have changed service delivery within the financial services industry. Users can perform quick and convenient transactions using E-banking, while banks benefit from efficiency, competitive advantage and cost savings. However, adoption rates remained low in emerging economies, like Algeria regardless of these extensions; thereby outdated channels still dominating financial services. Therefore, comprehending consumer adoption determinants has become vital for the e-banking systems' success (Bellahcene & Latreche, 2023).

Digital Banking and Project Management Efficiency

Fintech adoption is influenced by IT governance influences, which connected fintech efforts with strategic vision of an organization, and prioritized investments in most rational products. IT governance models, for instance can assists banks to make alignment with fintech projects, such as digital wallets and mobile banking, with widened objectives to elevating customer experience and advocating digital products' growth (Almaqtari et al., 2025). The fintech

popularity since COVID-19 pandemic in particular developing countries has facilitated banking transition with digital operations. The technological use like big data analytics (BDA), blockchain and artificial intelligence (AI) are involved in Fintech, to derive new financial services and products (investment platforms, digital cash, wealth management, digital currencies and crowd funding) (Badrous et al., 2025). Banking organizations emphasizing organizational learning have been more inclined to harness and detect evolving sustainable finance conveniences, like renewable energy investment or socially responsible projects' contribution (Alsoukini et al., 2025). Transaction volumes gain increase due to customer satisfaction aligned with banking services, as an outcome that elevate profitability. Financial literacy improvement also bolster the SMEs financial performance (Toni, 2025).

Bibliometric Analysis of Mobile and Digital Banking Adoption, Technology Integration, and Project Management Efficiency

(Barru, 2025) conducted a bibliometric analysis of digital banking research, with emphasis on the Brimo application. The study mapped trends, challenges, and opportunities, highlighting key themes such as technological adoption, customer engagement, and security. The findings provided insights into evolving research directions and practical implications for digital banking development. (Alsmadi et al., 2022) presented a bibliometric analysis of mobile banking research (2000–2020), outlining development trends, sustainability issues, and key research themes shaping the global evolution of mobile banking services. Kumar and Yadav (2024) conducted a systematic literature review and bibliometric analysis on mobile payments. Their study identified key research trends, adoption factors, and future directions, emphasizing mobile payments' growing role in digital finance and consumer behavior. (Aziz et al., 2021) performed a bibliometric analysis of literature on digital banking and financial inclusion from 2014 to 2020. The study identified major publication trends, influential authors, and thematic clusters, underscoring digital banking's role in advancing financial inclusion and offering directions for future research.

Research Methods

The research utilizes the method of bibliometric analysis to conduct a systematic study of the international literature in mobile and digital banking adoption, technology integration and the efficiency of project management in the research. Bibliometric techniques are especially effective in the mapping of intellectual frameworks, influential literature and tracing thematic change in new disciplines (Donthu et al., 2021). With an interest in academic publications dating back to the recent ten years, this study aims at identifying the prominent research trends, co-authorship networks, and theme clusters that inform the discourse of digital transformation in banking and organizational performance.

The information used in this research was obtained in the Scopus database which is a well-known and trusted bibliographic library and includes a large number of peer reviewed academic journals (Pranckutė, 2021). The choice of Scopus was because it has an extensive indexing of quality journals in the fields of finance, information systems, project management and studies on innovation. It is also one of the most authoritative bibliometric research databases, which offer credible metadata and citation record to analyse it.

A strict search plan was established that utilized the Boolean operators and that obtained the publications that covered the three thematic dimensions of the current research mobile and digital banking adoption, technology integration, and project management efficiency. The search query that would be used to select studies in the areas where digital finance, technological transformation, and project management performance intersect was the following query applied to Title, Abstract, and Keywords (TITLE-ABS-KEY) fields:

(mobile banking" OR digital banking" OR m-banking" OR mobile financial services" OR mobile payments" OR digital payments" OR fintech adoption" OR online banking" OR information systems adoption" OR innovation adoption" OR IT capabilities" OR product improvement/digital performance) and (PUBYEAR > 2014) and (PUBYEAR < 2026).

Peer-reviewed journal articles were selected as only those that were relevant and of quality could be retained. Non-English publications, dissertations, book chapters and conference papers were not included. The period was limited to the period of publications in 2015-2025 that are representative of modern trends in financial technology and the digital transformation. Other filters were used to make sure that duplicate records and irrelevant studies were eliminated. The bibliographic data were then exported as CSV which could then be analyzed later. The most important details, including the names of the authors, their associations, publication year, keywords, references, and sources of the journals were obtained. To eliminate inconsistency and duplicate author entries, and accuracy in the standardization of keywords, data cleaning was performed.

VOSviewer and Biblioshiny (R package) were used to conduct citation analysis, co-authorship analysis, mapping of the co-occurrence of keywords, and bibliographic coupling (Klarin, 2024). Citation analysis was used to find out the most influential studies and those that had the highest number of citations whereas co-authorship analysis was used to find the collaboration networks institutions and between countries. Co-occurrence of keywords indicated prevailing themes and new directions of research. Thematic mapping has been done to visualize the way in which the literature agrees with the three core domains namely: (1) mobile and digital banking adoption, (2) technology integration and (3) project management efficiency. The review was done in an objective and transparent manner and all sources of data appropriately referenced in order to uphold ethics in research. The rigor and replicability of the study were done through the detailed process accompanied by Figure 1 as proposed by Donthu et al. (2021).

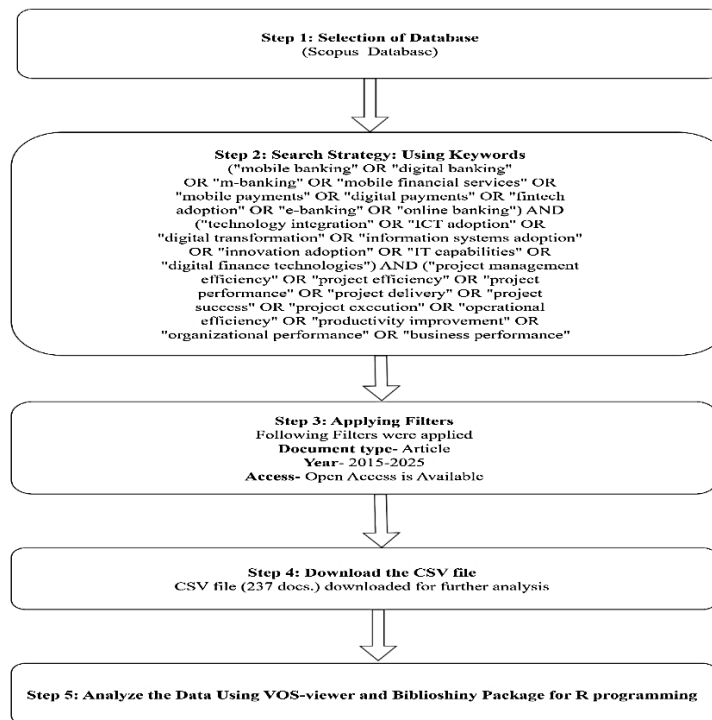


Figure 1: Steps in Bibliometric Analysis

Result and Analysis

This section is an in-depth review of international studies on the adoption of mobile and digital banking, integration of technology, and project management efficiency. Based on bibliometric methods, the analysis shows important publication patterns, prominent authors, collaboration patterns, theme groups and perspectives in future research. The results offer an insight on the development and influence of digital banking studies.

Description of Bibliometric Analysis *Main Information*

Table 1 Main Information

Description	Results
Timespan	2015:2025
Sources (Journals, Books, etc)	130
Single-authored Docs	0
Review	5
References	2058
MAIN INFORMATION ABOUT DATA	
Keywords Plus (ID)	621
International Co-authorships %	28.27
Documents	237
DOCUMENT TYPES	
DOCUMENT CONTENTS	
Document Average Age	1.57
Conference Paper	29

Co-Authors per Doc	10.1
Book Chapter	27
Book	5
Average Citations per Doc	11.96
Authors of Single-authored Docs	0
AUTHORS COLLABORATION	
AUTHORS	
Authors	1591
Author's Keywords (DE)	1248
Article	171
Annual Growth Rate %	64.87

The analysis will be conducted using 237 documents released in 2015-2025 and covering 130 sources, which is quite impressive considering the annual increase rate of 64.87. The most representative types of documents are journal articles (171). The collaboration is also very high with an average co-authors per document of 10.1, and international co-authorships of 28.27 percent. There were no single-authored publications, and in total, 1591 authors were included in the dataset. The documents were cited on average 11.96 times each.

Three-Field Plot

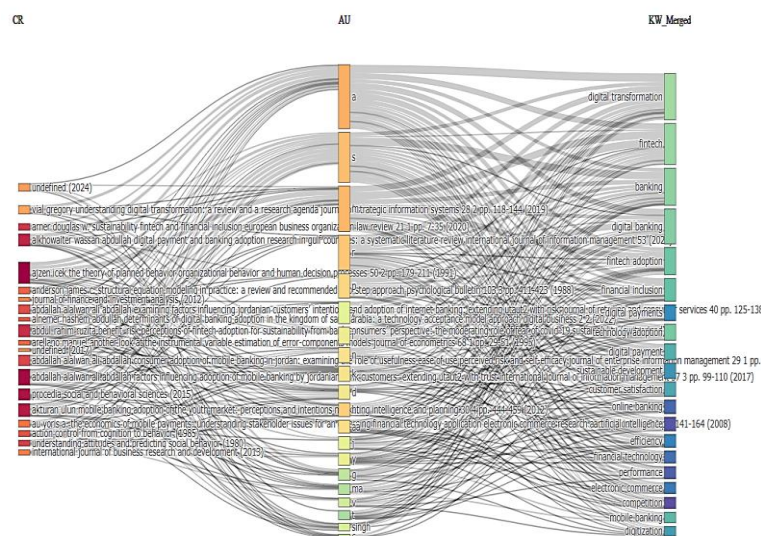


Figure 2: Three – Field Plot

This three-field plot represents the relationships between Cited References (CR), Authors (AU) and Merged Keywords (KW_Merged). As the visualization demonstrates, the most important works on digital transformation and fintech (KW) are often referenced, and the works of such authors as Al-Hawari and Al-Farsi (AU) play an important role in these domains. The mentioned sources (CR) are mostly associated with high-impact journals and address such topics as digital payments, mobile banking, and the use of technology.

Publication Over the Years

Table 2: Annual Scientific Production

Year	Articles
2015	0
2016	1
2017	3
2018	7
2019	5
2020	6
2021	13
2022	17
2023	32
2024	63
2025	90

The annual scientific production demonstrates an overall exponential growth trend, reflecting the rising research interest in the field. Beginning at a slow pace in 2015 with no published articles, output accelerated notably from 2021, when 13 articles were recorded. Production increased sharply in the final years, peaking at 90 articles in 2025. In total, 237 published documents highlight the strong and sustained momentum of scholarly output in this domain.

Sources

Most Relevant Sources

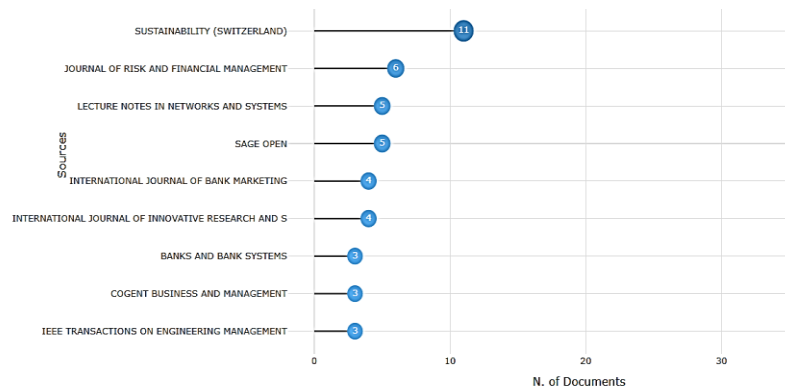


Figure 3: Most Important Sources

Based on the number of documents, Sustainability (Switzerland) stands out as the most significant source as it provides 11 documents. Universal Networks Systems, Journal of Risk and Financial Management with 6 documents is followed by Lecture Notes in Networks and Systems and SAGE Open with 5 documents each. The statistics give an idea that the literature in this area is mostly covered in multidisciplinary sustainability journals, financial management publications, and expert conference proceedings in the field of computer science/ engineering.

Sources Production Over Time

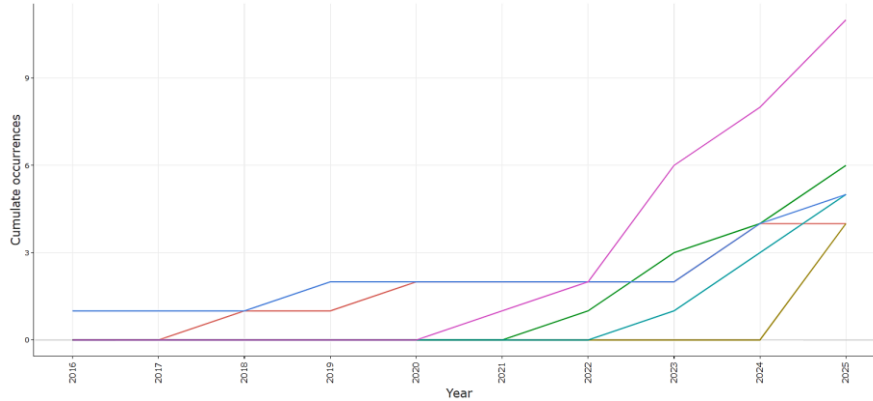


Figure 4: Production of Sources

This is a plot of the cumulative growth of the number of publications from the top sources over time. The pink line (probably Sustainability) represents the first and most dominant output starting before 2019 with an acceleration in 2022, and with the highest cumulative count (over nine publication). In contrast, most other sources (e.g. green, blue and cyan lines) only started contributing significantly from 2023 onwards, with primary growth being observed between 2023 and 2025. This trend points to a recent growth in the number of publishing outlets in this field.

Author Analysis

Author analysis assesses the work, background, style of writing and impact of researchers on a particular field to know their contributions and credibility (Shakya & Karki, 2025). It includes identifying the author most relevant to each context, analyzing the contributions of the author and how their work is cited or related to other authors (bibliographic coupling).

Most Relevant Authors

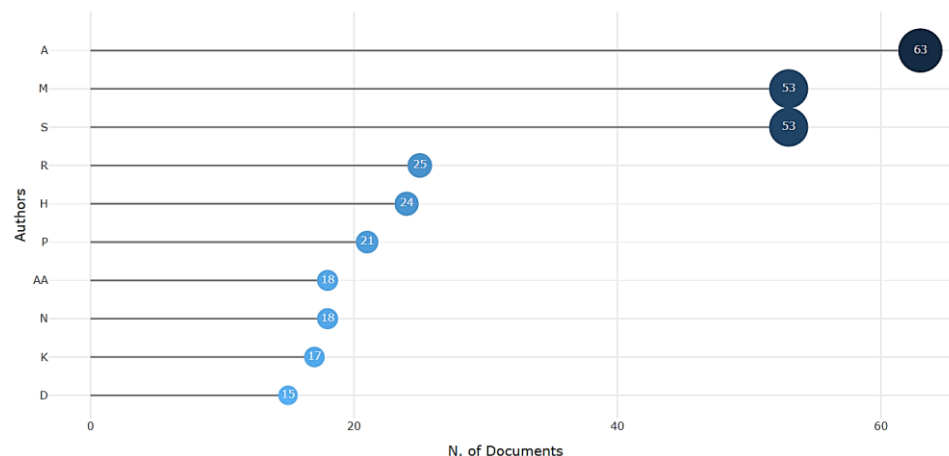


Figure 5: Most Relevant Authors

This plot brings out the most prolific authors in the field according to the publication output. Author A is the most contributing author with 63 documents. Authors M and S come in close behind with 53 documents each. The data shows a high degree of productivity concentrated in these top three authors, where their combined contributions are much higher than those of a set of the next tier, such as Author R (25 documents) and Author H (24 documents), highlighting the existence of a few key research leaders who contribute to a large portion of the research work in this field.

Co-Authorship by Authors

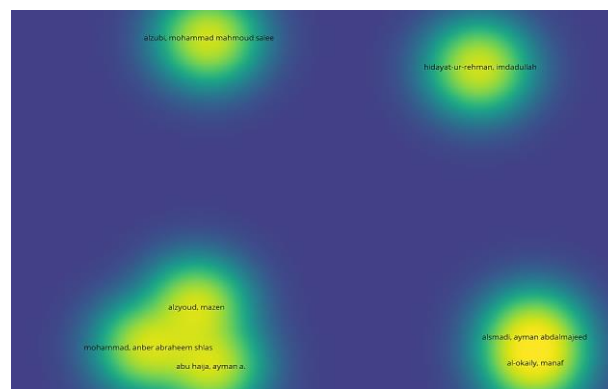


Figure 6: Network Density of Co-authorship

This density visualization of co-authorship shows the existence of four different clusters, which correspond to highly collaborative research groups with little interaction between them. The bottom centre cluster represents the highest density around Alzyoud, Mazen and Mohammad, Anber Abraheem Shlas, which represents a tightly-knit and highly productive partnership. Other notable but relatively isolated groups include those in the top left (including Alzubu, Mohammad Mahmoud Salee), top right (dominated by Hidayat-ur-Rehman, Imdadullah) and on the bottom right (created by Alsmadi, Ayman Abdalmajeed and Al-Okaily, Manaf). The large empty area between these clusters shows that although there is a strong collaboration within individual groups, there is little to no co-authorship between the major collectives of researcher activity.

Bibliographic Coupling of Authors

Unlike co-authorship, bibliographic coupling connects researchers who cite the same references in their work. This implies that even if the two authors have never collaborated directly, their research interests and intellectual foundations are closely related.

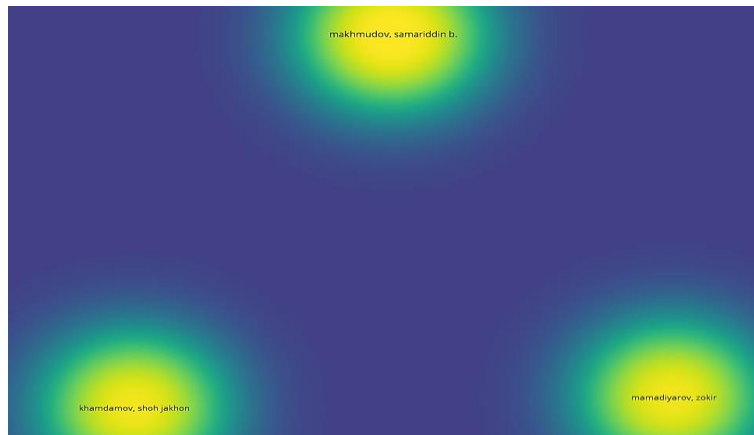


Figure 7: Bibliographic Coupling of Authors

This density visualization displays the bibliographical coupling between authors, the degree to which the works of authors cite shared references. The plot clearly shows three completely isolated streams or schools of thought, research, and there is virtual lack of coupling (share common cited work) observed between them. Each prominent hotspot is an independent cluster of authors citing distinct fundamental literature: Makhumudov, Samariddin B. in the top cluster, Khamdamov, ShohJakhonin the bottom-left and Mamadiyarov, Zokir in the bottom-right. This separation is quite strong, which could mean that there is a basic different research base or tradition which these authors operate from and which reflect different knowledge territories within the research field.

Citation Analysis

Citation analysis evaluates the frequency and impact of citations to academic works, considering aspects such as the average citations per year and identification of the most globally cited document (Kleminski et al., 2022). It also includes document-level citation analysis, which tracks how frequently a specific work is cited in another research, thereby highlighting its influence and relevance within the field.

Average Citations per Year

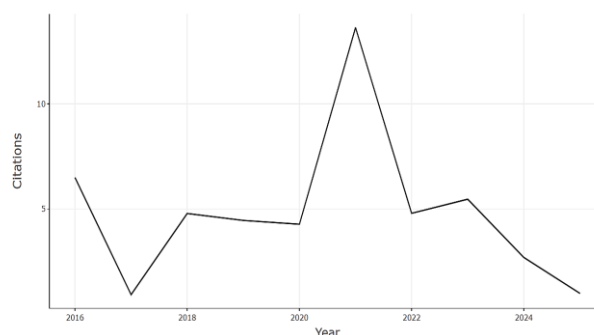


Figure 8: Average Citation Per Year

This graph depicts the fluctuation in the mean annual citations. The citation rate revealed an initial decrease from 2016 to 2017, after which there were relative stability between 2018 and 2020 (on average 4-5 citations). An important peak was observed in 2021, with its highest value (more than 12 citations), which is probably the result of the publication of a fundamental or highly influential work in that year. The average number of citations per year then dropped rapidly after this peak in 2022 and continued to decrease steadily until 2025.

Most Global Cited Documents

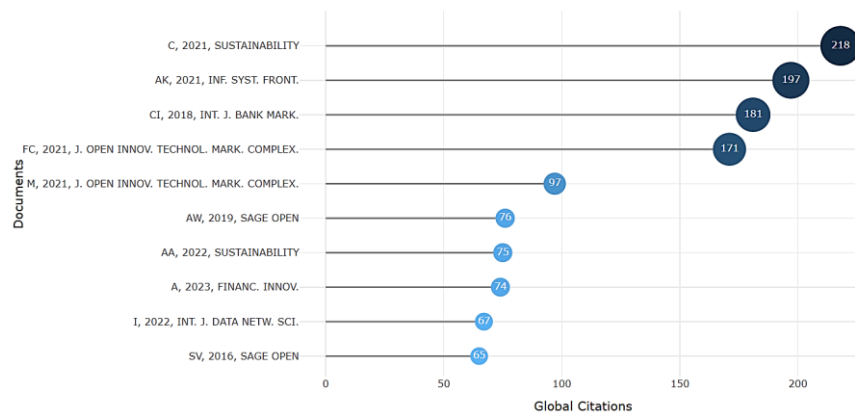


Figure 9: Most Global Cited Documents

The top documents are featured with the four leading papers published between 2018 and 2021. The paper, titled C (2021, in Sustainability), is the most cited with 218 citations around the world. The second most cited paper is AK (2021, in Information Systems Frontier), with 197 citations; and the third is CI (2018, in International Journal of Bank Marketing), with 181 citations. There is a dramatic jump in the number of citations (from 97 to 977 in the top four results, a scalar increase of 817 times) which means that the four top papers are far more influential than the other papers, thereby confirming that a few particularly important works tend to monopolize research.

Citation Analysis Based on Documents

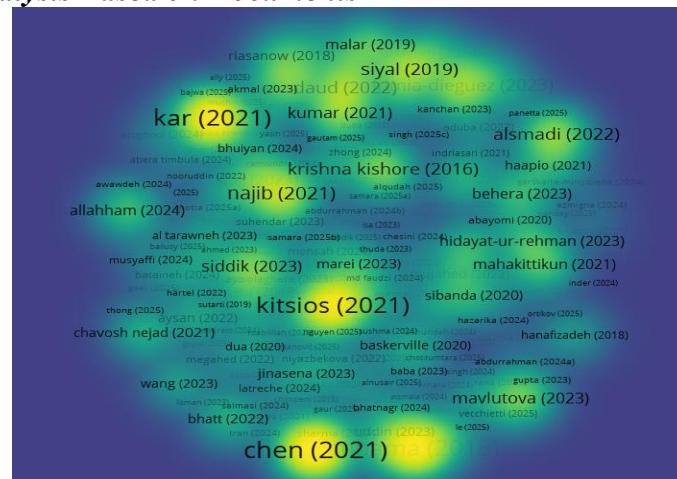


Figure 10: Citation Analysis Based on Documents

This network density visualization of document co-citation reveals a highly centralized and densely interconnected knowledge base. A major portion of the research is dominated by several cores, the most frequently cited papers, most of which were published in 2021 Key influential works include those by Kar(Kar, 2021), Kitsios (2021)(Kitsios et al., 2021), and Chen (2021)(Chen et al., 2021), which form intense hotspots. The single, combined cluster denotes a unified field where the new research is intensively dependent on a unified background of books and articles, which implies having a powerful common focus within the field.

Most Local Cited References

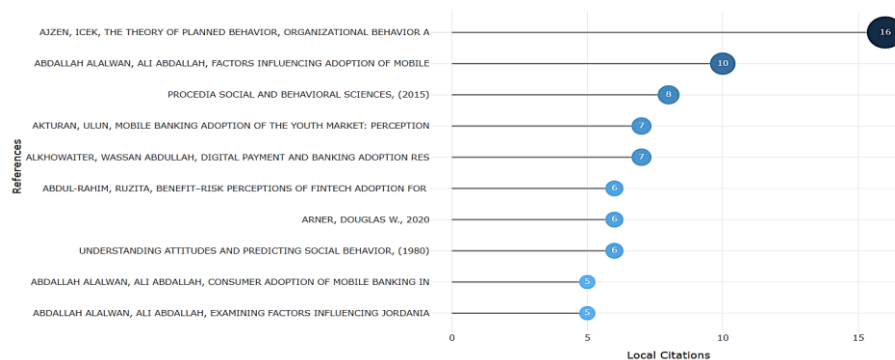


Figure 11: Most Local Cited References

The Theory of Planned Behaviour by Ajzen is one of the most referenced ones (it has 16 citations, all in the country) and the basic contribution is significant. The second document that is the most cited is Abdallah Alawan and Ali Abdallah (10 citation) regarding factors that determine the adoption of mobile. These results confirm that the present research is grounded on behavioral theories and mobile adoption literatures.

Network Analysis

Network analysis examines the connections between authors and institutions, revealing collaboration patterns and co-authorship networks(Carchiolo et al., 2022). It involves identifying the most relevant author affiliations, analysing collaborative and co-authorship networks, and conducting collaborative analysis of publications to understand how authors, institutions, or research groups are interconnected through shared research and publications.

Most Relevant Affiliations

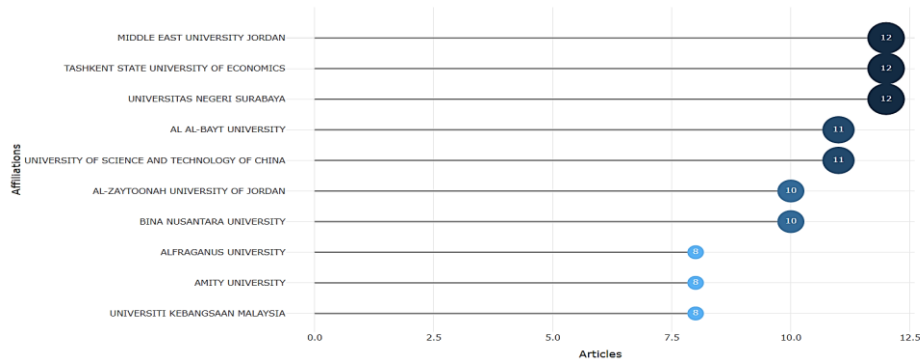


Figure 12: Relevant Affiliations

The three most relevant affiliated organizations are Middle East University (Jordan), Tashkent State University of Economics, and Universitas Kepriyaan Surabaya with 12 articles each. These are followed by Al al-Bayt University (11) and the University of Science and Technology of China (11). This distribution focuses on high production of research contribution mainly coming from Jordan, Uzbekistan, and Indonesia.

Collaboration Theme

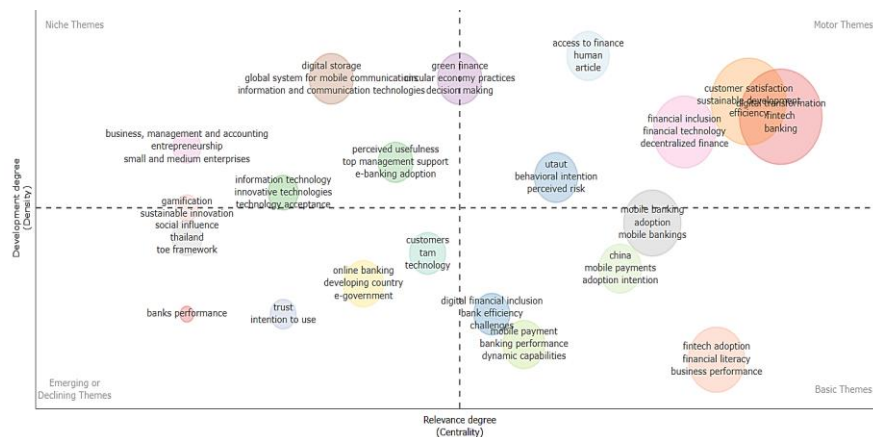


Figure 13: Thematic Map

The mapping of the themes used by the category shows that Motor Themes (banking, fintech, financial inclusion) are well represented and developed. Niche Themes: green finance and digital storage are more niche areas of research. Emerging/Declining Themes (bottom left): Themes such as banks performance and trust/intention to use, are low in terms of development and centrality. Altogether, the primary interest of the field is mature content at the crossroads of technology, finance and sustainability.

Collaborative Analysis of Publications

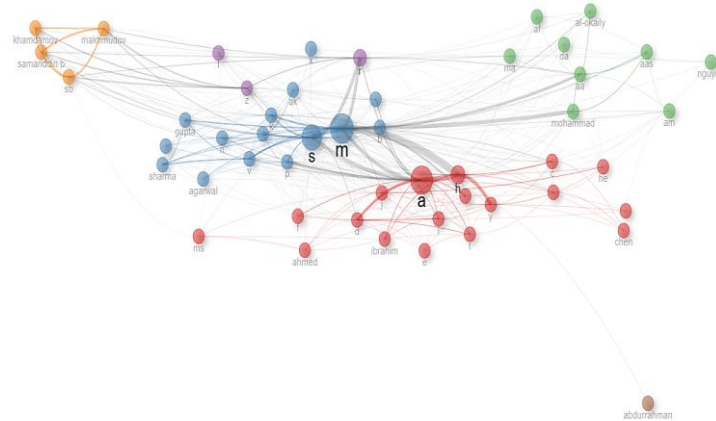


Figure 14: Collaboration Network

The collaboration network shows five different clusters, underlining a fragmented research environment. The blue and red clusters appear to be the largest and central, with authors M, S, and A as their most central and focused. Within these clusters there is a lot of collaboration, which is shown by the thick connecting lines which are dense. However, the intra-cluster links are weak, indicating that, although there is a lot of intensive collaboration within groups, collaboration across groups is relatively low.

Keyword Analysis

Keyword analysis involves identifying and evaluating the most frequently used and most relevant terms within academic research (Corrin et al., 2022). This method reveals some of the central topics, trends, and themes by looking for repeated words or phrases. By doing this analysis, researchers can track the evolution of emerging areas and enhance search engine optimization (SEO) and discoverability.

Most Frequent Words

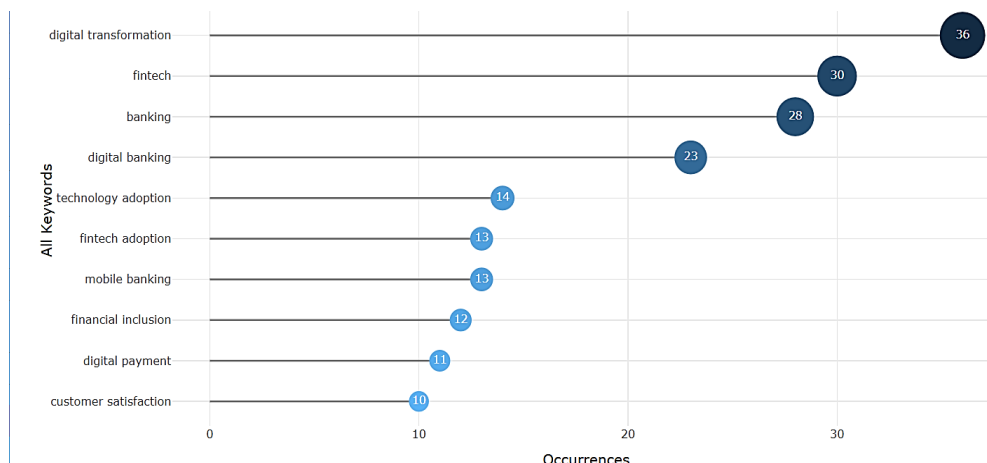


Figure 15: Most Frequent Words

The keyword frequency analysis shows the key focus of the research on digital transformation (36 times), fintech (30 times) and banking (28 times). These concepts are however by far dominating the field, along with related technological applications spanning digital banking (23) and technology adoption (14). The remaining themes that are found from the analysis include financial inclusion, mobile banking, and digital payment.

Co-occurrence Network

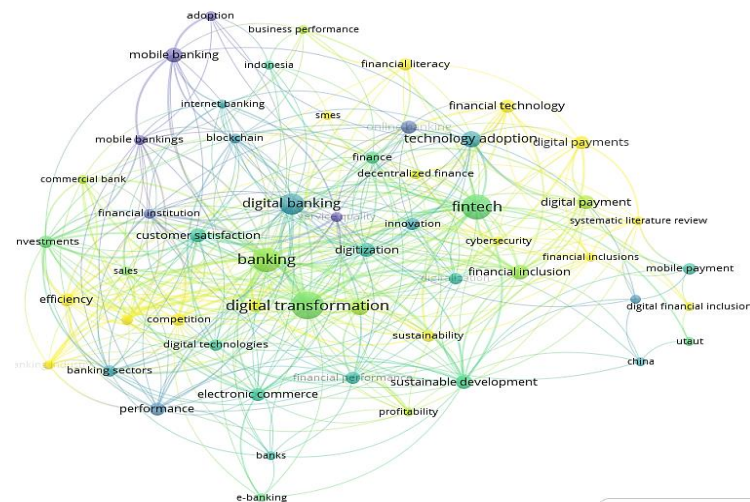


Figure 16: Co-occurrence Network of Keywords

The keyword co-occurrence network visualization can be analyzed into three main clusters. The green cluster focuses on digital transformation and banking, which relate to the sustainable development. The yellow cluster is about financial technology and fintech. The purple cluster shows the adoption and mobility aspect. The high interconnectivity between clusters demonstrates that these concepts are core concepts which are studied together often within the field of research.

Project Management Themes and Research Gaps

The bibliometric analysis showed little research but a growing body of literature that relates digital banking transformation to project management efficiency. In particular, keywords such as project efficiency, project success and organizational performance occurred relatively often in the dataset, but had relatively low frequencies and network centralities. The findings imply that project management is still an understudied area of digital banking and technology integration research. Only a few publications directly discussed the impact of digital technologies on project implementation, risk management, and performance improvement in financial institutions. Most papers were related to customer transformation and digital transformation plans. This hole outlines the need for empirical studies on the relationship between fintech innovations and ICT tools, on the one hand, and better project delivery, cost management, and time efficiency, on the other hand, for the banking sector. Hence, the empirical work requires to rectify this in future studies by integrating PM frameworks such as

agile and digital project governance to the digital banking transformation discourse. This alignment can drive organizational efficiency and innovation potential, which contribute to the overall purpose of sustainable digital finance.

Discussion

The result of this bibliometric research is that the last decade has seen the rapid and multidimensional expansion of studies on the mobile and digital banking adoption and integration of technology and efficiency of project management. The subsequent increase in publications, particularly since 2021, is the testament to the increase in awareness of the fact that digital transformation has become a strategic need by the banking industry. The high evolution of academic output between 2023 and 2025 is associated with the pace of digitalisation globalisation as a result of fintech development, consumer behaviour, and adoption of advanced technological systems including artificial intelligence, blockchain, big data analytics.

The majority of multidisciplinary journals (Sustainability (Switzerland) and the Journal of Risk and Financial Management (UK)) can be located as the results of the sources analysis. This evolving trend highlights the fact that digital banking studies are expanding outside the world of finance and are connected to sustainability practices, technology use and company performance. What is more, the fact that the number of papers with the high impact in the magazines is overrepresented proves that it plays a significant role in the development of the academic discussion at the intersection of the financial innovation and sustainable development. The author analysis reveals strengths and weaknesses of the collaborative organization of the field. Although a few authors (Alzyoud and Mohammad) have formed focused research groups, the whole remains uncoordinated and there is little cross-group cooperation. On the other hand, bibliographic coupling highlights schools of literature that are clearly isolated from each other and have little common ground in the literature they are cited from, which suggests that the field has not yet come together on any common theoretical or conceptual common ground. Whilst such fragmentation may have impacts on cumulative knowledge building, on one hand it may also be seen as a reflection of the diversity of perspectives and contexts in which digital banking transformation is being undertaken.

Citation analysis also confirmed results of the field's reliance on a few very influential works. Theory-oriented research in the behavioural sciences, such as the Theory of Planned Behaviour, continues to be the largest source of scholarly influence. This makes consumer adoption frameworks central to digital banking transformation. However, the keywords that are emerging like green finance, digital storage, and fintech adoption indicate that the field is slowly becoming more expansive beyond the adoption models towards sustainability and project management efficiency.

Thematic and keyword analyses identified three major areas: digital transformation, fintech and banking, all of which have strong relationships to financial inclusion and organizational performance. Motor themes based on financial inclusion and fintech innovation are in line with the global development priorities, while niche and emerging themes represent new opportunities for further scholarly investigation. All in all, this research paper shows that digital

banking and project management efficiency research is a dynamic and fast-growing field. Nonetheless, the restricted interaction between clusters and dependency on a small number of core texts imply that future scholarship needs to make a concerted effort to integrate in interdisciplinary terms, to compare studies across contexts, and to generate common conceptual categories to reinforce the body of knowledge in the field. The bibliometric analysis results directly answer the study's objectives and questions. The 'Digital Banking: Emerging Academic Importance 2021' article reports high growth rates in research publications and citations, demonstrating the exponential rise of digital banking research since the onset of the Covid-19 pandemic. The keyword and thematic cluster analysis reveals that technology integration and fintech adoption are key drivers of operational performance enhancement, however the relationships are only indirect towards project management. The thematic and co-occurrence analyses show a clear gap in research where project management efficiency is overlooked. Finally, synthesis of findings will inform future research and policy implications to guide scholars and practitioners in considering project efficiency in their digital transformation strategies.

Conclusion and Implications

In this paper, we used bibliometric methods to systematically review the international research into mobile and digital banking adoption, technology integration and project management efficiency. The findings showed a rapid increase in academic interest towards this field since 2021, which is in line with the transformational influence of fintech ideas, digital platforms, and new technologies in revolutionizing financial services. As the rise of multi-disciplinary journals such as Sustainability (Switzerland) and Journal of Risk and Financial Management suggests, digital banking research is increasingly moving beyond the boundaries of finance and now includes sustainability, organizational performance and macro socio-economic issues. Lastly, the findings reveal that even here we have the case of highly coupled but weakly coupled clusters of research, in which authors are working in their small worlds, and reference various literature. This fragmentation though is an indication of intellectual pluralism is also a sign of inability to integrate schools of thought. Although the development of traditional research using the behavioural adoption theory remains effective, the recent themes of research such as green finance, sustainability, and project efficiency are emerging, which indicates that the research agenda is evolving. Differently put, these findings indicate that there lies a raw potential of project management professionals to juxtapose digital banking transformation and project performance models. Nevertheless, through the adoption of agile and digital governance, business processes might become more productive and technology-based initiatives can guarantee performance growth. This study seems to indicate to academics the necessity to develop integrative frameworks to connect the disjointed strands of research and permit interdisciplinary work. The further diversification of the adoption model beyond the scope of adoption to sustainability, risk management, and operational efficiency will have not only the potential to strengthen the development of theory, but also expand the potential academic scope. The implications to practitioners include the fact that digital transformation has ceased being an option, it has become a strategic necessity. Therefore, not only should banks and other fintech firms be able to offer a good experience to their end customers, but also to serve their projects, conduct their operations effectively and be competitive in the long term. The policy implications include the idea that there should be regulatory models that are

balanced between innovation, security and inclusion. The partnership between technology players, regulators and financial institutions will be an important source of trust, risk management and enduring financial development. Lastly, this research paper will give a detailed mapping of the intellectual space that gives both theoretical and practical implications in the development of effectiveness in digital banking and project management.

Limitations and Future Research

While this research provides valuable information regarding the worldwide research environment of mobile and digital banking, technology integration, and efficiency of project management, the following limitations should be noted. First, the bibliometric analysis was limited to the Scopus database. Although Scopus has been noted as the "gold standard" for high-quality journal content, this dependence on one source can omit relevant works that are tagged in other repositories such as Web of Science or more field or regional specific ones. Future work should use a multi-database approach to get a more complete picture of the literature.

Second, this research only looked at articles published between 2015 and 2025. While this time frame is inclusive of developments in the modern era, the contributions made earlier in the creation of such theory and models of adoption are not necessarily covered. To be able to track the historical development of digital banking research more thoroughly, the timeline should be extended. Third, bibliometric methodologies mainly consider citation patterns, co-authorship and keyword co-occurrence, which emphasize quantitative mapping and ignore qualitative aspects. This limits the analysis of contextual factors that affect adoption and performance outcomes, including cultural, regulatory and organizational differences.

Future research needs to supplement bibliometric results with systematic literature reviews, meta-analyses, or case-based studies to offer more detailed analyses. Third, the thematic clusters identified show fragmentation across streams of research. We invite researchers to investigate interdisciplinary connections between innovation in fintech and sustainability, ESG frameworks, and digital governance in order to produce more integrated frameworks. Future research initiatives: Future research should take a more longitudinal view of the relationship between digital banking, project management efficiency, and sustainable financial performance to further advance the field.

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HALAL CERTIFIED PRODUCTS PREFERENCES AMONG GENERATION Z IN MALAYSIA

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Abstract: *The halal industry has experienced significant growth globally, driven by increasing consumer awareness, lifestyle changes, and demand for ethical and quality-assured products. In Malaysia, Generation Z represents an emerging consumer segment whose preferences towards halal certified products remain underexplored, particularly beyond religious considerations. Despite the widespread availability of halal certified products, limited empirical evidence exists on the factors influencing Gen Z consumers' preferences in the Malaysian context. This study aims to examine the influence of halal lifestyle and values, social circle influence, and perceived halal benefits of halal certified products on preferences towards halal certified products among Generation Z consumers in Malaysia. A quantitative research design was employed, using a structured questionnaire administered through an online survey. Data were collected from 200 Generation Z respondents using a snowball sampling technique. The data were analysed using SPSS, incorporating reliability analysis, correlation analysis, and multiple regression analysis. The results reveal that halal lifestyle and values, and perceived halal benefits of halal certified products have a significant positive influence on preferences towards halal certified products. In contrast, social circle influence was found to have no significant effect. The findings suggest that Generation Z consumers' preferences are primarily driven by personal values and perceived functional benefits such as health, safety, and quality, rather than social influence. This study contributes to the halal marketing literature by providing insights into Gen Z consumer behaviour and offers practical implications for halal producers and marketers in developing targeted strategies that align with the values and expectations of younger consumers.*

Keywords: *Generation Z; Halal Certified; Halal Lifestyle; Social Influence*

Introduction

The global Muslim population was estimated at 1.6 billion in 2020 and is projected to reach approximately 2.2 billion by 2030 (Usman et al., 2021). In parallel, the halal industry has experienced substantial growth, with its value estimated at USD 2.2 trillion in 2019 and

expected to reach USD 3.2 trillion by 2024. Malaysia, as one of the leading Muslim-majority countries, has emerged as a key hub in the global halal market and plays an important role as an exporter of halal products. This development has contributed to the growing academic interest in halal-related studies across disciplines such as marketing, management, and supply chain management. Malaysia's strong position in the halal industry is supported by a large Muslim population and a robust institutional framework. The country is widely recognized as a global leader in halal certification, largely due to the role of the Department of Islamic Development Malaysia (JAKIM), which oversees the halal certification process. Halal-certified products ensure compliance with Islamic dietary principles and undergo strict verification procedures before certification is granted. For Muslim consumers, halal certification represents both a religious obligation and an assurance of product permissibility. At the same time, halal certification has increasingly become an important consumer preference, particularly among younger consumers. Despite the growing demand for halal-certified products, consumer behavior related to halal purchasing decisions remains relatively underexplored, highlighting the need for further investigation into the factors influencing consumers to purchase halal-certified products (Fauzi, 2023).

This study therefore focuses on Generation Z consumers in Malaysia and their preferences toward halal-certified products. Generation Z, generally defined as individuals born between 1997 and 2012, represents a cohort shaped by rapid technological and social change. They are considered the first generation of digital natives, having grown up with smartphones, social media, and continuous internet connectivity (Lev, 2021). Academically, Gen Z is often characterized by diversity, pragmatism, entrepreneurial orientation, and a strong concern for social and environmental responsibility. Previous research suggests that Gen Z forms an increasingly important segment of halal product consumers. Studies applying the Theory of Planned Behavior (TPB) indicate that factors such as attitudes, subjective norms, and perceived behavioral control significantly influence their intention to purchase halal products (Sudarsono et al., 2023; Widyanto, 2020). The motivation for this study can be summarized in three aspects. First, it aims to identify the factors influencing Gen Z consumers' preferences toward halal-certified products beyond the traditional focus on food and beverages. Second, the study also considers non-Muslim Gen Z consumers, as the halal market is expanding beyond Muslim-majority countries. Research shows that consumers in non-Muslim-majority nations increasingly purchase halal products due to perceptions of quality, safety, and ethical production practices (Ali et al., 2021). Finally, halal represents a rapidly growing business sector that continues to gain attention among younger consumers (Fauzi, 2023; Haleem et al., 2020). As awareness of food safety, cleanliness, and sustainability increases, halal-certified products are expected to capture a larger share of the global market in the future (Ab Talib et al., 2020). Therefore, this study aims to address the following research questions:

- RQ1: Does halal lifestyle trends and values have a positive and significant relationship on the preferences of halal-certified products among Generation Z in Malaysia?
- RQ2: Does social circle influence have a positive and significant relationship on the preferences of halal-certified products among Generation Z in Malaysia?
- RQ3: Does perceived benefit of halal-certified products have a positive and significant relationship on the preferences of halal-certified products among Generation Z in Malaysia?

Literature Review

Generation Z Preferences Towards Halal Certified Products

Generation Z, defined as individuals born between 1997 and 2012, represents the fourth generational cohort after Generation Y, Generation X, and the Baby Boomer generation. This group is often described as the new learner generation (Lev, 2021). In several countries, including Indonesia, Generation Z Muslims are increasingly contributing to the growth of the halal industry. Many of them were raised in relatively stable economic environments and multicultural, technology-driven societies (Darlis et al., 2021). In Malaysia, Generation Z accounts for about 29% of the total population (Jabar, 2024), making them an influential consumer segment and an important market for halal products. Recent studies indicate that Malaysian Gen Z consumers are attracted to halal-certified products not only for religious reasons but also due to perceptions of quality, safety, and ethical production. Factors such as religious beliefs, subjective norms, and perceptions of halal as a symbol of quality and ethical practices significantly influence their preferences (Jabar et al., 2024).

Halal Lifestyle and Value

A halal lifestyle refers to an individual's way of living that reflects Islamic values such as sincerity, integrity, responsibility, dignity, and fairness (Handayani et al., 2023). Similarly, Mutmainah et al. (2023) explain that a halal lifestyle includes all activities conducted in accordance with Islamic law to fulfil an individual's needs. In recent years, the concept of halal lifestyle has expanded beyond fulfilling basic religious obligations and has developed into a broader social trend. For many Muslim consumers, practicing a halal lifestyle strengthens their identity as Muslims and reflects their commitment to Islamic values. As awareness increases, consumers are becoming more attentive to the halal status of products and are increasingly selective when making purchasing decisions. Although the halal lifestyle has gained considerable attention in recent studies, existing research largely focuses on millennial Muslim consumers (Mutmainah et al., 2023). Therefore, further investigation is needed to examine how a halal lifestyle influences Generation Z consumers' preferences toward halal-certified products.

Social Circle Influence

Social influences pertain to the perceived social pressure that impacts an individual's choice to adopt or avoid a specific behavior (Ajzen, 1991). Additionally, they include an individual's beliefs, which are shaped by how others perceive a behavior, whether positively or negatively. The social influences may originate from various reference groups, such as spouses, parents, or friends, who are likely to offer advice, share opinions, and provide support for an individual's actions. Thus, the Theory of Planned Behavior (TPB) highlights the significance of social norms in shaping individual behavior. Previous studies the significant impact of social norms on Muslim consumers' decision-making process when selecting halal products (Jabar et al., 2024) and proposed that this predictor enhance consumers' trust and purchase decisions regarding halal products (Azizan et al., 2022). Other studies related to choosing halal cosmetics found that consumers' attitudes toward halal cosmetics, along with family and peer

expectations, shape constructive behaviour (Ibeabuchi et al., 2024; Ngah et al., 2021). In conclusion, social influence plays a crucial role in consumers' decision-making when choosing halal products.

Perceived Benefits of Halal Certified Products

Perceived benefits of halal certified products, like the assurance of meeting strict religious guidelines, high quality standards, and ethical production practices, significantly influence consumer halal purchasing by building trust and confidence in the product. A study of Suryawan et al., (2022) explained that positive consumers' perception is often associated with the belief that halal products are healthier, have a superior quality, and produced more ethically. Apart from that, the perceived benefits of halal certified products particularly halal food is views as reputation for being healthier and safer. Even though Muslim consumers are the primary consumers of Halal certified products, but non-Muslim consumers nowadays are also becoming interested in it. However, barriers to consumption for both consumers may include the perception that halal certified products are more expensive, limited availability, and lack of knowledge about its benefits. Likewise, products that received halal certification as refer to halal certified products are essential for establishing trust and confidence among consumers (Saleh & Rajandran, 2024). Meanwhile, for non-Muslim consumers, the presence of halal certification logos on products serves as a visual assurance where the products follow strict quality and safety standards (Calder, 2020). This in line with a study of Al-Teinaz et al., (2020) explained that Halal certification is a sign of quality assurance in many nations with a majority of non-Muslim population.

Research Framework

The Theory of Planned Behavior (TPB) is widely used in studies related to purchase intention among consumers because it provides a strong framework for understanding the psychological factors influencing consumer decisions. According to TPB, three key factors, which are attitude, subjective norms, and perceived behavioral control, directly shape an individual's intention to perform a behavior, such as purchasing a product. Therefore, the conceptual framework for this study was formed based on the TPB to determine the preferences of halal certified products among Gen Z consumers in Malaysia. The proposed model attempted to explain the connection between three (3) independent variables: halal lifestyle and value, social circle influence and perceived benefits of halal certified products toward the dependent variable, the Gen Z preferences on halal certified products in Malaysia. This study extends the TPB by adding context-specific variables that better capture consumer behavior in halal purchasing. In line with a study by Shah Alam et al. (2011) extended TPB to include perceived value and consumer effectiveness in predicting sustainable food consumption, including halal products, in Malaysia. Figure 1.0 illustrates proposed factors that may influence the preferences of Gen Z consumers towards halal certified products, and this model is applied in this study.

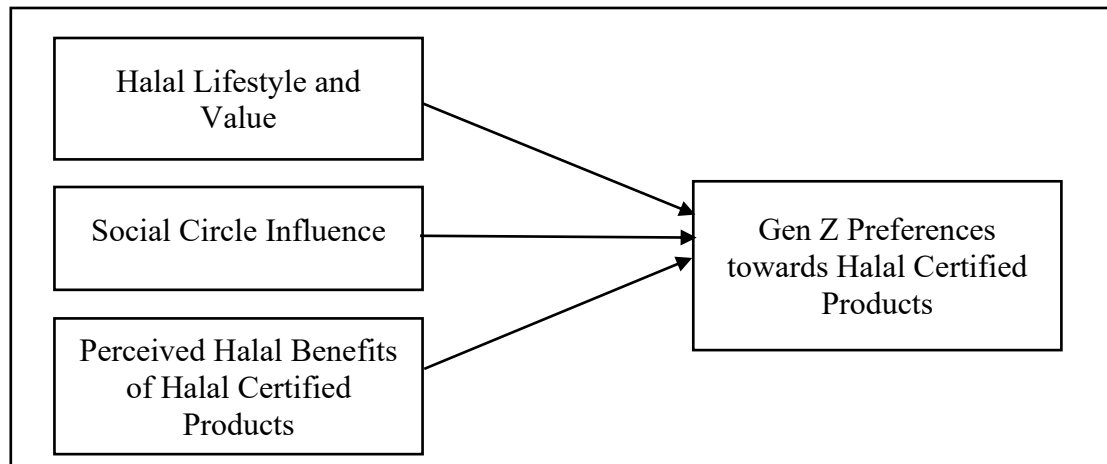


Figure 1: Research Framework

Methodology

This study adopts a quantitative research design to examine the determinants influencing Generation Z consumers' preferences toward halal-certified products in Malaysia. Based on the proposed research framework, three independent variables were examined: halal lifestyle and values, social circle influence, and perceived halal benefits of halal-certified products. These variables were analyzed in relation to the dependent variable, preferences toward halal-certified products. A structured questionnaire was developed based on concepts established in prior studies and adapted to suit the Malaysian Gen Z context. The questionnaire consisted of several sections covering demographic information, independent variables, and the dependent variable. All measurement items were assessed using a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree." The target population comprised Generation Z consumers in Malaysia, defined as individuals born between 1997 and 2012. Due to the dispersed and digitally connected nature of this group, a snowball sampling technique was used to distribute the questionnaire through online platforms. This approach enabled efficient data collection through peer sharing within social networks. A total of 200 valid responses were obtained, exceeding the minimum sample size required for multivariate analysis. The measurement items included halal lifestyle and values (7 items), social circle influence (4 items), perceived halal benefits (3 items), and preferences toward halal-certified products (5 items). Data were collected through Google Forms and analyzed using SPSS.

Result And Findings

Reliability Analysis

The reliability of the measurement instruments in this study was assessed using Cronbach's Alpha (α), which evaluates the internal consistency of items within each construct. As shown in Table 1, all four constructs achieved Cronbach's Alpha values above the minimum acceptable threshold of 0.70, indicating satisfactory to excellent reliability. The construct Halal Lifestyle and Values recorded a Cronbach's Alpha of 0.841 across seven items, demonstrating good internal consistency. Social Circle Influence, measured using four items, produced a Cronbach's Alpha value of 0.747, which is acceptable for exploratory research involving

consumer perceptions. The construct Perceived Halal Benefits of Halal Certified Products showed excellent reliability, with a Cronbach's Alpha of 0.930 for its three items, indicating highly consistent responses among participants. Finally, Preferences for Halal Certified Products, the dependent variable, yielded a Cronbach's Alpha of 0.882 across five items, signifying strong internal consistency. These results confirm that all constructs used in this study are reliable and suitable for further statistical analyses, including correlation and regression. Table 1 summarizes the findings.

Table 1: Reliability Test Result

Construct	Cronbach's Alpha	Number of Items
Halal Lifestyle & Values	0.841	7
Social Circle Influence	0.747	4
Perceived Halal Benefits of Halal Certified Products	0.930	3
Preferences for Halal Certified Products	0.882	5

Demographic Profile

Section A of the questionnaire covers the demographic profile of the respondents, and the summary is presented in Table 2. This section includes key demographic information such as age, type of consumer, gender, race, experience purchasing halal certified products, and the types of halal certified products frequently purchased by Generation Z consumers in Malaysia. The following is a detailed analysis of the findings:

Table 2: Summary of Demographic Profile of Respondents

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	60	30.0
	Female	140	70.0
Age	17–20 years	34	17.0
	21–23 years	148	74.0
	24–27 years	18	9.0
Types of Consumers	Secondary school students	23	11.5
	Form 6 / Pre-University	4	2.0
	University students	168	84.0
	Working individuals	5	2.5
Race	Malay	190	95.0
	Chinese	3	1.5
	Indian	6	3.0
	Others	1	0.5
Experience Purchasing Halal Certified Products	Yes	197	98.5
	No	3	1.5
	Food & beverages	195	97.5

Variable	Category	Frequency (n)	Percentage (%)
Frequently Purchased Halal Certified Products	Cosmetics	3	1.5
	Medicine & pharmaceuticals	2	1.0

Correlation Analysis

Correlation analysis was performed to examine the strength and direction of the relationships between the key constructs in this study: halal lifestyle and values, social circle influence, perceived halal benefits of halal certified products, and preferences towards halal certified products among Generation Z consumers in Malaysia. Pearson correlation coefficients were used to evaluate these associations, as this method is suitable for determining linear relationships between continuous variables. Table 3 presents the results of the correlation analysis.

Table 3: Summary of Correlation Analysis

		Halal Lifestyle & Values	Social Circle Influence	Perceived Halal Benefits	Preferences for Halal Certified Products
Halal Lifestyle & Values	Pearson Correlation	1	.657**	.733**	.725**
	Sig. (2-tailed)		<.001	<.001	<.001
	N	200	199	199	199
Social Circle Influence	Pearson Correlation	.657**	1	.611**	.553**
	Sig. (2-tailed)	<.001		<.001	<.001
	N	199	199	199	199
Perceived Halal Benefits	Pearson Correlation	.733**	.611**	1	.788**
	Sig. (2-tailed)	<.001	<.001		<.001
	N	199	199	199	199
Preferences towards Halal Certified Products	Pearson Correlation	.725**	.553**	.788**	1
	Sig. (2-tailed)	<.001	<.001	<.001	
	N	199	199	199	199

** . Correlation is significant at the 0.01 level (2-tailed).

The results show that all independent variables are positively and significantly correlated with preferences toward halal-certified products at the 0.01 significance level (2-tailed). Halal lifestyle and values demonstrate a strong positive correlation with preferences ($r = .725$, $p < .001$), indicating that Gen Z consumers who emphasize halal principles tend to show stronger preferences for halal-certified products. Social circle influence shows a moderate positive

relationship ($r = .553$, $p < .001$), suggesting that peers and family members play a role in shaping purchasing preferences.

The strongest correlation is observed between perceived halal benefits and preferences toward halal-certified products ($r = .788$, $p < .001$), indicating that perceptions of quality, safety, and health benefits strongly influence Gen Z consumers' preferences.

Additionally, the independent variables are significantly correlated with one another. Halal lifestyle and values are positively related to social circle influence ($r = .657$, $p < .001$) and perceived halal benefits ($r = .733$, $p < .001$). Perceived halal benefits are also positively associated with social circle influence ($r = .611$, $p < .001$). Overall, these results demonstrate significant relationships among all variables and support further hypothesis testing through regression analysis.

Multiple Regression Analysis

Multiple regression analysis was performed to determine the influence of the three independent variables, which are halal lifestyle and values (Mean_B), social circle influence (Mean_C), and perceived halal benefits of halal certified products (Mean_D) on the dependent variable, preferences towards halal certified products among Generation Z consumers (Mean_E). This analysis enables the identification of the strongest predictors and the extent to which each independent variable contributes to explaining the variance in Gen Z's halal product preferences. The Model Summary shown in Table 4 shows that the regression model produced an R value of 0.817, indicating a strong positive relationship between the set of predictors and the dependent variable. The R^2 value of 0.668 indicates that approximately 66.8% of the variance in preferences towards halal certified products is explained by the three predictors included in the model. The Adjusted R^2 of 0.663 further confirms that the model fits the data well, with minimal shrinkage after adjusting for the number of predictors. The standard error of estimate (0.36336) suggests good predictive accuracy for behavioral studies in social science.

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.817 ^a	.668	.663	.36336

a. Predictors: (Constant), Mean_D, Mean_C, Mean_B

The ANOVA results as presented in Table 5 below further support the model's significance. The F-statistic of 130.652 with a significance value of $p < .001$ indicates that the overall regression model is statistically significant. This implies that the combination of halal lifestyle and values, social circle influence, and perceived halal benefits significantly predicts Gen Z consumers' preferences for halal certified products.

Table 5: ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	51.750	3	17.250	130.652	<.001 ^b
	Residual	25.746	195	.132		
	Total	77.495	198			

a. Dependent Variable: Mean_E

b. Predictors: (Constant), Mean_D, Mean_C, Mean_B

The coefficients table (Table 6) provides detailed insights into the contribution of each predictor. The results show that perceived halal benefits of halal certified products (Mean_D) emerged as the strongest predictor of preferences towards halal certified products, with a standardized beta value of $\beta = 0.552$, $t = 8.810$, and $p < .001$. This indicates that Gen Z consumers place high emphasis on the health, safety, and quality assurances associated with halal certification when making purchase decisions.

Table 6: Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.929	.201		4.611	<.001
	Mean_B	.341	.071	.314	4.768	<.001
	Mean_C	.008	.052	.009	.161	.873
	Mean_D	.460	.052	.552	8.810	<.001

a. Dependent Variable: Mean_E

The construct halal lifestyle and values (Mean_B) was also found to be a significant predictor, with $\beta = 0.314$, $t = 4.768$, and $p < .001$. This suggests that individuals who integrate halal-conscious behaviors and values in their daily lives are more likely to prefer halal certified products. This aligns with existing literature that highlights the role of lifestyle and value-driven consumption patterns among younger Muslim consumers. However, social circle influence (Mean_C) did not show a significant effect on preferences, yielding $\beta = 0.009$, $t = 0.161$, and $p = .873$. This indicates that peer or family influence does not significantly shape Gen Z consumers' halal product preferences in this study. The finding suggests that Gen Z may make halal-related purchasing decisions more independently, guided by personal beliefs, product attributes, or perceived benefits rather than external social pressures. Overall, the regression analysis demonstrates that two variables, which are halal lifestyle and values, and perceived halal benefits, are significant determinants of preferences for halal certified products among Generation Z in Malaysia, with perceived benefits being the dominant factor. Social circle influence, however, does not significantly impact their preferences.

Discussion

Halal Lifestyle and Values and Preferences towards Halal Certified Products

The results of the multiple regression analysis indicate that halal lifestyle and values have a positive and statistically significant effect on preferences towards halal certified products among Generation Z consumers ($\beta = 0.314$, $p < 0.001$). Therefore, H1 is supported. This finding suggests that Gen Z consumers who actively integrate halal principles into their daily lifestyle, such as checking halal logos, seeking halal-certified alternatives, and perceiving halal consumption as appropriate behavior, are more likely to prefer halal certified products. This result is consistent with prior studies that emphasize halal lifestyle as a key determinant of halal consumption behavior (Mutmainah et al., 2023). As highlighted in the literature review, halal lifestyle reflects not only religious adherence but also a broader value system associated with

cleanliness, ethics, and responsibility (Handayani et al., 2023; Usman et al., 2023). The significant role of halal lifestyle and values also supports the Theory of Planned Behavior (TPB), where attitude towards behavior plays a crucial role in shaping behavioral preferences.

Social Circle Influence and Preferences towards Halal Certified Products

Contrary to expectations, social circle influence does not have a significant effect on preferences towards halal certified products ($\beta = 0.009$, $p = 0.873$). Thus, H2 is not supported. Although correlation analysis indicated a positive relationship between social circle influence and preferences, the regression results reveal that social influence does not independently predict Gen Z preferences once halal lifestyle and perceived benefits are considered. This suggests that Generation Z consumers may rely more on personal values and individual judgment rather than social pressure when making decisions related to halal certified products. This finding diverges from some earlier studies that emphasized the importance of subjective norms in halal purchase decisions (Ngah et al., 2021; Ibeabuchi et al., 2024). However, it aligns with recent literature suggesting that Gen Z consumers are more autonomous, pragmatic, and self-directed compared to previous generations (Lev, 2021). While friends and family may influence awareness, they may not directly determine final purchasing preferences for halal products among Gen Z. From a theoretical perspective, this result implies that subjective norms, a key component of TPB, may play a weaker role in halal-related preferences for Generation Z compared to attitudes and perceived outcomes. This highlights a generational shift where internalized values outweigh external social expectations.

Perceived Halal Benefits of Halal Certified Products and Preferences

The findings demonstrate that perceived halal benefits of halal certified products exert the strongest and most significant influence on preferences towards halal certified products ($\beta = 0.552$, $p < 0.001$). Therefore, H3 is strongly supported. This result indicates that Gen Z consumers place high importance on the tangible benefits associated with halal certified products, particularly in terms of health, safety, and quality. This is consistent with previous studies which found that halal certification serves as a signal of product quality, hygiene, and ethical production, appealing to both Muslim and non-Muslim consumers (Haleem et al., 2020; Suryawan et al., 2022; Saleh & Rajandran, 2024). The strong predictive power of perceived halal benefits suggests that halal certification is increasingly viewed beyond religious compliance and more as a quality assurance mechanism, especially among younger consumers. This supports findings by Arifin et al. (2023) and Rachmawati et al., (2022), who reported that halal-certified products are often associated with trustworthiness and superior standards. From a managerial perspective, this implies that Gen Z consumers are motivated primarily by what halal certification delivers, rather than who endorses it. This also explains why social circle influence becomes insignificant in the regression model, as perceived benefits overshadow external social factors.

Conclusion and Recommendations

Grounded in the Theory of Planned Behavior, this study extends halal consumption research by examining how value-based, social, and benefit-driven factors influence Generation Z

preferences toward halal-certified products beyond food contexts. The findings indicate that halal lifestyle and values, social circle influence, and perceived halal benefits are positively correlated with preferences toward halal-certified products. However, regression analysis shows that perceived halal benefits are the strongest predictor of Gen Z preferences, followed by halal lifestyle and values, while social circle influence does not have a significant direct effect when other variables are considered simultaneously. These results suggest that Gen Z consumers rely more on internalised values and perceived product benefits such as health, safety, and quality rather than social pressure when making consumption decisions. From a theoretical perspective, the findings partially support the proposed hypotheses. The hypotheses related to halal lifestyle and perceived halal benefits are supported, whereas the hypothesis concerning social circle influence is not supported. These results highlight the importance of attitudinal and belief-based components in explaining halal consumption preferences among younger consumers. From a practical standpoint, policymakers, certification bodies, and industry players should emphasise the functional and ethical benefits of halal-certified products, including quality assurance, safety, transparency, and health attributes. Strengthening communication strategies that highlight these benefits may enhance the perceived value of halal certification among Gen Z consumers. Future research may employ broader sampling techniques and examine additional factors such as religiosity or purchasing behaviour to provide deeper insights into Gen Z halal consumption.

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EXPECTATION-REALITY GAPS IN ONLINE RETAILING: TRANSPARENCY, CONSUMER DISAPPOINTMENT AND POST- PURCHASE BEHAVIOUR

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Abstract: *In the context of online retailing, consumers form expectations through a variety of factors, including product representations, delivery information, packaging descriptions, and cues provided by digital platforms. In the event of these expectations not being met, consumers experience disappointment, which in turn shapes their post-purchase perceptions and behavioural responses. This study employs expectation–disconfirmation theory as a framework to examine the expectation–reality gap in online shopping. It explores the implications of this gap for consumer dissatisfaction, post-purchase behaviour, and legal awareness in Malaysia. A qualitative-dominant hybrid approach was employed, combining a literature review with primary data from 40 households in Shah Alam collected via open-ended surveys. Thematic analysis identified five central themes which are representational misalignment, delivery realism gap, packaging transparency deficit, platform-mediated expectation formation, and legal awareness. The findings of the study indicate that greater transparency, realistic communication, and informed legal knowledge can reduce mismatches between expectations and actual outcomes, moderating negative responses such as complaints, product returns, and engagement with consumer protection mechanisms. The present study makes a contribution to the existing literature on retailing and consumer services by offering an empirical link between expectation management, transparency, platform cues and legal exposure. The study provides practical guidance for online retailers, platform operators and policymakers seeking to strengthen consumer trust and minimise post-purchase disputes.*

Keywords: *online retailing; transparency, consumer disappointment and post-purchase behaviour*

Introduction

Online shopping has become an integral part of modern consumer lifestyles, offering convenience, broad product selection, and 24/7 access. However, many shoppers experience frustration when purchased products fail to meet expectations. For instance, a household in Shah Alam may order multiple items anticipating timely delivery and product accuracy, yet parcels may arrive late, items may differ from online depictions, and inadequate packaging may result in damage. Such experiences are reflected in official complaints. Between 2021 and October 2025, Malaysian authorities recorded 51,821 complaints related to online transactions, with over 28,000 involving misrepresented or undelivered products (The Star, 2026). Similarly,

Hong Kong reported 17,000 online shopping complaints in 2024, many related to delivery delays and misrepresented goods (SCMP, 2024).

Expectation–disconfirmation theory (Oliver, 1980) suggests that dissatisfaction arises when actual outcomes deviate from anticipated performance. In online contexts, the absence of physical inspection amplifies these gaps. While prior research focuses on satisfaction and trust, limited attention has been given to the link between expectation gaps and legal consequences. This study addresses this gap by examining how transparency, realistic communication, and legal awareness moderate consumer disappointment in Malaysian online retailing.

Expectation and Disappointment in E-Commerce

Expectations in online shopping are shaped by product images, descriptions, and delivery promises. Misalignment between expected and actual product attributes leads to consumer dissatisfaction (Mokhtar, Yusoff, Asmuni, & Fauzi, 2020). Delivery performance is critical, as late or unreliable shipments intensify negative evaluations (Lee & Lin, 2005). Misleading information, such as exaggerated product imagery or unclear descriptions, further amplifies expectation gaps (Awad & Othman, 2024).

Product Representation and Packaging Transparency

Information asymmetry is inherent in online retailing. Misrepresentation of products through images, descriptions, or labels contributes to dissatisfaction and increases the likelihood of returns (Awad & Othman, 2024). Packaging transparency, including protective quality and accurate labeling, has emerged as a critical factor in shaping consumer post-purchase perceptions (Lee & Lin, 2005).

Transparency, Trust, and Legal Moderation

Transparent communication regarding product specifications, delivery timelines, and packaging reduces both consumer disappointment and potential legal risk (Gefen, 2000; Braun & Clarke, 2006).

Legal Consequences of Expectation Gaps

Unmet expectations may trigger statutory or contractual liability. In Malaysia, the *Consumer Protection Act 1999* mandates that goods must match descriptions and meet acceptable quality standards (Consumer Protection Act 1999, Malaysia; Roslan et al., 2025). However, consumer awareness of legal remedies is often limited (Nurhayati Abdul Ghani, 2023).

Research Design

This study employs a qualitative-dominant empirical approach to investigate online shopping experiences among households in Shah Alam, Malaysia, focusing on expectation gaps in household product purchases. The qualitative emphasis allows for an in-depth exploration of

consumer perceptions, emotional responses, and behavioural intentions, which are difficult to capture fully through quantitative methods alone. This approach is particularly suited for understanding complex constructs like expectation formation, transparency, and legal awareness within the dynamic online retail context. The study is guided by the conceptual framework (Figure 1), which highlights the moderating role of transparency and realistic communication on the expectation–reality gap and subsequent consumer outcomes.

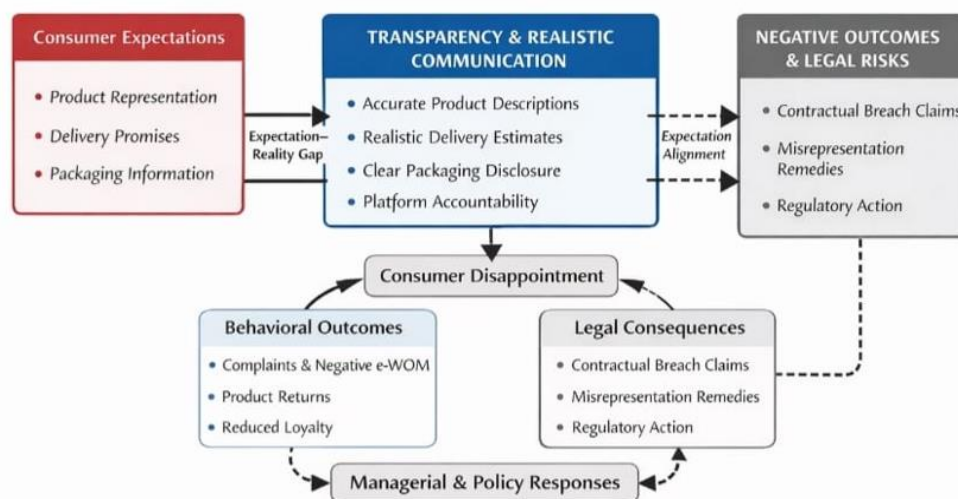


Figure 1: Conceptual Framework of Expectations, Transparency, and Legal Consequences in Online Shopping

Population and Sampling

The study targets households in Shah Alam that purchased household products online within the past 12 months. Purposive sampling was employed to select participants who could provide relevant, experience-based insights into the phenomenon under study (Anizah et al., 2022). This non-probabilistic sampling method is justified given the study's exploratory nature and the need to recruit participants with direct exposure to online shopping, ensuring data richness and relevance.

A sample size of 40 respondents was chosen based on qualitative research standards, which suggest that 30 to 50 participants typically suffice to reach thematic saturation where no new themes or insights emerge from additional data (Guest, Bunce, & Johnson, 2006). This sample size balances depth of data with practical considerations of accessibility and response quality, supporting robust thematic analysis.

Data Collection

The data were collected through a structured online survey featuring open-ended questions. The choice of questions was made with two objectives in mind: first, to enable broad geographic coverage within Shah Alam; second, to allow participants to respond at their convenience, and to encourage candid, detailed reflections on their experiences. The employment of open-ended inquiries was imperative in order to elicit comprehensive

qualitative insights concerning consumer dissatisfaction, perceptions of transparency, and legal awareness, which might have been overlooked by close-ended formats. The survey explored the types of household products purchased online, experiences related to product quality, packaging, and delivery, specific instances of unmet expectations and resulting disappointment, consumer responses such as complaints or returns, and awareness of legal rights and protection mechanisms. This ensured a comprehensive examination of the expectation gap and its consequences.

Data Analysis

Thematic analysis (Braun & Clarke, 2006) was employed due to its flexibility and rigor in identifying, analyzing, and reporting patterns within qualitative data. This method enables systematic coding while allowing interpretative depth, aligning well with the study's exploratory and theory-building aims. The analysis followed a five-step process. Initially, the researchers familiarised themselves with the dataset in order to gain an understanding of the full scope and depth of the participant responses. Secondly, preliminary coding systematically identified meaningful data units linked to key constructs, including representational accuracy, delivery realism, transparency in packaging, platform-mediated expectation formation, and legal awareness. Thirdly, related codes were grouped into broader themes, including the Delivery Realism Gap, Packaging Transparency, Platform-Mediated Expectations, and Legal Awareness. The fourth stage of the process involved the review and refinement of themes to ensure clarity, distinctiveness, and alignment with the dataset. Finally, the interpretation of the themes was situated within the study's conceptual framework (Figure 1) and existing literature, explaining how transparency moderates' expectation gaps and shapes behavioural and legal outcomes.

The use of thematic analysis facilitates both inductive insights grounded in participant data and deductive alignment with existing theory. A qualitative approach was selected to capture nuanced, context-dependent consumer experiences. Open-ended responses allow participants to express subjective perceptions of expectation gaps, disappointment, and legal awareness, which quantitative surveys may not fully reveal (Mokhtar et al., 2020; Awad & Othman, 2024).

Conceptual Framework

Figure 1 illustrates the conceptual framework underpinning this research. Consumer expectations shaped by product representation, delivery promises, and packaging information may result in an expectation–reality gap when transparency and communication are insufficient. Transparency and realistic communication (accurate product descriptions, realistic delivery estimates, clear packaging disclosures, and platform accountability) serve to reduce this gap and foster expectation alignment.

Persistent gaps lead to consumer disappointment, which manifests in behavioural outcomes such as complaints, product returns, and reduced loyalty, as well as legal consequences including contractual breach claims, misrepresentation remedies, and regulatory actions. Managerial and policy responses form a feedback loop that enhances transparency and communication practices, mitigating future expectation gaps and their adverse effects.

Results

The thematic analysis of 40 household responses in Shah Alam revealed five (5) primary themes, reflecting the conceptual framework of expectation–reality gaps, transparency, and legal consequences in online shopping.

Representational Misalignment

The majority of respondents ($n = 31/40$) reported dissatisfaction arising from discrepancies between product representations and the actual items received. Participants frequently identified exaggerated product images, vague descriptions, and misleading promotional content as key contributors to inflated expectations. This issue was particularly prominent in categories such as furniture, home décor, and kitchen appliances, where visual cues heavily influenced purchasing decisions.

It was reported by respondents that the quality of products appeared to be higher in online contexts than in reality. For instance, one participant explained that "the sofa looked exactly like the picture, but the fabric quality was much poorer and the colour was darker than expected." In addition, it was observed that items designated as premium often failed to meet expectations with regard to quality and durability.

It has been demonstrated that these discrepancies frequently resulted in returns, complaints, and diminished trust in both the sellers and the platforms. The findings indicate that representational accuracy is a critical determinant of consumer satisfaction, as misalignment directly contributes to negative post-purchase experiences. This finding aligns with prior research highlighting how misleading visuals and unclear descriptions amplify expectation–reality gaps and dissatisfaction (Awad & Othman, 2024).

Delivery Realism Gap

A considerable proportion of respondents ($n = 27/40$) reported issues pertaining to delivery, which was identified as a primary contributor to their dissatisfaction. A significant number of participants noted delays in delivery that exceeded the stipulated timeframe, the occurrence of incomplete shipments, and the inconvenience of delivery hours that did not align with customer convenience. These issues were especially prevalent during promotional periods and peak sales events.

It was emphasised by several respondents that delivery timelines were often overly optimistic and did not reflect actual logistics conditions. One participant noted that they had expected their cleaning supplies to arrive within two days, but that they had only arrived after a week, which had resulted in a disruption to their schedule. As reported by numerous individuals, considerable frustration was experienced when essential household items failed to arrive as scheduled.

The consequences of delivery delays were far-reaching, extending beyond mere inconvenience to affect household planning and, in some cases, discourage future purchases. The findings of

this study demonstrate that delivery realism plays a crucial role in managing consumer expectations. Failure to adhere to the stipulated delivery schedules has been shown to directly contribute to a decline in satisfaction and a concomitant reduction in trust (Lee & Lin, 2005; Mokhtar et al., 2020). This underscores the significance of ensuring delivery communications are both accurate and transparent.

Packaging Transparency Deficit

Approximately half of the respondents ($n = 21/40$) expressed concerns regarding inadequate packaging and the lack of transparency about protective measures. Participants reported that inadequate packaging frequently resulted in product damage, particularly for fragile items such as glassware and liquid containers.

The respondents further highlighted that they were often unaware of how products would be packaged prior to delivery, which limited their ability to assess potential risks. One participant stated, "The glass bottles were not wrapped properly and many arrived broken, and I was unaware that I could claim compensation." It has been reported by other parties that items were received that exhibited signs of scratching, leakage, or other visible damage.

The findings of the study indicate that packaging transparency exerts an influence not only on product protection but also on perceptions of retailer reliability. Inadequate packaging has been demonstrated to contribute directly to dissatisfaction (Smith, 2023). Conversely, clear communication regarding packaging standards has been shown to help manage expectations and reduce uncertainty (Brown et al., 2021). This finding is consistent with extant literature emphasising the role of service quality elements in influencing consumer satisfaction (Lee & Lin, 2005).

Platform-Mediated Expectation Formation

A significant proportion of respondents ($n = 24/40$) indicated that platform-generated cues, including ratings, reviews, "top seller" badges, and promotional labels, had a substantial impact on their expectations. A significant proportion of participants reported relying heavily on these indicators when making purchase decisions, often assuming that such cues guaranteed product quality and reliable service.

This reliance diminished the extent to which consumers critically evaluated product descriptions. One respondent elucidated that their initial assumption of the product's high quality, as evidenced by its 5-star rating and 'top seller' badge, was not substantiated by the product's actual performance. It has been demonstrated that platform cues frequently result in the establishment of unrealistic expectations, which are subsequently not aligned with the actual performance of the product.

The findings demonstrate that platform-mediated signals function as powerful extrinsic factors in shaping consumer expectations. In instances where these signals are incongruent with the subsequent actual outcomes, the level of dissatisfaction is known to increase. This underscores

the necessity for enhanced platform accountability to ensure the accuracy of such indicators in reflecting product and seller performance (Gefen, 2000).

Legal Awareness

In comparison, the level of legal awareness among respondents was comparatively lower, with approximately 40% ($n = 16/40$) indicating that they were aware of their consumer rights. However, even among those who were aware, many expressed uncertainty about how to pursue formal remedies in cases of misrepresentation or product damage.

Participants frequently described experiencing confusion regarding complaint procedures and the allocation of responsibility between themselves and the platforms on which they trade. A respondent noted, "I was unaware of the possibility of claiming for damaged goods under the law, and so I simply returned the item and left a bad review." It has been documented that other parties have reported relying on informal actions, such as negative reviews, as an alternative to pursuing formal legal channels.

The findings reveal a significant gap in awareness of the protections afforded by the Malaysian Consumer Protection Act 1999, consistent with prior research (Nurhayati Abdul Ghani, 2023; Roslan et al., 2025). It appears that limited legal literacy exerts an influence on the manner in which consumers respond to dissatisfaction, frequently resulting in passive rather than formal action.

The findings demonstrate that gaps between expectations and reality in online shopping are influenced by a range of factors. The most common issues are representational misalignment, delivery realism and platform-mediated expectations, followed by packaging transparency and legal awareness, which shape consumer experiences. Transparency and realistic communication play a critical role in reducing these gaps, enhancing trust and reducing dissatisfaction. The study highlights the importance of platform accountability and consumer legal literacy.

Discussion

This study examined expectation–reality gaps in online shopping among Malaysian households, focusing on product representation, delivery performance, packaging practices, platform-mediated cues, and legal awareness. The findings corroborate and extend existing e-commerce literature by demonstrating that expectation gaps are multidimensional and shaped by informational accuracy, service performance, and platform design.

Consistent with prior research, representational misalignment emerged as the primary source of dissatisfaction, reaffirming the importance of accurate product depiction in shaping expectations. However, the findings indicate that these gaps are not confined to product attributes alone. Rather, they are systemically generated across the consumer journey, spanning pre-purchase (platform cues), transaction (delivery), and post-purchase (packaging). This supports a shift from viewing expectation gaps as isolated outcomes to understanding them as a process-driven phenomenon.

A key contribution of this study is the identification of packaging transparency as a significant yet underexplored determinant of satisfaction. While existing studies have largely emphasised delivery and service quality, the results show that inadequate packaging and unclear information regarding protective measures intensify dissatisfaction. Packaging therefore serves not only a functional role but also acts as a signal of care, professionalism, and reliability, influencing perceived quality and trust. This extends service quality frameworks by positioning packaging as a critical component of expectation management.

The findings further highlight the role of platform-mediated cues in shaping expectations. Ratings, reviews, and seller badges function as heuristic shortcuts that simplify decision-making. However, when such signals are inconsistent with actual performance, they contribute to inflated expectations and heightened disappointment. This reinforces trust-based models of e-commerce while demonstrating that platform design actively constructs expectations, thereby bearing partial responsibility for expectation–reality discrepancies.

Delivery performance also emerged as a critical factor, particularly in relation to delivery realism. Overly optimistic timelines especially during peak sales periods were found to disrupt household routines and undermine trust. These findings emphasise that accurate and transparent communication is as important as operational efficiency in managing expectations and reducing dissatisfaction.

Beyond immediate dissatisfaction, the study reveals that expectation gaps influence consumer behavioural and legal responses. While some respondents demonstrated awareness of their rights, many lacked clarity regarding formal complaint mechanisms. This suggests that legal awareness moderates post-purchase behaviour, shaping whether consumers pursue formal remedies or resort to passive responses such as negative reviews. These findings are consistent with prior research indicating that legal literacy influences consumer engagement in dispute resolution.

From a regulatory perspective, the findings align with the objectives of the Consumer Protection Act 1999 and ongoing discussions on platform accountability. The results provide empirical support for strengthening enforcement related to misleading representations, improving transparency standards, and clarifying the responsibilities of digital platforms in shaping consumer expectations.

Integration with the Conceptual Framework

The findings provide strong support for the proposed conceptual framework. Consumer expectations are shaped by multiple inputs, including product representations, delivery commitments, packaging practices, and platform signals. Expectation–reality gaps arise when these elements lack transparency or realism, leading to dissatisfaction and subsequent behavioural responses such as complaints, returns, and negative word-of-mouth. In some cases, these responses may extend to legal action, particularly where misrepresentation or contractual issues are perceived.

Transparency and realistic communication emerge as key moderating factors that reduce negative outcomes and reinforce trust. Effective expectation management therefore requires an integrated approach encompassing product information, delivery communication, packaging standards, platform interface design, and consumer legal awareness.

Theoretical Contributions

This study contributes to consumer behaviour and e-commerce literature by extending expectation–disconfirmation perspectives through the incorporation of platform-mediated signals and legal awareness as moderating factors. The identification of packaging transparency as an additional dimension further broadens the understanding of how expectations are formed and evaluated in online retail contexts. In addition, the study establishes a clearer link between expectation formation, dissatisfaction, and legal consequences within a unified framework of post-purchase behaviour, offering a more comprehensive explanation of consumer responses in digital marketplaces.

Managerial and Policy Implications

The findings provide several practical implications for retailers, platforms, and policymakers. Retailers should prioritise accurate product representation, supported by detailed descriptions and realistic visuals, to minimise expectation gaps. Delivery timelines must be communicated clearly and realistically, with timely updates to manage uncertainty. Strengthening packaging standards and clearly conveying protective measures can further reduce damage-related dissatisfaction and enhance perceived reliability.

Platform operators should also review interface elements such as ratings, badges, and promotional cues to ensure they do not unintentionally inflate expectations beyond actual performance. At the same time, improving access to information on consumer rights and dispute resolution processes can empower users to respond more effectively to negative experiences.

From a policy perspective, the findings highlight the need to strengthen transparency requirements, enforcement mechanisms, and platform accountability. Public education initiatives aimed at improving legal awareness are equally important, as informed consumers are more likely to engage in formal and structured dispute resolution processes.

The findings and discussion have resulted in an action plan to address the gaps between expectations and reality across the online consumer journey. See Table 1 for details of the recommended strategies, responsible stakeholders and expected outcomes.

Table 1: Action Plan for Improving Expectation Management in Online Retail

Theme	Evidence from Findings	Recommended Actions	Responsible Stakeholders	Expected Outcome	Timeframe
Representational Misalignment	Majority of respondents reported discrepancies between product images and actual items	- Use verified product images (no excessive editing) - Provide detailed, standardised product descriptions (size, material, colour accuracy) - Include user-generated photos in listings	Sellers, E-commerce Platforms	Reduced expectation gaps; improved trust and satisfaction	Short–Medium term
Delivery Realism Gap	Frequent delays and unrealistic delivery promise, especially during peak periods	- Provide realistic delivery timelines based on logistics capacity - Implement real-time tracking and proactive updates - Adjust expectations during sales campaigns	Sellers, Logistics Providers, Platforms	Improved reliability perception; reduced complaints and frustration	Short term
Packaging Transparency Deficit	Product damage due to poor packaging and lack of information on protective measures	- Standardise packaging guidelines (especially for fragile items) - Display packaging methods in product listings - Introduce “secure packaging” labels or certifications	Sellers, Platforms	Reduced product damage; enhanced perceived quality and trust	Medium term
Platform-Mediated Expectation Inflation	Heavy reliance on ratings, badges, and “top seller” indicators leading to inflated expectations	- Audit and refine rating/badge systems - Ensure badges reflect consistent performance (not just sales volume) - Increase transparency in how ratings are calculated	E-commerce Platforms, Regulators	More accurate expectation formation; reduced post-purchase dissatisfaction	Medium–Long term
Low Legal Awareness	Only ~40% aware of consumer rights; confusion about complaint procedures	- Provide clear, visible information on consumer rights - Simplify complaint and dispute resolution processes	Government, Platforms, Consumer Protection Agencies	Increased consumer empowerment; higher use of formal dispute mechanisms	Medium–Long term

Theme	Evidence from Findings	Recommended Actions	Responsible Stakeholders	Expected Outcome	Timeframe
		- Launch consumer education campaigns			
Expectation–Reality Gap Across Journey	Gaps occur at multiple stages (pre, during, post purchase)	- Adopt integrated expectation management strategy - Align product info, delivery communication, packaging, and platform signals - Monitor customer feedback continuously	Sellers, Platforms	Holistic improvement in customer experience and loyalty	Long term
Transparency Deficiencies (Overall)	Lack of clear and accurate information across multiple touchpoints	- Implement transparency standards for listings, delivery, and packaging - Enforce disclosure requirements under Consumer Protection Act 1999	Regulators, Platforms	Reduced disputes; stronger regulatory compliance and trust	Long term

Limitations and Future Research

Despite its contributions, this study has several limitations. The qualitative sample of 40 households in Shah Alam may limit generalisability, and the reliance on self-reported experiences introduces the possibility of recall bias. Future research should incorporate larger and more diverse samples, as well as mixed-method approaches combining survey and behavioural data.

Further studies could also explore different product categories or conduct cross-country comparisons to examine how cultural and regulatory contexts influence expectation formation and post-purchase behaviour. Expanding the methodological and contextual scope would enhance understanding of expectation management in e-commerce.

Conclusion

This study demonstrates that expectation–reality gaps in online shopping are multifaceted, process-driven, and shaped by both market dynamics and regulatory factors. Discrepancies arising from product representation, delivery performance, packaging practices, and platform cues contribute significantly to consumer dissatisfaction.

Improving transparency and ensuring realistic communication across all stages of the consumer journey can reduce negative experiences, strengthen trust, and minimise disputes. By integrating platform design and legal awareness into the analysis, the study offers a more

comprehensive understanding of how expectations are formed, evaluated, and acted upon in digital marketplaces. These insights are particularly relevant for enhancing consumer protection and advancing more transparent and accountable e-commerce environments.

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STRATEGIC SIGNALING AND FORCE PROJECTION IN THE STRAITS OF MALACCA (2023–2025)

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Abstract: *This article investigates strategic signalling and force projection in the Straits of Malacca between 2023 and 2025, focusing on naval transits and exercises by major powers, particularly the United States and China. As one of the world's most critical maritime chokepoints, the strait has evolved into a contested geopolitical space where naval deployments serve as instruments of deterrence, reassurance, and influence. U.S. carrier movements and multinational exercises such as RIMPAC and CARAT reflect a deliberate campaign to reinforce Indo-Pacific stability and assert freedom of navigation. Simultaneously, China's expansion of maritime infrastructure in Gwadar and Kyaukpyu signals its intent to mitigate strategic vulnerabilities and reshape regional maritime dynamics. Using a qualitative methodology, the study draws on primary and secondary sources including open-source intelligence reports, defence white papers, naval press releases, and expert interviews. The findings reveal that these strategic movements are part of a broader signalling architecture aimed at shaping regional security perceptions and alliance behaviour. Regional actors namely Malaysia, Indonesia, and Singapore have responded with differentiated maritime strategies, balancing sovereignty concerns with cooperative frameworks such as joint patrols and maritime domain awareness platforms. The study highlights the limitations of existing mechanisms, which often suffer from fragmented mandates and uneven institutional capacity. It argues for a shift from reactive posturing to proactive maritime governance, emphasizing the need for integrated regional diplomacy and sustained political commitment. Looking forward, the article identifies hybrid threats and naval cyber vulnerabilities as emerging challenges requiring doctrinal innovation and inter-agency coordination. As maritime systems become increasingly digitized, the potential for cyber–physical disruption grows, necessitating the development of cyber governance norms tailored to the maritime domain. The Straits of Malacca will remain central to Indo-Pacific security, demanding strategic foresight and collaborative resilience from regional stakeholders.*

Keywords: CARAT, Indo – Pacific, Major Powers, RIMPAC, Straits of Malacca

Introduction

The Straits of Malacca, situated between Peninsular Malaysia and Sumatra, remain one of the most strategically significant maritime corridors globally. Linking the Indian Ocean to the South China Sea and ultimately the Pacific Ocean, the strait functions as a critical artery of global trade. Approximately 94,000 vessels transit annually, carrying nearly 25% of the world's traded goods and over 60% of energy shipments, including crude oil and liquefied natural gas (Informare, 2026). Its narrowest point, the Phillips Channel, spans only 2.8 kilometres,

rendering it highly vulnerable to congestion, accidents, piracy, and strategic manipulation. Thus, the strait is not merely a commercial passage but a geopolitical fulcrum in the Indo-Pacific. Between 2023 and 2025, the strategic relevance of the strait has intensified amid escalating great power competition and evolving maritime security dynamics. The Indo-Pacific has emerged as the epicentre of global strategic recalibration, with the United States, China, and regional actors vying for influence across critical sea lines of communication (Noraini, 2025). Naval transits by U.S. aircraft carriers such as the USS *Nimitz* and USS *Carl Vinson* in 2025 exemplify deliberate demonstrations of maritime dominance, reaffirming Washington's commitment to freedom of navigation and Indo-Pacific stability (U.S. Indo-Pacific Command, 2024). These deployments are part of a broader strategic narrative aimed at deterring adversarial behaviour, reassuring allies, and reinforcing the rules-based maritime order.

Strategic signalling, rooted in classical naval theory and deterrence frameworks, posits that visible military movements serve as communicative acts intended to shape perceptions and behaviour (Till, 2013). In the Straits of Malacca, U.S. naval operations simultaneously reassure regional partners and deter China's growing assertiveness in the South China Sea. China's vulnerability, often termed the "Malacca Dilemma," stems from its reliance on the strait for energy imports and trade flows. This chokepoint represents a strategic liability in the event of conflict or blockade, prompting Beijing to diversify routes through the China–Pakistan Economic Corridor, the proposed Kra Canal, and Arctic shipping lanes (Lane, 2025). Regional actors have also recalled their maritime postures. Malaysia balances non-alignment with strategic hedging, Indonesia advances its archipelagic defence modernization, and Singapore leverages advanced naval infrastructure and intelligence capabilities to serve as both logistics hub and interlocutor in regional security dialogues (Pitakdumrongkit, 2023). These responses underscore the strait's evolving role as a site of geopolitical contestation and maritime diplomacy.

This study argues that naval transit by great powers through the Straits of Malacca between 2023 and 2025 are emblematic of a broader strategic signalling campaign aimed at shaping the regional security architecture. By analysing the timing, messaging, and regional responses to these movements, the strait emerges as a locus of force projection and strategic influence. In doing so, this analysis contributes to scholarly discourse on naval strategy, maritime chokepoints, and Indo-Pacific security, while offering policy-relevant insights for regional stakeholders navigating an increasingly complex strategic environment.

Literature Review

The strategic importance of maritime chokepoints has long been central to naval theory and international security discourse. Mahan's sea power doctrine underscores the enduring relevance of controlling vital sea lanes as a means of projecting influence and safeguarding national interests (Till, 2013). The Straits of Malacca, as a narrow and congested corridor linking the Indian and Pacific Oceans, exemplify this principle. Contemporary scholarship extends Mahanian logic to examine how great powers leverage chokepoints for strategic signalling and deterrence, particularly in the Indo-Pacific where maritime competition has intensified in recent years (Shukla, 2016; Jamison, 2022).

Freedom of Navigation Operations (FONOPS) have emerged as a central instrument of U.S. naval strategy, designed to challenge excessive maritime claims and reinforce the rules-based order under UNCLOS. In the Straits of Malacca and adjacent waters, FONOPS serve not only legal purposes but also strategic messaging, particularly in response to China's growing maritime assertiveness (U.S. Indo-Pacific Command, 2021; IPDForum, 2025). These operations reflect a broader pattern of force projection aimed at maintaining open sea lanes, deterring coercive behaviour, and reassuring allies of U.S. commitment to Indo-Pacific stability.

China's "Malacca Dilemma," its strategic vulnerability arising from reliance on the strait for energy imports, has prompted diversification efforts through alternative corridors such as the China-Pakistan Economic Corridor and the proposed Kra Canal. At the same time, China has expanded its naval footprint under the "Far Seas Protection" doctrine, signalling its intent to mitigate chokepoint dependency and assert maritime presence (Lane, 2025). This dual strategy of diversification and naval expansion reflects Beijing's recognition of the strait as both a critical lifeline and a potential liability in the event of conflict or blockade.

Regional scholarship highlights the differentiated responses of Southeast Asian states. Malaysia, Indonesia, and Singapore have adopted maritime strategies shaped by domestic priorities and geopolitical constraints, balancing sovereignty concerns with the imperatives of regional stability. ASEAN has promoted cooperative mechanisms such as the Malacca Straits Patrol and the Code for Unplanned Encounters at Sea (CUES), which facilitate communication and reduce misperceptions. Yet institutional limitations and sovereignty sensitivities continue to hinder deeper integration (Rosnani et al., 2022; Asmussen, 2025). These dynamics underscore the complexity of regional maritime governance, where great power rivalry intersects with local security imperatives.

The Straits of Malacca illustrate the enduring salience of maritime chokepoints in global strategy. They function simultaneously as commercial arteries, sites of strategic signalling, and arenas of geopolitical contestation. The interplay of U.S. FONOPS, China's diversification and naval expansion, and ASEAN's cooperative but constrained mechanisms highlights the strait's evolving role as a locus of both deterrence and diplomacy (Noraini, 2025). This complexity reinforces the need for integrated governance frameworks that balance sovereignty with collective security, ensuring that one of the world's most vital sea lanes remains open, stable, and resilient amid intensifying Indo-Pacific rivalry.

Methodology

This study employs a qualitative content analysis to investigate strategic signalling and force projection in the Straits of Malacca between 2023 and 2025. Qualitative content analysis is appropriate for interpreting complex geopolitical phenomena, as it enables the systematic examination of textual data within its strategic and institutional context (Schreier, 2012). The research design integrates triangulated sources to enhance analytical validity and ensure methodological rigor. Secondary data is drawn from open-source intelligence reports, including the *Asia-Pacific Regional Security Assessment 2025* by the International Institute for Strategic Studies (IISS, 2025), which offers authoritative insights into naval deployments,

regional threat perceptions, and maritime posture. Complementing this are incident reports from the Regional Cooperation Agreement on Combating Piracy and Armed Robbery against Ships in Asia (ReCAAP ISC, 2025), which provide empirical evidence of maritime insecurity and operational vulnerabilities in the strait. National defence white papers from Malaysia, Indonesia, and Singapore are critically analyzed to assess strategic priorities, doctrinal shifts, and regional engagement frameworks. Malaysia's Defence White Paper (Ministry of Defence Malaysia, 2020) articulates a maritime-centric security vision, while Indonesia's strategic documents emphasize archipelagic defence and naval modernization. Singapore's publications highlight its role as a logistics and intelligence hub within the Indo-Pacific security architecture (UPNM, 2019). To capture strategic intent and operational framing, the study examines official press releases from the U.S. Pacific Fleet detailing carrier strike group movements, joint exercises, and bilateral engagements (U.S. Pacific Fleet, 2025). These sources are essential for tracing the temporal and rhetorical dimensions of U.S. naval signaling. Where feasible, semi-structured interviews with regional security analysts and naval officers are conducted to supplement textual data with practitioner insights. These interviews follow a thematic guide and are designed to elicit expert perspectives on strategic calculus, inter-agency coordination, and maritime governance challenges (George, 2022). The integration of documentary and experiential data supports a multi-layered analysis of how great power naval movements shape regional maritime security dynamics.

Strategic Naval Movements (2023–2025)

Between 2023 and 2025, the Straits of Malacca served as a strategic corridor for high-profile naval transits and multinational exercises that reflected intensifying great power competition and evolving regional maritime postures. The transits of U.S. aircraft carriers USS *Carl Vinson* and USS *Nimitz* in April and June 2025 respectively were emblematic of deliberate force projection and strategic signaling. These deployments occurred amid heightened tensions in the Middle East and concurrent Chinese naval maneuvers in the South China Sea, underscoring the strait's role as a pivot between multiple theatres of operation (Shelbourne, 2025; Greet, 2025). The USS *Carl Vinson* was redeployed from East Asia to reinforce operations in the Arabian Sea, while the USS *Nimitz* transited westward through the Singapore and Malacca Straits en route to relieve *Vinson* under U.S. Central Command. These movements were not merely logistical but formed part of a broader deterrence narrative aimed at adversaries and reassurance toward allies.

Complementing these transits were multinational exercises such as RIMPAC 2024 and CARAT 2024, which reinforced alliance cohesion and operational interoperability. RIMPAC 2024, hosted by the U.S. Pacific Fleet, involved 29 nations and emphasized integrated maritime operations, humanitarian assistance, and joint tactical readiness (Indo-Pacific Defense Forum, 2024). CARAT exercises, particularly between the U.S. and Indonesia, demonstrated a steady expansion in complexity and scope, integrating advanced technologies and joint force coordination (Yuson, 2024). These exercises served dual strategic functions: enhancing regional capacity and projecting a unified commitment to the rules-based maritime order.

The timing and routing of these deployments through the Straits of Malacca carry significant implications for regional actors. Malaysia has maintained a cautious balancing posture,

emphasized strategic autonomy while participated in cooperative mechanisms such as the Malacca Straits Patrol (MSP) and the Tripartite Technical Experts Group (TTEG) (Setiawan & Padilla, 2025). Indonesia has reinforced its archipelagic defence strategy, focusing on coordinated patrols and intelligence fusion to address both traditional and non-traditional threats. Singapore, with its advanced naval infrastructure and surveillance capabilities, continues to serve as a logistical and intelligence hub, facilitating maritime domain awareness and multilateral engagement (Permal & Moorthy, 2024). These strategic naval movements and exercises reflect a broader pattern of deterrence, alliance signalling, and maritime governance recalibration in Southeast Asia. They also underscore the enduring relevance of the Straits of Malacca as a contested yet indispensable maritime corridor in the Indo-Pacific security architecture. The intensification of naval deployments and exercises in the Straits of Malacca must also be situated within the broader Indo-Pacific strategic discourse. The corridor functions not only as a conduit for military signalling but also as a critical artery for global trade and energy flows. Approximately one quarter of the world's traded goods and nearly half of its energy shipments pass through this narrow passage, rendering its security inseparable from global economic stability. The deliberate use of the strait by major powers for force projection therefore intertwines military strategy with economic statecraft, amplifying the stakes of maritime governance. The dual-use nature of the strait, as both a commercial lifeline and a theatre of strategic competition, complicates regional policymaking, requiring states to balance sovereignty concerns with cooperative security imperatives.

Malaysia's cautious balancing posture exemplifies the dilemmas faced by middle powers in the Indo-Pacific. While committed to safeguarding national sovereignty, Malaysia has recognized the necessity of participating in cooperative frameworks such as the MSP and TTEG to mitigate risks of escalation and enhance maritime domain awareness (Setiawan & Padilla, 2025). Indonesia's emphasis on archipelagic defence reflects its strategic geography, where the fusion of intelligence and patrol coordination is essential to counter both piracy and potential incursions. Singapore's role as a logistical and intelligence hub highlights the importance of technological superiority and infrastructure in sustaining maritime governance (Permal & Moorthy, 2024). Collectively, these national strategies illustrate the diversity of approaches within Southeast Asia, yet they converge on the recognition that the Straits of Malacca cannot be secured unilaterally.

The multinational exercises RIMPAC and CARAT further underscore the role of alliances and partnerships in shaping the maritime security environment. Their emphasis on interoperability, humanitarian assistance, and tactical readiness reflects a deliberate effort to embed military cooperation within a broader rules-based framework (Indo-Pacific Defense Forum, 2024; Yuson, 2024). Such exercises serve as instruments of reassurance to allies and deterrence to adversaries, while simultaneously reinforcing the normative architecture of the Indo-Pacific. However, their effectiveness depends on sustained political commitment and the ability to reconcile asymmetries in capabilities among participating states. The challenge lies in ensuring that these exercises do not merely function as episodic demonstrations of strength but evolve into institutionalized mechanisms that enhance collective resilience. The Straits of Malacca between 2023 and 2025 epitomized the intersection of strategic competition, alliance signalling, and maritime governance recalibration. The transits of U.S. aircraft carriers and the conduct of multinational exercises were not isolated events but integral components of a

broader deterrence narrative and cooperative security agenda. For regional actors, the implications are profound: the strait's security is inseparable from both national sovereignty and regional stability. The future of Indo-Pacific maritime governance will therefore depend on the ability of states to institutionalize cooperative mechanisms, invest in capacity-building, and embed maritime security within the wider framework of international law. Absent such measures, the risk of escalation and erosion of maritime norms will persist, threatening not only Southeast Asia but the integrity of the global maritime order.

Strategic Signalling and Deterrence

Between 2023 and 2025, strategic naval movements in the Straits of Malacca and surrounding Indo-Pacific waters have functioned as deliberate instruments of signalling and deterrence, particularly by the United States. These operations, ranging from carrier transits to multinational exercises, were not merely tactical deployments but calculated demonstrations of maritime resolve. The transits of *USS Carl Vinson* and *USS Nimitz* in 2025, alongside intensified joint operations such as RIMPAC and CARAT, reaffirmed Washington's commitment to Indo-Pacific stability and the preservation of a rules-based maritime order (Shelbourne, 2025; Indo-Pacific Defence Forum, 2024). These manoeuvres were designed to deter adversarial behaviour, especially China's assertiveness in the South China Sea, while simultaneously reassuring regional allies of sustained U.S. engagement. Strategic signalling through naval presence is rooted in deterrence theory, where visible and credible force projection shapes adversary calculations and reinforces alliance cohesion (Paparo, 2025). The U.S. Navy's Navigation Plan 2024 and Project 33 emphasized joint all-domain operations, unmanned systems integration, and forward logistics to enhance responsiveness and survivability in contested maritime environments (Paparo, 2025). These initiatives reflect a doctrinal shift toward distributed lethality and dynamic force employment, designed to counter China's expanding naval footprint and ensure operational resilience.

In contrast, the People's Liberation Army Navy (PLAN) has expanded its operational reach through sustained infrastructure development and strategic port investments. China's dual-use facilities in Gwadar (Pakistan) and Kyaukpyu (Myanmar) exemplify its maritime Belt and Road strategy, enabling logistical support and surveillance capabilities along critical sea lanes (Ahmad, 2024; GDA, 2025). Gwadar, integrated into the China-Pakistan Economic Corridor (CPEC), is being transformed into a commercial and strategic hub, while Kyaukpyu provides Beijing direct access to the Bay of Bengal, bypassing the Malacca chokepoint. These developments, coupled with PLAN's carrier deployments and submarine patrols, signal China's intent to reshape regional maritime dynamics and reduce its strategic vulnerability, often referred to as the "Malacca Dilemma" (Lane, 2025). The juxtaposition of U.S. and Chinese naval strategies reveals a competitive signalling environment in which both powers seek to shape perceptions of dominance, legitimacy, and deterrence. For Southeast Asian littoral states, these maneuvers necessitate calibrated responses. Malaysia, Indonesia, and Singapore continue to navigate a complex strategic landscape, balancing sovereignty concerns with cooperative security frameworks. Their participation in multilateral patrols and maritime domain awareness initiatives reflects an evolving regional calculus shaped by external signalling and internal capacity-building imperatives (Permal & Moorthy, 2024). The Straits of Malacca remain a contested yet indispensable maritime corridor, where great power rivalry

intersects with regional strategies of resilience and cooperation. The interplay of U.S. deterrence signalling, China's infrastructural expansion, and Southeast Asia's adaptive responses underscores the strait's enduring role as a fulcrum of Indo-Pacific security architecture.

Regional Responses and Strategic Calculus

Between 2023 and 2025, the strategic naval movements of great powers in the Straits of Malacca compelled Southeast Asian littoral states to recalibrate their maritime postures, balancing national sovereignty with regional cooperation. Malaysia, Indonesia, and Singapore, each with distinct geostrategic identities, have responded through nuanced defence strategies shaped by domestic priorities, institutional capacities, and external pressures. Malaysia has continued to pursue a policy of nonalignment while engaging in strategic hedging to mitigate risks associated with intensifying U.S.–China rivalry. This equidistant approach, rooted in Malaysia's historical commitment to neutrality, enables pragmatic defence partnerships while safeguarding autonomy in foreign policy decision-making (Kuik, 2024). As Chair of the 58th ASEAN Foreign Ministers' Meeting in 2025, Malaysia reaffirmed its commitment to neutrality and proactive diplomacy, emphasizing the need for a legally binding Code of Conduct in the South China Sea and advocating ASEAN centrality amid shifting global dynamics (Bernama, 2025).

Indonesia, as the world's largest archipelagic state, has advanced its archipelagic defence strategy through incremental naval modernization. Under the Jokowi administration, the Global Maritime Fulcrum (GMF) concept provided strategic impetus for enhancing maritime sovereignty and deterrence capabilities. Yet post-MEF (Minimum Essential Force) assessments reveal persistent challenges, including budgetary constraints, fragmented institutional coordination, and underdeveloped force structure planning (Marzuki et al., 2025). The transition to President Prabowo Subianto's administration introduced uncertainty, with the dissolution of key maritime governance bodies such as MARVES, signalling a shift in priorities and raising concerns about strategic coherence (Darmawan, 2025). Despite these setbacks, Indonesia continues to invest in naval assets and interisland connectivity to secure its maritime domain and assert its regional role.

Singapore, by contrast, has consolidated its position as a maritime logistics and intelligence hub, leveraging advanced infrastructure, digital capabilities, and strategic location. The expansion of Tuas Port and Changi Air Cargo Hub, alongside initiatives to streamline intermodal logistics, reflect Singapore's ambition to remain the region's preferred transshipment and surveillance node (Straits Times, 2024; Maritime and Port Authority of Singapore, 2025). Its emphasis on maritime domain awareness, submarine safety, and smart port technologies positions Singapore as a key enabler of regional maritime governance and crisis response.

At the regional level, ASEAN's collective maritime security initiatives continue to evolve but remain constrained by structural limitations. Frameworks such as the ASEAN Regional Forum (ARF) Work Plan on Maritime Security and the ASEAN Outlook on the Indo-Pacific (AOIP) reflect normative aspirations for cooperation, yet suffer from agenda fragmentation, capacity

gaps, and consensus-based decision-making that hinder operational effectiveness (ASEAN Regional Forum, 2023; Parameswaran, 2025). Mechanisms like the Malacca Straits Patrol (MSP) and the ASEAN Coast Guard Forum provide platforms for coordination, but the absence of binding enforcement and divergent threat perceptions among member states limit their strategic utility. Regional responses to great power naval signalling in the Straits of Malacca are shaped by a complex interplay of national strategies, institutional capacities, and ASEAN frameworks. Understanding these dynamics is essential for assessing the prospects of maritime stability and cooperative security in Southeast Asia, where littoral states must balance sovereignty concerns with the imperatives of collective resilience in an increasingly contested Indo-Pacific.

Implications for Maritime Security and Policy

Between 2023 and 2025, the Straits of Malacca and the wider Indo-Pacific region have experienced a marked intensification of strategic naval movements and geopolitical competition, significantly heightening the risk of escalation and miscalculation in congested maritime corridors. The surge in maritime incidents, most notably in the Singapore Strait, which recorded a fourfold increase in piracy and armed robbery cases in early 2025, underscores both the fragility of regional maritime security and the potential for unintended conflict in high-traffic zones (Security Council Report, 2025). The proliferation of naval assets, coast guard deployments, and irregular maritime actors in contested waters such as the South China Sea has further complicated operational safety and crisis management, raising the stakes for both state and commercial actors (UNODC, 2023; Ship Universe, 2025).

This evolving security environment highlights the urgent need to strengthen inter-agency coordination and institutionalize rules-based frameworks that promote transparency, accountability, and operational interoperability. Malaysia's maritime governance model, which emphasizes collaboration among the Royal Malaysian Navy (RMN), Malaysia Maritime Enforcement Agency (MMEA), and Eastern Sabah Security Command (ESSCOM), illustrates both the potential and limitations of multi-agency approaches. Persistent challenges in harmonizing jurisdictional mandates and resource allocation weaken operational effectiveness, mirroring broader regional difficulties in achieving coherent governance across fragmented maritime jurisdictions (Rahman, 2023). The UN Secretary-General has similarly stressed that inconsistent enforcement mechanisms undermine global efforts to secure maritime domains, calling for enhanced coordination and legal harmonization (United Nations, 2025).

Confidence-building measures (CBMs) and joint patrols remain critical pathways for mitigating tensions and fostering cooperative security. Mechanisms such as the Code for Unplanned Encounters at Sea (CUES), the ASEAN Coast Guard Forum, and the Malacca Straits Patrol (MSP) have demonstrated value in facilitating communication, reducing misperceptions, and enhancing maritime domain awareness (Koh, 2023). Yet their effectiveness is constrained by political sensitivities, asymmetrical capabilities, and divergent threat perceptions among ASEAN member states. As Collin Koh observes, most CBMs in Southeast Asia remain bilateral and limited in scope, but they nonetheless serve as foundational instruments for building trust and managing interstate differences in contested maritime spaces (Koh, 2023).

The implications for maritime security and policy are therefore multifaceted. Policymakers must prioritize the development of integrated maritime strategies that balance national sovereignty with regional cooperation, invest in institutional capacity-building, and support the evolution of inclusive, enforceable frameworks grounded in international law. Without such measures, the risk of escalation, strategic miscalculation, and erosion of maritime norms will persist, threatening the stability of one of the world's most vital sea lanes. The Indo-Pacific's maritime future will thus depend not only on naval strength but also on the ability of states to institutionalize cooperative mechanisms that transform fragile waters into zones of stability and shared security.

In addition, the intensification of maritime competition has highlighted the importance of embedding maritime security within broader regional architectures of economic integration and political dialogue. The interdependence of trade flows, energy security, and supply chain resilience means that maritime governance cannot be divorced from wider strategic considerations. The Straits of Malacca, as a critical chokepoint for global commerce, exemplifies the nexus between economic vitality and security imperatives. The fourfold increase in piracy incidents in the Singapore Strait in early 2025 demonstrates how disruptions in maritime safety can reverberate across global markets, amplifying the urgency of coordinated responses (Security Council Report, 2025). This underscores the necessity of integrating maritime security into ASEAN's broader agenda of regional stability and prosperity.

Furthermore, the proliferation of irregular maritime actors, including non-state groups engaged in smuggling, illegal fishing, and armed robbery, complicates the operational environment for both navies and coast guards (UNODC, 2023; Ship Universe, 2025). These actors exploit jurisdictional ambiguities and resource gaps, thereby undermining state authority and eroding confidence in maritime governance. Malaysia's multi-agency model, while commendable in its emphasis on collaboration, continues to face challenges in harmonizing mandates and ensuring resource efficiency (Rahman, 2023). This reflects a broader regional struggle to reconcile national sovereignty with collective responsibility, a tension that remains at the heart of Indo-Pacific maritime politics.

The role of CBMs and joint patrols, though limited, should not be underestimated. Mechanisms such as CUES and the MSP provide essential platforms for communication and coordination, reducing the likelihood of misperceptions and inadvertent escalation (Koh, 2023). However, their effectiveness depends on sustained political will and the willingness of states to transcend narrow national interests in favour of collective security. The ASEAN Coast Guard Forum, for instance, has created opportunities for dialogue and technical cooperation, but its potential remains constrained by divergent threat perceptions and asymmetrical capabilities among member states. As Koh notes, the predominance of bilateral CBMs reflects both the cautious pragmatism of regional actors and the enduring sensitivities surrounding sovereignty (Koh, 2023).

Ultimately, the Indo-Pacific's maritime future will hinge on the ability of states to institutionalize cooperative mechanisms that are both inclusive and enforceable. This requires not only investment in institutional capacity but also a commitment to embedding maritime

governance within international legal frameworks. The UN Secretary-General's call for enhanced coordination and legal harmonization reflects the global dimension of maritime security, emphasizing that fragmented enforcement undermines collective efforts to secure maritime domains (United Nations, 2025). For Malaysia and its regional partners, the challenge lies in balancing national sovereignty with regional cooperation, ensuring that fragile waters are transformed into zones of stability and shared security. Without such measures, the risk of escalation, miscalculation, and erosion of maritime norms will persist, threatening not only regional stability but also the integrity of global maritime order.

Conclusion

The Straits of Malacca continue to function as a strategic fulcrum in the Indo-Pacific, where naval movements and maritime exercises by major powers serve as deliberate instruments of signaling, deterrence, and influence. The convergence of U.S. carrier deployments, Chinese maritime infrastructure expansion, and regional naval recalibrations has reaffirmed the strait's role not only as a commercial artery but as a contested geopolitical space. These developments underscore the enduring relevance of chokepoint dynamics in shaping maritime strategy and alliance behavior. In this context, regional diplomacy must evolve beyond reactive posturing toward proactive maritime governance. Southeast Asian states face the dual challenge of preserving strategic autonomy while engaging in cooperative security frameworks. The effectiveness of existing mechanisms such as joint patrols, maritime domain awareness platforms, and codes of conduct depends on sustained political will, institutional capacity, and trust-building across jurisdictions. A nuanced diplomatic approach that balances sovereignty concerns with multilateral engagement is essential to prevent escalation and miscalculation in increasingly congested waters. Looking ahead, future research should interrogate the intersection of hybrid threats and naval cyber vulnerabilities. As maritime systems become more digitized and interdependent, the potential for cyber-physical disruption grows exponentially. Addressing these risks requires not only technological resilience but also doctrinal innovation, inter-agency coordination, and the development of cyber-governance norms tailored to the maritime domain. Integrating these dimensions into strategic planning will be critical for ensuring long-term stability and operational integrity in the Straits of Malacca and beyond.

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ADOLESCENTS PERSPECTIVE ON DIGITAL SURVEILLANCE BY PARENTS AND TEACHERS IN PREVENTING ONLINE VIOLENCE

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Abstract: Parental and teacher surveillance of adolescent activities in the digital space is an important factor in preventing online violence but it can be perceived differently by adolescents as active users of digital media, especially social media. Therefore, this study was conducted to explore adolescents' experiences and views regarding online violence and how they interpret the role of parental and teacher surveillance in their activities in the digital space. This study uses a qualitative approach with a constructivism paradigm. The research subjects were 12-14 year old middle school students at a junior high school in Deli Serdang, North Sumatra, Indonesia. Data collection techniques were carried out in stages through semi-structured questionnaires, focus group discussion (FGD), in-depth interviews, and supplemented interviews with Guidance and Counseling (Bimbingan dan Konseling, BK) teacher as data triangulation. Data analysis was carried out through the stages of data condensation, data presentation, and conclusion drawing. The findings showed that most participants had experienced online violence, such as hateful comments on social media, the distribution of photos or videos without permission, and online fraud on gaming platforms. The patterns of parental and teacher surveillance were restrictive and the family communication patterns tended to reflect conformity orientation which emphasizes obedience, making it difficult for adolescents to open up and causing them to hide their digital activities. Adolescents perceived themselves as individuals entitled to privacy and may tolerate the parental surveillance; however, they resist surveillance practices that are imposed unilaterally and not embedded in open and reciprocal dialogue. These findings emphasize the importance of strengthening digital literacy and developing participatory communication patterns between adolescents, parents, and teachers as preventive measures in dealing with online violence.

Keywords: adolescents, online violence, digital surveillance, parental mediation, digital literacy

Introduction

Generation Z is aged between 12 and 27 (born between 1997 and 2012) and is the largest generation in Indonesia, numbering 71.5 million people (BPS, 2020). These demographic data make Generation Z the majority of online media users, accounting for 34.4% (APJII, 2024). Most of this group falls into the adolescent age category, making them one of the groups most vulnerable to various inequalities in society (Anugrah, 2024). One such inequality is the risk of becoming a victim of online violence, as evidenced by various reports and studies published by relevant institutions.

A Plan International survey states that 32% of girls and young women have experienced online gender-based violence. This study involved 14,000 girls from 31 countries, 500 of whom were

from Indonesia (Plan International, 2020). During the Covid-19 pandemic, it was even found that adolescents aged 14-18 in Manado City, North Sulawesi, Indonesia, often used social media such as MiChat for sex work. The “nearby” feature on the app makes it easy for pimps and teenage sex workers to offer their services, and many of these teenagers are exploited by their own boyfriends for economic reasons (Juditha, 2022). Online violence figures were also reported by the Online Information System for Women and Children (SIMFONI PPA), which recorded more than 15,000 children as victims of online violence, and the Ministry of Women's Empowerment and Child Protection, which recorded around 5.5 million cases of child pornography in the last four years (KemenPPA, 2025).

Online violence can have a negative psychological impact on victims, such as causing fear, anger, heartache, depression, and lack of confidence, and even suicidal ideation (Maurya et al., 2022; Sulubere et al., 2023; Yulieta et al., 2021). These negative emotions can even appear in perpetrators, where they have a desire to harm themselves, attempt suicide, or even engage in antisocial behavior (Skilbred-Fjeld et al., 2020).

The factors causing the increasing rate of violence occurring in the online realm can be examined from various angles, such as a low understanding of digital security, issues of legal protection and security in the digital space, and surveillance of the use of devices by children and adolescents by parents and other competent parties around them, such as teachers or schools. Based on the 2022 national digital literacy index, the aspect of *digital safety* in Indonesia has the lowest score of 3.12 (Kominfo, 2022). Moreover, from a legal perspective, the handling of online violence cases is still relatively low, with only about 18% of cases being followed up and less than 6% resulting in punishment for the perpetrators (Hukumu et al., 2025).

The role and surveillance of parents and teachers are also considered to be quite important in minimizing online violence among adolescents as active media users. A study in Medan by Mazdalifah & Moulita (2021) found that parents still apply a passive model in supervising their children's use of gadgets, namely by limiting their children's time and monitoring the websites they visit, rather than sitting together and accompanying their children in the process. In fact, a consensual communication pattern between adolescents and parents is essential, as it can significantly reduce cyberbullying behavior (Alfiroh & Jamaluddin, 2021).

Preventing online violence and shaping children's digital behavior can be done through active collaboration between teachers and parents. Teachers play an important role in providing education about healthy online behavior, digital ethics, and the impact of cyber violence, as well as monitoring student interactions at school. Meanwhile, parents have a crucial role in monitoring their children's online activities, using *parental controls*, and communicating openly with their children (Chiner et al., 2025; Jerusalem & Hidayati, 2024). These efforts also need to involve the perspective of adolescents as active media users. Preventive interventions using the concept of *real-time nudges* that work directly in digital interaction spaces are proposed in the study by Agha et al. (2023), which can be applied when potential risks are detected. This feature protects media users by guiding the perpetrator's behavior before they commit violence while strengthening adolescents' ability to manage risks independently.

The context of parental and teacher surveillance of adolescents' media use and the risk of online violence has been accommodated in various studies through qualitative and quantitative approaches that describe the perspectives of teachers and parents. However, the views of adolescents as active users of media and the internet also need to be elaborated to obtain a more in-depth picture of their perspectives and experiences in constructing the meaning of online violence and surveillance itself. Therefore, this study will address these issues through research on adolescent students attending a junior high school in North Sumatra Province, Indonesia.

Based on preliminary observations, this school supports the digital literacy movement while implementing certain rules regarding the use of electronic devices by students on school grounds. The school, parents, and students communicate actively, either in person or face-to-face, and are fully supported by the use of social media such as WhatsApp in their daily interactions. The researcher also conducted preliminary interviews with the school representative which stated that some students had experienced violence in the digital space, particularly through their social media. This indicates that the school monitors students' social media behavior, but there has been no specific research exploring their perspectives on ideal monitoring patterns that create a sense of security and trust among the school, teachers, and students themselves as teenagers. The findings of this study will certainly contribute to the development of studies related to adolescents' digital monitoring by highlighting the perspective of adolescents as the main subject.

Literature Review

Digital Literacy

Richard Lanham defines digital literacy as not limited to reading and writing skills but also the ability to understand information in various forms, including complex images and sounds, selecting appropriate diction according to context, and presenting messages tailored to the media and audience (Lankshear & Knobel, 2015). Furthermore, digital literacy refers to the ability to understand and use information in various forms from various sources presented by computers, especially through the internet. Digital literacy requires mastery of ideas and competencies in organizing knowledge, evaluating information, searching for information through the internet, and navigating *hypertext* (Gilster, 1997),

The term digital literacy is also defined as a combination of competencies and attitudes closely related to psychological characteristics, value systems, and critical thinking skills required by individuals involved in the digital environment to be able to prioritize ethical, safe, and productive principles (Erdyneeva et al., 2024). This definition is complemented by (Phippen, 2024), who views digital literacy as a series of technical skills, information and media literacy, data literacy, cyber security and safety, and responsible communication. Phippen also argues that critical thinking skills are essential in the digital context, including digital well-being. Achieving digital literacy requires collaboration among various parties, including the government, educators, technology providers, and community organizations.

Online Violence

Online violence, commonly known as *cyberbullying*, is a form of violence or abuse committed through digital technology, such as social media, messaging platforms, gaming platforms, and mobile phones. These actions are carried out repeatedly to scare, anger, or humiliate the victims. Forms of online violence include: *flaming* (use of abusive language), *harassment* (repeated hurtful messages), *denigration* (spreading rumors/slander), *impersonation* (imitating someone's identity), *outing* (spreading personal information), *doxxing* (spreading personal identity), *trickery* (deception to obtain personal material), as well as *digital sexual harassment* (unwanted sexual comments or messages), *image-based abuse* (sexual harassment or intimidation using artificial intelligence), and *scams* (fraud with the aim of stealing money or valuables) (Adorjan & Colaguori, 2023; Bansal & Choudhary, 2023; Ray et al., 2024).

Parental and Teacher Mediation

The concept of parental and teacher surveillance in the digital space can be examined from the theory of *parental mediation*, which was originally related to methods for regulating, guiding, and mediating children's interactions with media, especially television (Clark, 2011; Livingstone & Helsper, 2010). Classifications of *parental mediation* include: 1) *Active Mediation*; parents actively discuss with their children the dangers or risks of the internet, privacy issues, internet ethics, and how to deal with problematic situations in the digital space; 2) *Restrictive Mediation*; parents implement rules regarding screen time limits, restrictions on access to certain websites or applications, and the types of content that children are allowed to view; 3) *Co-using*; parents and children use digital media together, for example watching videos, playing games, or surfing the internet without commenting on the content or its impact; 4) *Interaction Restriction*; restrictions on interactive activities such as *e-mail*, *chat*, instant messaging, and *downloading*; 5) *Technical Restrictions*; use of software such as content filters and *parental controls*; 6) *Monitoring*; checking children's computers or activities either covertly or openly after internet use, and 7) *Participatory Learning*; parents engage in open dialogue with their children in the digital space as a forum for discussing the values and norms agreed upon by the family.

The concept of *parental mediation* has given rise to the concept of mediation or surveillance by teachers and schools regarding risks in the digital space. Chiner et al. (2025) developed the concept of digital surveillance within the framework of a *positive risk management* approach, which is risk management that aims to build students' awareness, responsibility, and autonomy in dealing with the digital environment. Teachers do not only act as supervisors but also as mediators who guide students to recognize, assess, and respond to online risks independently.

Family Communication Pattern Theory

Family Communication Pattern Theory introduced by Macleod and Chaffee in the 1970s, which considers the harmonious relationship between children and parents, intrapersonal perfections in the context of parental suitability and authority, and interpersonal concepts embodied by parental encouragement, for example, towards ideas and attitudes such as politics and religion (Pyecha, 2020). This theory was later developed by Koerner and Fitzpatrick which

has several key elements namely *conversation orientation* and *conformity orientation* (Schrodt & Carr, 2012):

1. *Conversation orientation*; the extent to which families encourage open conversation and discussion among their members. Families with a high conversation orientation create an environment where each individual is free to express their opinions, voice their concerns, and participate in decision-making. This openness is associated with healthier communication behaviors and can reduce negative traits.
2. *Conformity orientation*; in contrast to the conversation orientation above, places primary emphasis on similarities in beliefs and values within the family. Families with high conformity orientation tend to prioritize common interests over personal opinions, leading to a more hierarchical structure. This limits open communication and can cause negative traits to develop.

The intersection between conversation and conformity orientation creates a typology of family types that have different communication dynamics that can influence individual behavior:

- a. *Protective (high conformity, low conversation)*; a protective or sheltering family type where the family has a high level of uniformity or conformity with a low level of conversation;
- b. *Pluralistic (low conformity, high conversation)*; a pluralistic family type that has a low level of conformity but a high level of conversation;
- c. *Consensual (high conformity, high conversation)*; a consensual family type with high levels of both conformity and conversation;
- d. *Laissez-faire (low conformity, low conversation)*; a family type with low levels of both conformity and conversation.

Methodology

The research subjects were male and female students aged 12–14 years old who attended Harapan 3 Delitua Junior High School, Deli Serdang Regency, North Sumatra, Indonesia. The research was conducted from September 2025 to January 2026. Data collection techniques were carried out in stages; the first stage through a survey with a semi-structured questionnaire, the second stage through focus group discussions (FGD), and the third stage through interviews. The first stage involved 45 adolescent students representing grades 7, 8, and 9. This stage aimed to obtain a general picture of adolescents' experiences and perceptions of online violence and digital surveillance by teachers and parents. The second stage was narrowed down to 15 adolescents who were purposively selected, with a ratio of 8 males and 7 females. The informants were then given serial numbers according to their attendance at the time the research was conducted. The selection of informants was based on the opinions reflected in the previous questionnaire answers so that they could provide relevant information for the needs of this study. Furthermore, in the third stage, the researcher interviewed two informants to obtain a more in-depth narrative of their experiences.

The data obtained from the questionnaire, FGD, and interview data collection processes were analyzed through the stages of data condensation, data presentation, and conclusion drawing

and verification (Miles et al., 2014). The researcher also interviewed school officials, namely Guidance and Counseling (BK) teacher to confirm the findings and obtain the educational institution's perspective on the role of teachers in preventing online violence among their students.

Results

The findings of data collection through questionnaires show that a total of 29 out of 45 adolescent students admitted that they had experienced online violence, such as the distribution of photos or videos without permission, being insulted or bullied on social media, and being scammed through online platforms as the most common forms of violence experienced. The participants identified the causes of online violence as dislike or jealousy towards others, a bad social environment, and a lack of surveillance or guidance from parents. Conversely, according to the participants, the reasons why someone becomes a victim of violence include differences of opinion on social media, physical appearance or style of dress, achievements, sensitive content, and not daring to fight back against the perpetrator.

As many as 40 participants agreed that parents need to supervise their children's media use. The reasons include that they are still minors, so that parents can supervise their children's social interactions, and so that children can complain to their parents if they experience bullying and their parents can report it to the authorities. On the other hand, most participants, namely 36 people, stated that the role of teachers was not important in supervising their online activities. The reasons that emerged included privacy issues, teachers being easily exposed to hoaxes, and liking to make inappropriate comments. This finding is interesting because, amid an era of collaboration between various important elements such as families and schools in preventing online violence, teenagers actually consider that the roles of parents and teachers are not equally important. They consider the issue of media use to be a personal matter that does not need to be known by teachers. This aspect was then elaborated in the FGD.

The students expressed their discomfort in telling their parents or teachers about the online violence they experienced. Informant 1, a 9th grade male student, admitted that he had been cheated out of Rp 1 million through an online game application. Informant 15, a 7th grade male student, had a similar experience, being cheated out of Rp 600,000. Neither informant dared to report it to their parents for fear of being scolded or lectured. This finding is noteworthy because when linked to the answers that appeared on the questionnaire, where 40 people agreed that parents should supervise, the above statements reveal the actual response from the perspective of students as teenagers.

In addition, among the FGD informants, there were those who shared certain methods or strategies to limit parental surveillance on social media. One of the informants, Informant 5, a male 7th grader, stated that he allowed his parents to follow his Instagram account but blocked his parents' accounts on TikTok. According to him, *"They don't need to know, parents don't need to know, it feels like being monitored."* Informant 5 admitted to having up to 3 social media accounts and setting them up so that his parents could only see certain accounts. Additionally, Informant 3 also expressed discomfort when parents monitor or check his devices because they do not fully understand what the kids do on social media. The possession of more

than one social media account was confirmed by the other participants, and they also admitted that not all accounts are accessible to their parents.

Participants also described their parents' attitudes or responses to their activities on social media. Some parents imposed night-time restrictions on smartphone use while others discouraged their children from creating content they perceived as unproductive, such as dance videos on TikTok. This was acknowledged by Informant 7, a female eighth grader, who said, *"My mom is cool, but my dad gets angry when I post dance videos."* Another opinion was expressed by Informant 14, a ninth-grade female, who thinks that her mother gives her more freedom to express herself on social media because she understands current trends better, but her father does not really follow developments on social media. Similarly, Informant 11 stated that she feels afraid when her parents check her smartphone and find videos or messages sent by her friends that are meant as jokes but are misinterpreted as something serious by her parents.

Furthermore, the researchers explored the students' views and experiences regarding surveillance by teachers. Based on the results of the FGD, the researchers found that most participants viewed that teacher involvement was not very significant in supervising their social media activities. According to the informants, their concern lay in the tendency of teachers to immediately reprimand or make unilateral judgments without fully understanding the context of what was happening on social media. Informant 7 stated that, *"Because teachers immediately judge, 'don't do that' or scold us in class."* Informant 7 added that there were some teachers who were considered fun and appropriate for sharing social media content and discussing it, but there were also other teachers who did not meet her expectations.

Furthermore, the participants described their experiences about teacher involvement in resolving problems between students that arose on social media. This was responded to by Informant 10, a female student from grade 8, who revealed that there were teachers who cared and others who did not really care if problems arose between students, such as "commotion" in the class WhatsApp group. Based on her experience, she would consult with teachers who were more open and willing to listen to students' problems and help resolve their conflicts. Another informant also responded that there were teachers who would simply "lecture" when problems arose.

Restrictions on the use of gadgets and social media accounts emerged as a form of parental surveillance. This finding was obtained from an interview with Informant 12 (female, 8th grade), who was only allowed to have WhatsApp and Instagram accounts, even though her peers already had other more popular social media accounts, such as TikTok. She admitted that she was only allowed to have an Instagram account when she was about to enter high school for the purposes of the School Environment Introduction Period (MPLS) because every student was required to upload a photo of themselves.

Informant 12 stated that her parents, especially the father, *were strict* in supervising her use of media and her daily social interactions. However, Informant 12 also revealed that her parents did this for her own good. Informant 7 also experienced restrictions on gadget use when her parents felt that she was using the gadgets excessively. When it was nighttime and time to

sleep, but Informant 7 was caught still using the gadget, they would take and keep the gadget. Both informants also admitted that they never had an explicit dialogue with their parents about what they could and could not consume or upload as content on their social media. Some reprimands or prohibitions from parents appeared before photos were uploaded to social media, while others appeared after seeing certain types of content uploaded by informants, such as content using certain filters on the face or dance content that was viral on TikTok.

Regarding surveillance and intervention from teachers or schools, the informants hoped for direct action that could reconcile the conflicting parties among them. Informant 7, for example, did not want the use of language that was not appropriate for teenagers or simply being advised to make up. Informant 12 added that teachers needed to take certain actions, such as ordering students who were fighting to do activities that required interaction between the two.

The informants expect communication and guidance from parents about what is and is not acceptable on their social media, while still respecting their privacy. Monitoring of social media accounts is acceptable on Instagram and TikTok, but not on WhatsApp. According to them, conversations between friends on WhatsApp sometimes seem rude but are normal among them, only to be perceived differently by parents.

Interviews with the BK Teacher of this school, a 47-year-old woman, revealed that students' openness in dealing with problems in the digital space is usually preceded by complaints from friends who have experienced bullying. Her strategy in resolving problems is usually to call the child in and ask about the issue. She will advise the victims and motivate them to be more courageous in facing the bullying they experience. Similarly, she will advise the perpetrator not to repeat the act. The BK Teacher and/or the school will call and communicate with the parents if necessary. BK Teacher also responds to the issue of surveillance and the use of electronic devices, which should be the responsibility of the student's parents due to the limited time the teacher spends with students at school. The mechanism for supervising the use of electronic devices at school is carried out by having students collect their devices in a storage box during class hours. Devices may be used if there are lessons that require an internet connection.

"We cannot say that this is the school's responsibility. Because they (are at school) from such and such time to such and such time. The real responsibility lies with us as parents. How *to manage* children's use of cell phones, giving them certain rules that they must consistently follow." (BK Teacher, January 13th 2026).

In addition, the BK Teacher also emphasized the need for parents to be firm in enforcing discipline regarding their children's device usage and the importance of communication in discussing the benefits of device usage and how to resolve potential problems, including online violence. According to her, children cannot be responsible if they are unable to solve their own problems. Furthermore, adolescents should not have the right to privacy from their parents' surveillance, such as locking their devices with passwords. She also reminded students to use their devices more wisely and understand the limits, especially regarding time and polite interaction, such as not sending inappropriate stickers among their peers. Based on the

interview results, it was also found that schools do not yet include specific material related to media literacy and digital literacy. Teachers insert information and knowledge about the negative impacts of media and the internet in between the subject matter they teach.

Discussion

The distribution of photos or videos without permission was agreed by the participants to be a form of online violence if it was distributed by and/or to strangers. In addition, this type of violence also reflects students' interpretation of their daily communication practices, particularly their frequent exchange of messages involving so-called 'shame stickers' created by their peers using certain applications. Students send each other stickers containing photos of their friends' faces in poses that they consider ugly, such as yawning, daydreaming, and so on. In other cases, there are even students who find stickers of themselves edited to appear naked (*deepfake*). The victims generally feel unhappy and upset when they find their faces circulating in these *shame stickers* and often retaliate. The types of online violence commonly experienced by adolescents in the context of this study are in the form of *image-based abuse*, *flaming*, and *scamming*. Regarding the types of violence experienced, the participants admitted that some of them were committed by friends or acquaintances, while others were committed by strangers.

Table 1. Type of Online Violence Experienced by Adolescents

Type of Online Violence	Description	Platform Context
Flaming	The use of hostile, insulting, or humiliating language directed at adolescents in online interactions	Social media and online games
Online scamming	Deceptive practices aimed at manipulating adolescents for financial or in-game benefits	Online games
Image-based harassment	The circulation or threat of sharing photos, videos, or stickers intended to embarrass or harm the victim	Messaging platforms

Similarly, having more than one account on a social media platform can be described as a form of protection and privacy for adolescents in their online activities. The motivation to appear authentic often conflicts with the need to appear normative, creating a dilemma for them because they have to deal with many circles of "friendship," including parents, teachers, friends, and others (Alamsyah et al., 2025; Darr & Doss, 2022).

These findings show that adolescents are not yet fully aware of the risks they may face in relation to online violence, including issues of digital ethics. Similarly, in terms of surveillance, this illustrates the weak control of teachers in these online class groups and also the lack of surveillance by parents of their children's activities in the digital space. Parents and schools apply a *restrictive mediation* pattern where some students experience restrictions on gadget use. However, the communication pattern that is formed tends to be *conformity orientation*,

which requires a higher level of compliance than open conversation. This pattern describes a *protective* family style, where parents have high control but relatively limited dialogue. This type of surveillance can be perceived as control rather than guidance, triggering a tendency for adolescents to close themselves off and avoid parental involvement in the media issues they face.

Ideally, an *active parental mediation* pattern, which strengthens the quality of the parent-child relationship, should be prioritized because it has been proven effective in reducing internet abuse by adolescents and decreasing their tendency to hide their online activities. Parents also need to improve their capacity to build active and open dialogue and provide reflective guidance on their children's digital activities (Liu et al., 2023; Lou et al., 2024). The importance of digital literacy for students, especially those in the child and adolescent age range, can help them increase their awareness of personal data protection and as part of online risk prevention (Malik, 2024; Stevanovska et al., 2025).

Parental mediation and the classroom environment have a significant effect on the digital citizenship of secondary school students in Jakarta (Agustina et al., 2024). The more effective the role of parents in mediating their children's use of digital media, the higher the children's responsibility in their activities in the digital space. Additionally, schools can create a supportive classroom environment, integrate ethical values and digital responsibility into the teaching and learning process, and provide teacher support in discussions about digital safety. The school curriculum can also be strengthened by incorporating digital literacy content, starting with the simple concept of 'questioning (?)' first. The UNESCO Digital Literacy Framework (Judith & Romina, 2025) can be used as a reference: 1) *Information and Data Literacy*, 2) *Communication and Collaboration*, 3) *Digital Content Creation*, 4) *Safety, Wellbeing and Responsible Use*, 5) *Problem Identification and Solving*.

Conclusion and Recommendations

Adolescents in this study perceive themselves as individuals entitled to privacy in their digital activities. Therefore, they want a media surveillance process that is accompanied by open and dialogical discussions while still respecting their privacy. The current surveillance pattern is more restrictive, but not all parents clearly state what those restrictions are. Parents and teachers are expected to provide more practical guidance on the limits of media use, rather than simply imposing prohibitions or unilaterally confiscating devices.

Adults and authority figures, in this case parents and teachers, should be willing to listen to the voices of adolescents as digital natives in this era in order to build their trust so that they are willing to be open about the online issues and risks they face. Schools are expected to consider developing a curriculum related to digital security and ethics to prevent online violence. Further research could explore the perspectives of teenagers, teachers, and parents simultaneously to obtain a more comprehensive picture of digital surveillance of adolescents.

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A CONCENTRIC RING MODEL FOR DIAGNOSING PROFESSIONAL LEARNING COMMUNITY (PLC) EFFECTIVENESS: A CONCEPTUAL STUDY

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Abstract: *Professional Learning Communities (PLCs) are widely promoted to improve teaching and learning, yet many schools report uneven impact despite formal adoption. Persistent variability suggests that structural arrangements alone do not guarantee sustained professional learning or instructional change. Schools often misdiagnose and confuse procedural compliance with effectiveness and overlook the interplay between organizational conditions and teachers' psychological readiness. Without a clear diagnostic lens, leaders tend to apply generic solutions that fail to move practice. This conceptual study develops a practical, theory-informed framework to explain and diagnose PLC effectiveness by distinguishing enabling structures from enabling psychologies, and by positioning PLCs along developmental continua of leadership distribution and motivational quality. Using a structured conceptual synthesis, the study integrates recent evidence on PLCs, leadership, implementation, and teacher motivation to construct a proposed Concentric Ring Model that separates Organizational factors (time, resources, routines, facilitative leadership) from Individual factors (trust, collective efficacy, autonomous motivation). Two orthogonal axes, which are Hierarchy to Collaboration and Control to Commitment, are overlaid to identify typical PLC states and pathways for improvement. The study shows that durable PLC improvement requires the concurrent alignment of structural and psychological prerequisites. The axes enable the diagnosis of PLC maturity by capturing interaction quality and motivational climate. PLC success is most likely when organizational supports and professional psychologies converge at a clearly defined "bullseye." The Concentric Ring Model offers both an explanatory lens and a practical diagnostic tool, helping schools move beyond compliance toward collaborative, inquiry-rich, and sustained professional learning.*

Keywords: *Professional Learning Communities (PLC), School Improvement, Collective Teacher Efficacy, Instructional Leadership, Proposed Diagnostic Model*

Introduction

The implementation of Professional Learning Communities (PLCs) has emerged as a promising strategy for enhancing educational practices and improving student outcomes across various contexts. Despite the widespread adoption of PLCs, many educational institutions struggle to translate the mechanical processes of PLC implementation into tangible improvements in student learning. This disconnect often results from a predominant focus on organizational factors, such as leadership structures and procedural frameworks, while

neglecting critical individual factors, which encompass the beliefs, commitments, and interactions of educators and students (Donohoo, 2017).

Research illustrates that effective school leadership plays a crucial role in bridging this gap. Transformational leadership styles, which promote shared decision-making and collaboration among educators, have been positively correlated with student achievement. The lack of emphasis on the interpersonal realms of teaching and learning can lead to ineffective PLCs where teacher autonomy and professional growth are stifled. This is further echoed in findings highlighting the significance of trust and collaboration among educators in fostering professional development and collective efficacy (Donohoo, 2017; Zabidi et al., 2023). By engaging teachers in reflective practices and dialogue, particularly within the framework of PLCs, schools can cultivate stronger relationships that contribute to improved student outcomes (Desimone, 2009).

The current discourse underscores the necessity for educational leaders to embrace a dual-axis framework that shifts from hierarchical control to collaborative commitment. The transition from traditional models of leadership to ones that emphasize collaborative learning environments has been shown to enhance both teacher efficacy and student engagement (Donohoo, 2017; Pilotti et al., 2023). Furthermore, interventions based on growth mindset principles have demonstrated substantial impacts on student achievement, illustrating the interconnectedness of educator beliefs and student performance (Yeager et al., 2019; Yeager et al., 2020). Therefore, a deeper understanding of the dual influence of organizational and individual factors is essential for driving effective PLC practices. Despite the widespread adoption of PLC structures, a significant gap remains in our understanding of how the interplay between organizational control and individual commitment dictates the long-term success of these communities. Most existing literature focuses on the mechanics of scheduling rather than the cultural shift required for authentic collaboration (Stoll et al., 2006). This study is significant because it provides educational leaders with a diagnostic lens to move beyond '*PLC Lite*', which is a state of superficial compliance, toward a self-sustaining culture of collective efficacy.

Past studies have underscored the importance of cultivating a deep learning environment that emphasizes collective efficacy rather than surface-level participation. Stoll et al. (2006) claimed that developing professional learning communities can significantly enhance the capacity for sustainable improvement within school systems. They argue that authentic PLCs empower educators to share knowledge and insights actively, thereby enriching the learning experience for both teachers and students. Similarly, Trilaksono et al. (2019) found that professional development initiatives focused solely on short-term knowledge acquisition often led to a disconnect from the personalized and social development needs of educators. Villeneuve and Bouchamma (2021) also emphasized the role of data-informed decision-making processes in supporting educational leaders as they navigate planned organizational changes within their PLCs. They noted that effective use of local data can help tailor initiatives that align with the unique contexts and needs of educational communities, thus promoting genuine buy-in from staff members and shifting the focus from extrinsic motivations towards building intrinsic commitment to the PLC's goals.

The significance of cultivating a culture of intrinsic motivation among educators is critical. Research suggests that when teachers are motivated by a shared vision and a collective responsibility for student learning, they engage more deeply in the PLC processes and contribute to more substantial educational outcomes (Cherkowski, 2016). To address these concerns, this paper proposes the PLC Multi-Dimensional Map, which serves as a diagnostic tool to help educational leaders identify the factors impeding successful PLC implementation. This model highlights the critical shifts required from Hierarchy to Collaboration and from Control to Commitment to foster a supportive culture where all stakeholders are invested in improving educational outcomes. In conclusion, a holistic approach that unites organizational and individual elements within the PLC framework is paramount to realizing the full potential of professional learning communities in enhancing student learning experiences.

Literature Review

Professional Learning Communities (PLCs) continue to be positioned as a central mechanism for building educator capacity, strengthening instructional coherence, and improving student learning. Over the past decade, research has increasingly emphasized that PLC effectiveness is contingent not merely on structural arrangements but on the interaction of organizational and psychological conditions. Recent evidence reinforces the need to examine PLCs as socio-cultural ecosystems where leadership, collaboration, motivation, and efficacy interact dynamically.

Structural Conditions and Leadership Dynamics in PLCs

A consistent thread in contemporary PLC scholarship is that structures enable, but do not guarantee, impact. Recent studies underscore that protected time, clear routines, facilitative leadership, and data infrastructures create the conditions under which collaborative inquiry can translate into instructional improvement. For example, a PISA-2022–based analysis of 16,072 STEM teachers showed that PLC participation significantly mediates the relationship between digital PD and classroom integration of technology. The analysis showed that PD is more likely to show up in teaching when teachers are embedded in functioning PLCs with regular and purposeful collaboration (Liu et al., 2024). At the conceptual level, Hudson (2024) argues that system and school leaders must specify operating norms, such as agenda protocols, roles, and decision rules, to reduce ambiguity and move PLCs beyond “*meeting compliance*,” proposing a definitional and operational framework for PLCs that integrates structural clarity with inquiry cycles.

Leadership emerges as the fulcrum that aligns structures with professional learning. In secondary schools situated in challenging contexts, ethnographic case studies show that shared leadership and co-responsibility foster extended PLCs that weave networks within and beyond school walls around a common improvement purpose. These arrangements are underpinned by principles of care and social justice and are experienced by participants as strengthening both social and professional capital (Olmo-Extremera et al., 2025). Complementing this, an international review of 355 outputs found that leadership which protects teacher autonomy, professional development, and voice is associated with stronger teacher commitment and retention, clarifying what leaders can do, for example, give choice over methods, support

instructional experimentation, and create formal avenues for teacher voice, to stabilize and deepen collaborative work (Nguyen et al., 2024).

Notably, reviews and mapping studies signal growth in PLC research worldwide and highlight structural priorities: adequate time, role clarity, and evidence use. A Scopus-based review of 2019–2024 publications identifies a rising trend in PLC studies, with Teaching and Teacher Education as a frequent outlet and “leadership,” “networks,” and “teacher growth” as focal themes, suggesting a pivot from generic collaboration to designed collaboration linked to improvement aims (Thanh et al., 2024). In summary, these findings converge on a design logic for PLCs, in which the structures (time, teams, tools) are necessary enablers and become sufficient only when leadership aligns them with inquiry, agency, and evidence (Liu et al., 2024).

Teacher Collaboration and Interaction Quality

The PLC interaction quality predicts professional learning gains among teachers. In a mixed-methods line of work, scholars have moved from the presence of collaboration to the nature of collaborative talk and joint work. Large-scale and case evidence indicate that when PLC conversations are open, elaborative, and evidence-seeking, teachers report greater learning and enact more ambitious instructional changes; conversely, “round-robin sharing” stalls learning even when meeting routines are in place (Hudson, 2024). A study of PLCs and collaborative teaching practices underscores that positive effects on student achievement and teacher growth materialize under conditions of adequate time, supportive leadership, and resource allocation, pointing to the interaction between structure and dialogic norm-setting (Khasawneh et al., 2023). Observational and ethnographic analyses within disadvantaged secondary settings further reveal that collaborative knowledge-building is sustained when teams connect internal and external networks, normalizing the circulation of practices and feedback across professional boundaries (Olmo-Extremuera et al., 2025). Contemporary literature reviews focused on facilitation and leadership of PLCs also catalogue the micro-moves that lift interaction quality, for example, establishing inquiry questions, structuring protocols for looking at student work, and designing cycles of trial and reflection, thereby preventing slippage into perfunctory meetings (Louca & Constantinou, 2023). In short, teacher collaboration is productive when it is dialogic, evidence-rich, and protocol-scaffolded, a conclusion echoed across conceptual and empirical sources.

Psychological Conditions: Trust, Motivation, and Collective Teacher Efficacy ***Relational Trust as a Mediator***

An expanding cross-national evidence base positions relational trust as a key mediator linking leadership practices to PLC functionality. Gu et al. (2025) show that teachers’ perceptions of principal trustworthiness mediate leadership’s effect on PLC development, implying that technical changes (time, agendas) are unlikely to yield robust collaboration without parallel relational work. Similarly, Wood et al. (2024) report that team trust explains substantial variance in PLC team functionality, suggesting that building vulnerability-safe norms, like surfacing errors and sharing failures, is not ancillary but central to PLC performance. These

findings show that trust enables and protects challenging and inquiry-oriented dialogue among teachers during PLC.

Collective Teacher Efficacy as a Proximal Mechanism

Collective Teacher Efficacy (CTE) is a powerful proximal predictor of instructional improvement and climate. Patterson's (2024) longitudinal study shows that routines that articulate teacher thinking, which consist of common language, visible pedagogy, and shared analysis, build CTE over time, yielding schoolwide pedagogical coherence. Beyond professional learning, CTE also correlates with teacher well-being, with Amirian et al. (2025) finding that CTE significantly predicts psychological well-being, outstripping even teacher leadership as a predictor, underscoring why high-CTE PLCs are more resilient and persistent. New multilevel work also links school-level CTE to reductions in disruptive behavior and finds that CTE moderates the relation between individual self-efficacy and disruption, implying system-level benefits when PLCs cultivate a shared sense of collective agency (Holter et al., 2026). Recent studies' advances extend CTE to inclusive education, validating a cross-national scale for *collective efficacy in inclusive practices* (TEIP-C) across Canada, Germany, and Switzerland, which is an important step for PLCs focused on equity and diverse learner needs (Knickenberg et al., 2025). Synthesis in special education suggests that higher CTE is associated with fewer externalizing behaviors and more prosocial outcomes for students facing behavioral risks, signaling practical dividends for PLCs that intentionally build collective agency (Müller et al., 2024).

Autonomous Motivation and Self-Determination Theory (SDT)

A 36-study systematic review and meta-analysis shows that SDT-based interventions significantly enhance autonomy and competence, which are the needs that underpin sustained professional engagement, across both experimental and quasi-experimental designs (Wang et al., 2024). Complementarily, Malmström and Öqvist (2025) show that teachers' self-efficacy (intrinsic) and social support (extrinsic) jointly shape motivation and consequent leadership behaviors, empirically affirming that autonomy-supportive contexts are more likely to yield committed PLC participation rather than mere attendance. The SDT also emphasizes parallel attention to teachers' needs (autonomy, competence, relatedness) to avoid motivational erosion from administrative control and inflexible curricula, which are the conditions that can derail PLCs into compliance (Wang et al., 2024; Ryan & Deci, 2017).

Integrated Perspectives and Emerging Trends

There are four converging trends in PLC scholarship. First, there is a measurable increase in PLC studies and a methodological broadening that includes network analysis and mixed methods, signalling the field's maturation (Nguyen et al., 2024). Second, research highlights PLCs as mediating infrastructures for translating professional learning into practice, particularly in digital integration, where routine participation and structured collaboration amplify the effects of PD (Liu et al., 2024). Third, literature across challenging contexts emphasizes networked PLCs that extend collaboration beyond the school, naming relational trust, shared leadership, and co-responsibility as necessary conditions for impact

(Olmo-Extremiera et al., 2025). Fourth, there is an explicit link to teacher well-being and retention, where leadership that protects autonomy, professional growth, and voice interacts to improve commitment and reduce attrition risks, which are the keys to sustaining PLC cycles over time (Nguyen et al., 2024).

Despite considerable advances in understanding PLC structures, interaction dynamics, and psychological underpinnings, several critical research gaps remain. Recent global reviews show a growing body of PLC research but also highlight that most studies concentrate on either structural enablers (leadership routines, scheduling, protocols) or psychological conditions (trust, collective efficacy, motivation), rather than examining how these domains interact to produce sustainable improvement (Nguyen et al., 2024; Liu et al., 2024). While emerging evidence underscores the importance of trust, collective efficacy, and autonomy-supportive climates for PLC functionality, few conceptual models integrate these variables into a unified diagnostic framework (Gu et al., 2025; Wood et al., 2024). Additionally, existing studies rarely address the misalignment problem, where schools possess well-defined structures but lack the psychological conditions required for inquiry-rich practice, or vice-versa, despite widespread acknowledgement that such imbalances lead to “PLC-lite” outcomes (Hudson, 2024; Hendrickx et al., 2025).

Although SDT-based motivation research provides strong evidence for the role of autonomy and need-supportive leadership in sustaining engagement, this work has seldom been explicitly connected to PLC development or mapped onto diagnostic continua (Wang et al., 2024). Furthermore, the literature lacks accessible multi-dimensional diagnostic tools that help leaders identify a PLC’s developmental position and detect the specific structural–psychological gaps impeding progress. Synthesizing across these developments and gaps, the literature increasingly supports the dual-ring perspective proposed in this conceptual study, where outer-ring structures (time, routines, facilitative leadership) are non-negotiables, yet inner-ring psychologies (trust, collective teacher efficacy, autonomous motivation) are the active ingredients that convert organizational capacity into sustained instructional improvement.

Methodology

This study adopts a conceptual research design using thematic synthesis and model construction to integrate evidence on PLC structures, interaction quality, and teacher motivation into a diagnostic framework. Conceptual articles warrant an explicit design, justified theory selection, and transparent synthesis procedures (Jaakkola, 2020). Table 1 shows the conceptual design phases of this study.

Table 1: Summary of the study’s conceptual design phases

Phase	Inputs	Activities	Outputs	Key citations
Literature Scoping	PLC leadership/operation; SDT motivation; international datasets	Purposeful search (2019–2026) prioritizing reviews and conceptual works	Curated corpus for synthesis	Hudson (2024); Liu et al. (2024); Wang et al.

				(2024); OECD (2025)
Open coding	Extracted passages on structures & psychologies	Identify descriptive themes	Codebook of themes	Hudson (2024); Liu et al. (2024)
Analytic categorization	Codebook	Group themes as Organizational vs Psychological	Two-ring variable set	Wang et al. (2024); Hudson (2024)
Dimensional mapping	Two-ring set	Map to axes: Hierarchy→Collaboration and Control→Commitment	Four developmental quadrants	Wang et al. (2024); OECD (2025)
Model construction	Themes and axes	Concentric Ring Model	Diagnostic States and Pathways	Jaakkola (2020); Hudson (2024)

Note: SDT = Self-Determination Theory; PLC = Professional Learning Community.

Literature Scoping

We conducted a focused scoping of two domains: (a) organizational/leadership research on hierarchy, distributed leadership, and PLC operation; and (b) motivation research grounded in Self-Determination Theory (SDT) (Ryan & Deci, 2017). Scoping prioritized recent systematic reviews, large-scale studies, and conceptual works (2019–2026), including PLC mediation of PD effects (Liu et al., 2024), operational principles for PLCs (Hudson, 2024), SDT meta-analytic findings (Wang et al., 2024), and TALIS-2024/2025 insights on collaboration and teacher agency (OECD, 2025).

Thematic Synthesis

We applied a three-stage synthesis, that are: (a) open coding of descriptive themes, including protected time, facilitative leadership, dialogic protocols, trust, collective efficacy, and autonomous motivation; (b) analytic categorization into Organizational vs. Psychological conditions; and dimensional mapping onto two continua, that are Hierarchy → Collaboration and Control → Commitment, reflecting leadership distribution and motivational quality (Hudson, 2024; Wang et al., 2024).

Model Construction

The synthesised themes were translated into a Concentric Ring Model, where the outer ring (time, routines, resourcing, facilitative leadership) and inner ring (trust, collective teacher efficacy, and autonomous motivation). Superimposing the two axes yields four diagnostic quadrants that represent typical PLC states and improvement pathways (Liu et al., 2024; OECD, 2025). Table 2 defines the variables used to build the conceptual model.

Table 2: Variables and operational definitions used in the Concentric Ring Model

Domain	Variable	Definition	Citations
Organizational (outer ring)	Protected time and routines	Scheduled, protocol-guided meetings focused on evidence	Hudson (2024); OECD (2025)
	Facilitative leadership	Leaders distribute roles, create psychological safety, and keep inquiry cycles on track	Hudson (2024); Liu et al. (2024)
	Resourcing	Access to data, materials, and peer observation opportunities	Liu et al. (2024); OECD (2025)
Psychological (inner ring)	Relational trust	Willingness to share problems and expose practice without fear	Hudson (2024)
	Collective teacher efficacy	Shared belief that the team can raise learning for students	Hudson, 2024; OECD, 2025
	Autonomous motivation (SDT)	Teachers' self-endorsed reasons for engaging in PLC work	Wang et al., 2024

Rationale for Methodological Approach

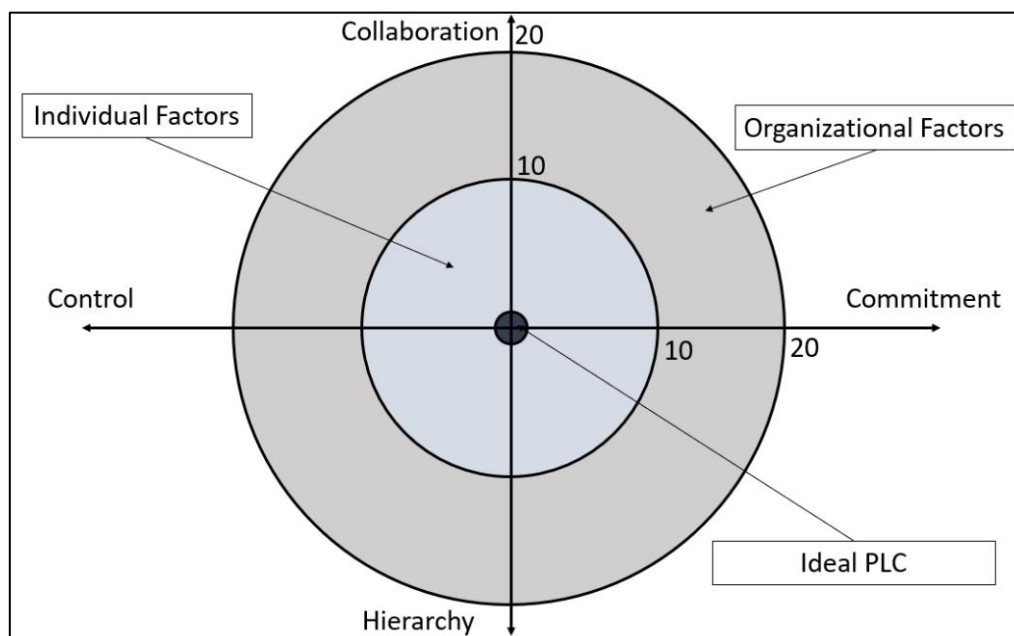
A conceptual synthesis design was selected because scholarship on PLCs is fragmented across leadership or organization studies, teacher motivation, and professional development, yielding valuable but partial insights that seldom cohere into an explanatory system for implementation. For example, time and routines, interaction quality, trust, collective efficacy, and motivational climate are often examined in isolation. A theory-building design allows us to integrate these strands systematically, as recommended for rigorous conceptual articles that must declare design logic, justify theory roles, and translate dispersed findings into coherent frameworks (Jaakkola, 2020). Recent PLC evidence shows that structured collaboration mediates the translation of professional development into classroom practice, while SDT meta-analytic work explains why motivation quality matters for sustained engagement; integrating these literatures closes a known gap between organizational enablers and psychological mechanisms (Liu et al., 2024; Wang et al., 2024).

Furthermore, international indicators from TALIS 2024/2025 underscore the policy relevance of teacher autonomy, collaboration, and voice, strengthening the case for a framework that links structural supports with professional psychologies in a way that leaders can diagnose and act upon (OECD, 2025). By mapping themes onto two empirically grounded continua, where Hierarchy→Collaboration and Control→Commitment, the approach identifies latent relationships between leadership distribution, interaction quality, and motivational regulation that single-factor studies cannot reveal (Hudson, 2024; Wang et al., 2024). The resulting Concentric Ring Model thus contributes a theoretically grounded yet practitioner-oriented diagnostic tool that helps school leaders locate PLCs developmentally, detect specific

misalignments between outer-ring structures and inner-ring psychologies, and plan targeted improvement pathways consistent with the latest evidence base (Nguyen et al., 2024; Liu et al., 2024; OECD, 2025).

Findings

Synthesizing findings across leadership or organizational studies, motivation research, and international indicators yielded a Concentric Ring PLC Diagnostic Model that specifies the joint conditions under which PLCs are most likely to be consequential for teaching and learning. The outer ring identifies non-negotiable organizational enablers, which are protected time, inquiry-oriented routines, resourcing, and facilitative leadership, without which collaboration tends to remain procedural and weakly connected to instructional change. Large-scale evidence shows PLC participation mediates the translation of professional development into classroom practice, clarifying the enabling role of structures when collaboration is routine and purposeful (Liu et al., 2024). The operational elements of those structures, such as protocols, roles, and decision rules, are consistent with contemporary conceptualizations of effective PLC operation that move beyond attendance toward inquiry cycles and evidence use (Hudson, 2024). System-level indicators from TALIS 2024/2025 corroborate the relevance of these conditions, linking collaboration and teacher participation in decision-making to stronger professional climate and adaptive instruction, underscoring their policy salience (OECD, 2025). Figure 1 shows the proposed concentric ring model for diagnosing the effectiveness of PLC.



Note: This figure visually corresponds to the narrative in Section 2 (Methodology) and should be placed after that section’s “Model Construction” subsection.

Figure 1: The Concentric Ring Model for Diagnosing the PLC Effectiveness

The inner ring isolates the psychological prerequisites that differentiate high-functioning from low-functioning PLCs, which are relational trust, collective teacher efficacy (CTE), and

autonomous motivation (Knickenberg et al., 2025). Recent work shows that trust mediates leadership effects on PLC development and team functionality, indicating that technical fixes absent relational work are unlikely to shift interaction quality (Gu et al., 2025; Wood et al., 2024). In parallel, emerging multilevel evidence links school-level CTE to a healthier instructional climate, including lower disruptive behaviour, while also showing CTE strengthens the benefits of individual self-efficacy, and it will amplify classroom-level effects in collectively efficacious schools (Holter et al., 2026). Finally, SDT meta-analytic findings demonstrate that autonomy-supportive contexts reliably enhance autonomy and competence, providing a mechanism for sustained, high-quality engagement in collaborative inquiry rather than short-term compliance (Wang et al., 2024). These strands ground the inner ring as the active ingredient that converts organizational capacity into durable collaborative work.

Overlaying two empirically anchored developmental axes, that are Hierarchy → Collaboration (leadership distribution or interaction quality) and Control → Commitment (motivational regulation), produces four diagnostic quadrants that describe typical PLC states and improvement pathways. The axes align with current PLC operations scholarship emphasizing dialogic, evidence-seeking interaction over perfunctory exchange (Hudson, 2024) and with SDT evidence that distinguishes controlled from autonomous participation (Wang et al., 2024). The model predicts that PLCs cluster away from impact when they sit in Directive–Compliance (strong structures, low trust/ownership) or Collaborative–Compliance (high collegiality, weak routines/resources) quadrants. Conversely, PLCs approach the “bullseye”, which is sustained, inquiry-rich collaboration with observable instructional uptake, when outer-ring enablers co-align with inner-ring psychologies in the Collaborative–Commitment quadrant. This configuration is consistent with previous studies and with international survey signals linking teacher voice or autonomy to adaptive instruction and job satisfaction, suggesting that leaders seeking durable gains must deliberately sequence structural supports and cultivate motivational and relational conditions (Liu et al., 2024; OECD, 2025).

Finally, the model functions diagnostically by making visible which ring or axis is constraining progress in each school. Where time and routines exist but interaction remains cautious and informational, the model attributes stagnation to inner-ring deficits, whether it lacks trust, CTE, or autonomy, and suggests autonomy-supportive facilitation and efficacy-building routines; where commitment and collegial energy are present, but work is episodic, it attributes stagnation to outer-ring deficits, such as time, protocols, resourcing, and prioritizes structural protections. These prescriptions align with practitioner-validated design guidance for PLC operation and with TALIS findings on collaboration and teacher agency, offering leaders a clear, evidence-aligned roadmap for moving PLCs toward the high-impact centre (Edwards, 2025).

Discussion

From Alignment to Enactment: Why Both Rings Matter

This conceptual study argues that PLC effectiveness hinges on simultaneous alignment of (a) organizational prerequisites (time, resources, facilitative leadership, and coherent structures) and (b) individual psychological prerequisites (relational trust, autonomous motivation, and collective teacher efficacy). The interpretation is consistent with recent reviews showing that

PLCs stagnate when structures exist without concomitant shifts in trust and efficacy, or when enthusiasm exists without protected time and resourcing to sustain collaborative inquiry. Cross-system evidence links leadership practices to collective teacher efficacy, serving as a powerful proximal driver of instructional improvement, while also showing that trust mediates leadership effects on PLC quality and team functionality (Gu et al., 2025; Çoğaltay & Boz, 2022). Complementary research in teacher motivation indicates that autonomy-supportive leadership is associated with higher self-determined motivation and engagement, offering a mechanism for movement along the Control → Commitment axis (Collie, 2023; Haw & King, 2023). For example, a headteacher introduces weekly PLC time but notices perfunctory “round-robin” updates. Using the framework, she diagnoses strong outer-ring alignment (time allocated) but weak inner-ring conditions (low trust, low efficacy). She responds by coaching middle leaders to use need-supportive moves by giving meaningful rationales and inviting teacher voice, and by explicitly tracking team-level efficacy indicators, rather than only attendance. Over a term, teachers report greater ownership and begin co-planning assessments, which will be a movement toward Commitment and Collaboration (Collie, 2023; Gu et al., 2025).

Interaction Quality as the Engine of PLC Gains

The proposed model helps explain why some PLCs remain “*busy but flat*.” Recent evidence shows that interaction patterns, whether conversations are open, elaborative, and inquiry-oriented versus merely informational, distinguish high-gain PLCs, thereby moving teams up the Hierarchy → Collaboration axis (Hendrickx et al., 2025; Hudson, 2024). Where inquiry and challenge are absent, gains stall even with time and agendas in place. For example, a Year-5 PLC analyses student writing but avoids probing why conventions are not transferring to independent work. The facilitator switches to structured protocols, such as noticing or hypothesis testing with work samples, that legitimate disagreement and evidence-seeking. Within weeks, the team pilots a shared mini-lesson routine and common formative checks, which is an observable shift from exchange to knowledge-building dialogue (Hendrickx et al., 2025; Hudson, 2024).

Trust as a Linchpin Mechanism

The synthesis identifies relational trust as a cross-cutting mechanism linking leadership to PLC team functionality. New analyses show trust explains a large share of variance ($\approx 46\text{--}60\%$) in PLC team functionality, establishing it as a proximal driver of whether teams function as communities of practice (Wood et al., 2024). At the school level, leadership practices that cultivate vulnerability-safe norms and redistribute voice are more likely to strengthen trust and thereby improve PLC functioning (Gu et al., 2025). Practically, this implies that technical fixes without relational work are unlikely to move teams toward the bullseye. For example, in a cluster of primary schools, leaders rotate meeting chairs and co-construct team norms. Over time, teams become willing to expose student errors and try each other’s strategies, which strengthens collective efficacy and accelerates joint problem-solving.

Motivation as a Pathway to Sustained Engagement

Anchoring the horizontal axis (Control → Commitment) in Self-Determination Theory (SDT) (Ryan & Deci, 2017) explains why PLCs built on mandate and surveillance often fade as controlled motivation can secure attendance but undermines durable, high-quality participation. A 36-study meta-analysis shows autonomy-supportive designs reliably enhance autonomy and competence, providing a mechanism for sustained effort in collaborative inquiry (Wang et al., 2024). Related SDT syntheses reinforce that autonomous (vs. controlled) motivation associates with better achievement and lower anxiety, strengthening the case for moving PLC climates rightward toward commitment (Alamer et al., 2025). System indicators also point in the same direction: TALIS 2024/2025 links teacher autonomy and voice to improved well-being and adaptive instruction, which are the conditions that sustain PLC work across cycles (OECD, 2025).

Diagnostic Use: Locating and Moving PLCs Across Quadrants

Superimposing the axes on the rings yields four diagnostic quadrants that account for common failure modes and prescribe targeted remedies. PLCs often stall in Directive–Compliance (tight structures, low trust/ownership) or Collaborative–Compliance (strong collegiality, weak routines), whereas movement toward Collaborative–Commitment occurs when leaders sequence supports, where first protecting time or routines, then intentionally coaching for autonomy-supportive facilitation and efficacy-building routines (Liu et al., 2024; Wang et al., 2024). The framework thus functions as a practical diagnostic: it reveals whether stagnation is predominantly structural (outer-ring deficits) or psychological (inner-ring deficits), guiding improvement design with greater precision than generic PLC implementation checklists (Hudson, 2024).

Boundary Conditions and Contextual Fit

In this study, there are two boundary conditions that emerge. First, collaboration quality matters more than frequency. For example, mandating weekly meetings without autonomy-supportive facilitation depresses agency and can entrench compliance cultures (Hendrickx et al., 2025; Wang et al., 2024). Second, implementation is path-dependent, where nascent PLCs may temporarily benefit from clearer structure and leader-led protocols, while mature PLCs profit from distributed leadership and flexible agendas (Hudson, 2024). Notably, studies in challenging contexts show that extended PLCs connecting internal and external networks advance equity aims when anchored in trust and co-responsibility, underscoring that the model travels but must be enacted with attention to local conditions (Olmo-Extremiera et al., 2025).

Implications for Leadership and Research

For leadership practice, the evidence suggests a sequenced strategy: (a) secure structural preconditions (time protection, protocols, resourcing), (b) train facilitators in autonomy-supportive moves and dialogic protocols, and (c) track proximal psychological indicators (trust, CTE, motivational climate) alongside participation metrics (Liu et al., 2024;

Wang et al., 2024). For research, two priorities follow from this conceptual paper. First, mixed-methods longitudinal designs should estimate the joint effects of outer-ring and inner-ring variables on PLC outcomes and model mediated pathways to instructional improvement (Nguyen et al., 2024; Liu et al., 2024). Second, experimental and quasi-experimental trials should compare bundled PLC interventions, such as the combination of time, autonomy-supportive facilitation, and efficacy routines, against single-factor approaches to test additive or interactive benefits (Wang et al., 2024; OECD, 2025). Beyond school-level effects, multilevel studies show that school-level CTE reduces disruptive behaviour and moderates individual self-efficacy effects, implying potential spillovers from PLC development to school climate, which is an agenda worth pursuing in future PLC trials (Holter et al., 2026).

Conclusion

This conceptual paper set out to develop a diagnostic framework that explains the conditions under which Professional Learning Communities (PLCs) become effective, sustainable, and instructionally impactful, with a particular interest in distinguishing the structural and psychological mechanisms that support or hinder PLC implementation. The findings of the synthesis process directly address this research objective. First, the study finds that PLC effectiveness depends on the simultaneous alignment of two domains: (i) Organizational factors, such as protected collaboration time, coherent routines, resource allocation, and facilitative leadership; and (ii) Individual psychological factors, particularly relational trust, collective teacher efficacy, and autonomous motivation. This dual-condition requirement is strongly supported in the literature, which shows that structural enablers alone are insufficient for sustained professional learning, and that psychological safety and efficacy are decisive for productive inquiry and collaboration. Second, this study proposes and introduces the Concentric Ring Model, clarifying how PLC improvement is often derailed not because conditions are absent, but because inner-ring and outer-ring conditions are misaligned. This model contributes to an understanding of PLC variability by demonstrating that many implementation failures arise from imbalances. For example, well-designed structures paired with low trust, or highly motivated teachers lacking organizational support. This finding responds directly to the research objective by offering a theoretically grounded way to diagnose the precise source of PLC stagnation. In conclusion, this Concentric Ring Model thus provides both an explanatory lens and a diagnostic tool, equipping school leaders, researchers, and policymakers to better understand, evaluate, and enhance PLC implementation. Future empirical work may validate and refine this model, but its current formulation already strengthens the conceptual and practical foundations of PLC development in Malaysia and beyond.

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DIGITAL TECHNOLOGIES AND RELIGIOUS TOURISM: EXPLORING THE POTENTIAL OF DIGITAL *DA'WAH* IN MOSQUE TOUR PROGRAMMES FOR ENGAGING NON-MUSLIM TOURISTS

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Abstract: *The growing intersection between digital technologies and religious tourism has reshaped how religious institutions communicate with increasingly diverse and global audiences. Within mosque tour programmes which function as important intercultural interfaces between Islam and non-Muslim tourists digital technologies offer substantial potential to support da'wah that is dialogic, educational, and culturally sensitive. This study explores the potential of digital da'wah in mosque tour programmes by examining how digital tools are utilised to engage non-Muslim visitors and enhance their understanding of Islamic beliefs, practices, and values within sacred spaces. Adopting a qualitative research design, the study employs semi-structured interviews with mosque tour guides and da'wah practitioners as well as committee members of the several mosques, complemented by document analysis of selected peer-reviewed journal articles on digital da'wah, religious tourism, mosque tourism, and intercultural religious communication. The data were analysed thematically to identify recurring patterns in digital da'wah practices, perceived benefits, and operational challenges within the context of religious tourism. The findings reveal that digital technologies enhance mosque tour experiences by facilitating self-directed learning, multimodal engagement, and flexible access to Islamic information tailored to non-Muslim audiences. Digital da'wah tools also play a significant role in addressing common misconceptions about Islam, fostering intercultural dialogue, and reducing uncertainty and anxiety during interfaith encounters by allowing visitors to engage with content at their own pace prior to or alongside guided interactions. Nevertheless, the study identifies several challenges, including uneven levels of digital literacy among da'wah personnel, concerns over content consistency and theological accuracy, and the need to maintain an appropriate balance between digitally mediated communication and meaningful face-to-face engagement. This study contributes to the literature on religious tourism, da'wah studies, and intercultural communication by demonstrating that digital technologies function primarily as communicative enablers rather than replacements for interpersonal interaction in mosque tour programmes. Practically, the findings offer valuable insights for mosque administrators and religious tourism stakeholders in developing digitally integrated mosque tour models that promote inclusive engagement and foster positive perceptions of Islam among non-Muslim tourists.*

Keywords: *Digital da'wah; Religious tourism; Mosque tour programmes; Intercultural communication; Non-Muslim tourists*

Introduction

In an era marked by rapid technological advancement, religious tourism is experiencing a profound transformation as digital technologies become integral to the visitor experience. Mosques, as both spiritual centers and cultural heritage sites, are increasingly leveraging digital platforms to enhance their tour programmes, reaching audiences far beyond their immediate communities. This digital shift is not merely about operational efficiency or convenience; it represents a reimagining of how religious heritage is communicated, preserved, and experienced. Mobile applications, augmented and virtual reality (AR/VR), and interactive online platforms are now central to the way mosque tours are designed and delivered, offering immersive storytelling, personalized navigation, and multilingual content that cater to the diverse backgrounds of global tourists. These innovations are particularly significant for non-Muslim visitors, who may approach mosque tours with curiosity but limited prior knowledge, and for whom digital tools can bridge gaps in language, culture, and religious understanding. The digitalization of mosque tours thus supports both the preservation of Islamic heritage and the promotion of intercultural dialogue, making religious tourism more accessible, engaging, and educational for all participants (Ajar, 2024; Chaudhury & Hemanth Kumar, 2025; Zaenuri, 2025).

Within this evolving landscape, the concept of digital *da'wah*—traditionally understood as the propagation of Islamic teachings has undergone a parallel transformation. Once confined to face-to-face interactions and sermons, *da'wah* now finds new expression through social media, mobile apps, and interactive digital content. This shift enables mosque tour programmes to present Islamic values and narratives in ways that resonate with contemporary audiences, including non-Muslim tourists. Digital *da'wah* not only democratizes access to religious knowledge but also fosters a climate of openness and mutual respect, essential for meaningful intercultural engagement. The integration of digital *da'wah* into mosque tours offers a unique opportunity to balance religious authenticity with inclusivity, ensuring that the spiritual and cultural significance of mosques is communicated effectively while promoting understanding and respect among diverse visitors. As such, the intersection of digital technologies, religious tourism, and digital *da'wah* represents a promising frontier for both academic inquiry and practical innovation, with the potential to reshape the role of mosques in global tourism and interfaith relations (Ajar, 2024; Chaudhury & Hemanth Kumar, 2025; Zaenuri, 2025).

Literature Review

The literature on digital technologies in religious tourism consistently highlights the transformative impact of digital interventions on visitor engagement and site management, particularly within mosque settings. Mobile applications, AR, and VR are at the forefront of this transformation, offering solutions to challenges such as overcrowding, language barriers, and the preservation of historical narratives. For instance, the ReligiGO app, which integrates GIS-based navigation with virtual tours and personalized recommendations, has demonstrated significant success in enhancing visitor engagement and interest in religious tourism destinations (Chaudhury & Hemanth Kumar, 2025; Permatasari et al., 2025; Rahman et al.,

2024; Sawari et al., 2024; Zhu et al., 2023). These technologies not only attract new audiences but also deepen the understanding of Islamic heritage, especially among non-Muslim tourists seeking cultural enrichment. Digital interpretive signage and multilingual content further improve accessibility and comprehension, making mosque tours more inclusive and informative. However, the literature also notes challenges such as maintaining the authenticity of the religious experience and addressing the digital divide, which can limit the reach and effectiveness of these innovations (Chaudhury & Hemanth Kumar, 2025; Sawari et al., 2024; Zhu et al., 2023).

Parallel to these technological advancements, the field of digital *da'wah* has evolved from traditional preaching to the strategic use of digital platforms. Early studies focused on the expanded reach of *da'wah* through social media, websites, and mobile applications, emphasizing accessibility and interactivity (Chaudhury & Hemanth Kumar, 2025; Zaenuri, 2025; Sikumbang et al., 2024; Othman et al., 2025; Zohdi et al., 2024). More recent research has shifted towards the quality of content, delivery methods, and audience engagement strategies, recognizing digital *da'wah* as a transformative tool for interfaith dialogue. In the context of mosque tours, digital *da'wah* enables the presentation of Islamic teachings in contemporary, relatable formats that resonate with global audiences. Transmedia storytelling, interactive infographics, and immersive digital experiences are among the methods identified as particularly effective in engaging non-Muslim tourists, fostering both religious awareness and intercultural understanding (Chaudhury & Hemanth Kumar, 2025; Othman et al., 2025; Sikumbang et al., 2024; Zaenuri, 2025; Zohdi et al., 2024). The literature underscores the importance of tailoring content to diverse audiences, using clear, multilingual, and contextually relevant messaging to overcome cultural and linguistic barriers (Othman et al., 2025).

Mosque tour programmes themselves have adopted a range of strategies to engage non-Muslim tourists, with varying degrees of success. Interpretive signage—especially when enhanced with digital and interactive features—has been shown to significantly improve visitor knowledge and appreciation of mosque architecture, history, and Islamic culture (Ajar, 2024; Ma'arif et al., 2024; Muin et al., 2024; Othman et al., 2025; Yasin et al., 2025). Facility management, including cleanliness, design, and the creation of welcoming environments, also plays a crucial role in attracting and retaining non-Muslim visitors. Programmes that emphasize cultural sensitivity, ethical tourism standards, and structured educational activities are particularly effective in fostering positive attitude shifts and deeper intercultural understanding (Ajar, 2024; Ma'arif et al., 2024; Muin et al., 2024; Othman et al., 2025; Yasin et al., 2025). Nonetheless, challenges persist, including language barriers, limited awareness of Islamic culture, and the underutilization of digital tools. The literature suggests that expanding the use of digital platforms, increasing multilingual inclusivity, and enhancing visitor interaction through technology are key to improving the mosque tour experience for non-Muslim tourists (Ajar, 2024; Ma'arif et al., 2024; Muin et al., 2024; Othman et al., 2025; Yasin et al., 2025).

Despite these advances, significant gaps remain in the integration of digital *da'wah* within mosque tour programmes. While studies have explored digital tools and *da'wah* practices separately, few have systematically examined how these elements can be harmonized to promote intercultural and interfaith understanding (Kohar et al., 2025; Mohd Khambali Hambali et al., 2025; Othman et al., 2025; Zaenuri, 2025; Zohdi et al., 2024). The literature

calls for the development of integrated frameworks and guidelines that balance technological innovation with religious authenticity, ensuring that digital *da'wah* supports both accurate religious representation and inclusivity. Addressing these gaps requires interdisciplinary research that draws on digital humanities, religious studies, and tourism management. Future research should focus on creating participatory, user-centered digital experiences that are accessible across languages and cultures, while upholding ethical standards and fostering respect for Islamic heritage. Such efforts are essential for enabling mosque tour programmes to contribute meaningfully to interfaith dialogue and cultural exchange in an increasingly digital and interconnected world (Kohar et al., 2025; Mohd Khambali Hambali et al., 2025; Othman et al., 2025; Zaenuri, 2025; Zohdi et al., 2024).

Theoretical Framework

This study is underpinned by an integrated theoretical framework combining Dialogic Communication Theory, Anxiety/Uncertainty Management (AUM) Theory, Intercultural Communication Theory, and Experience Economy Theory to explain the communicative role of digital *da'wah* in mosque tour programmes for non-Muslim tourists. Dialogic Communication Theory conceptualises communication as a relational and interactive process, providing a foundation for understanding digital *da'wah* as dialogic engagement rather than one-way religious transmission (Kent & Taylor, 2002). AUM Theory further explains how digitally mediated information can reduce anxiety and uncertainty during intercultural encounters, particularly when non-Muslim visitors engage with unfamiliar religious symbols and sacred spaces (Gudykunst, 2005). Intercultural Communication Theory highlights processes of meaning negotiation, cultural sensitivity, and adaptive communication across religious and cultural boundaries, which are essential in religious tourism contexts (Hall, 1990; Abu-Nimer & Smith, 2016). In addition, Experience Economy Theory frames mosque tours as experiential encounters in which digital technologies enhance immersion, interpretation, and visitor engagement beyond functional information delivery (Pine & Gilmore, 1999). Empirical studies in religious tourism and digital heritage contexts support this integrated approach, demonstrating that digital tools can enrich visitor understanding while maintaining authenticity when used as communicative enablers rather than substitutes for interpersonal interaction (Zhu et al., 2023; Sawari et al., 2024; Chaudhury & Hemanth Kumar, 2025).

Conceptual Framework

Guided by these theories, the study adopts a qualitative, process-oriented conceptual framework that foregrounds practices, interactions, and lived experiences rather than linear causal relationships. Mosque tour programmes are conceptualised as religious–tourism spaces where digital *da'wah* practices such as websites, QR-code systems, digital signage, mobile applications, and multimedia content, are embedded within specific institutional and cultural contexts (Othman et al., 2025; Muin et al., 2024). These practices shape communicative processes including dialogic engagement, self-directed learning, cultural mediation, and the management of anxiety and uncertainty during interfaith encounters (Gudykunst, 2005; Zaenuri, 2025). Through these processes, non-Muslim tourists interpret Islamic narratives, symbols, and values based on their personal backgrounds, resulting in emergent understandings, perceptions, and attitudes towards Islam and mosques (Yasin et al., 2025).

Influencing conditions such as the digital literacy of *da'wah* personnel, theological accuracy of content, and the balance between digital and face-to-face interaction operate across all stages of the framework, reflecting findings in recent studies on digital *da'wah* and mosque tourism (Sikumbang et al., 2024; Othman et al., 2025). This conceptual framework aligns with qualitative inquiry by emphasising meaning-making, contextual complexity, and interpretive depth in digitally mediated mosque tour experiences.

Methodology

This study employs a qualitative research design to explore the potential of digital *da'wah* within mosque tour programmes for engaging non-Muslim tourists, focusing on practices, interactions, and meaning-making processes in religious tourism contexts. Data were collected through semi-structured interviews with mosque tour guides and *da'wah* practitioners as well as committee members of the several mosques who are directly involved in designing and delivering mosque tour programmes as shown in Table 1. This approach enabled participants to share in-depth insights into their experiences, strategies, and challenges in integrating digital technologies into *da'wah* activities. In addition, document analysis was conducted on selected peer-reviewed journal articles on digital *da'wah*, religious tourism, mosque tourism, and intercultural religious communication. To ensure trustworthiness, the study adopted key criteria proposed by Lincoln and Guba, including credibility, dependability, and confirmability. Credibility was enhanced through data triangulation between interview data and document analysis, while dependability was supported by maintaining a clear audit trail of data collection and analytical procedures. Confirmability was strengthened by grounding interpretations in verbatim participant accounts and documented digital materials. This methodological approach provides an in-depth and context-sensitive understanding of how digital technologies function as communicative enablers that complement interpersonal engagement in mosque tour-based *da'wah* practices.

Table 1: Information of Informant

Informant	Institution	Jawatan	Jantina
Informant 1	Islamic Propagation Society International (IPSI)	Founder and President	Male
Informant 2	Tuanku Mizan Zainal Abidin Mosque, Putrajaya	Penolong Pengarah Kanan of JAKIM	Male
Informant 3	Angkatan Belia Islam Malaysia (ABIM)/Muslim Youth Movement of Malaysia	Mosque tour guide at Tuanku Mizan Zainal Abidin Mosque, Putrajaya	Female
Informant 4	The National Mosque of Malaysia/Masjid Negara, Kuala Lumpur	Penolong Pengarah Kanan of JAKIM	Male
Informant 5	India Mosque Kuching/Masjid India Bandar Kuching, Sarawak	Chairman	Male
Informant 6	Kota Kinabalu City Mosque/Masjid Bandaraya Kota Kinabalu, Sabah	Chairman	Male

Findings

The findings demonstrate how digital technologies function as communicative enablers that support dialogic, educational, and culturally sensitive *da'wah* in mosque tour programmes for non-Muslim tourists, while also revealing operational constraints that shape their effectiveness (Kent & Taylor, 2002; Gudykunst, 2005; Sa'ari et al., 2025).

1. Digital *Da'wah* and Self-Directed Learning in Sacred Tourism Spaces

Document analysis indicates that digital *da'wah* materials—such as official mosque websites, QR-code-based information systems, mobile applications, and on-site digital displays—primarily function as educational mediators that enable self-directed learning by providing structured explanations of Islamic beliefs, ritual practices, mosque architecture, and visitor etiquette in multilingual and visually supported formats (Othman et al., 2025; Sa'ari et al., 2025). This enables non-Muslim tourists to engage with Islamic content at their own pace, consistent with patterns identified in religious heritage tourism literature (Timothy, 2023; Zhu et al., 2023).

Interview data strongly reinforce this pattern. Mosque tour guides consistently described digital tools as entry points that allow visitors to acquire basic understanding before engaging in face-to-face interaction:

“Usually visitors scan the QR code first. After they understand the basics, only then do they start asking questions. The discussion becomes calmer and more meaningful.” (*Informant 1*)

Comparable perspectives emerged from mosque administrators in East Malaysia. At Masjid India Kuching, informants acknowledged the educational value of QR-code systems and digital feedback mechanisms, even though such tools were still at the planning stage:

“We are considering QR codes so visitors can read first and even leave feedback. Some mosques already have this, and it helps visitors understand before asking questions.” (*Informant 5*)

Similarly, mosque personnel in Kota Kinabalu described how structured explanations—currently delivered face-to-face—serve a function analogous to digital pre-learning tools by preparing visitors cognitively before deeper engagement:

“Before they enter, explanations are given about prayer, how Muslims worship, and what they will see inside. After that, interaction becomes much easier.” (*Informant 6*)

2. Reducing Anxiety and Addressing Misconceptions through Digital Mediation

Another key finding concerns the role of digital *da'wah* tools in reducing anxiety and uncertainty during interfaith encounters. Document analysis shows that digital materials

consistently address sensitive issues such as dress codes, spatial boundaries, behavioural norms, and the meanings of Islamic rituals, using neutral and visitor-friendly language (Othman et al., 2025). Similar functions of digital interpretation have been identified in studies of religious tourism and intercultural encounters (Abu-Nimer & Smith, 2016).

Interview data confirm the practical importance of this function:

“Non-Muslim visitors are often afraid of doing something wrong. When they read the guidelines first through QR codes or digital signage, they feel more confident entering the mosque.” (*Informant 4*)

This anxiety-reduction function is echoed in interviews from Masjid Kota Kinabalu, where administrators emphasised the importance of clear pre-visit guidance on etiquette and behaviour:

“Visitors are allowed to enter, but they must follow etiquette—proper clothing and behaviour. When guidelines are clear, there is no tension.” (*Informant 6*)

At Masjid India Kuching, respondents similarly noted that uncertainty among visitors could be minimised through accessible information, reducing the burden on guides to repeatedly clarify basic rules:

“The most important thing is that we welcome them. Proper dressing, basic guidelines—when this is clear, visitors feel at ease.” (*Informant 5*)

3. Multimodal Engagement and Experiential Enhancement in Mosque Tours

Findings further indicate that mosque tour programmes increasingly employ multimodal digital content, including visual displays, short videos, and architectural explanations, to transform mosque visits into experiential encounters rather than purely informational tours (Sawari et al., 2024; Zhu et al., 2023).

Interview participants highlighted the experiential value of these digital elements:

“Videos and visual displays really help. Visitors can feel the atmosphere of Islam, not just listen to explanations.” (*Informant 2*)

Parallel insights emerged from Masjid India Kuching, where visiting groups were introduced to Islam through slide presentations and visual materials provided by partner organisations:

“They use proper slides explaining what Islam is, followed by Q&A. It helps visitors understand visually, not only through verbal explanation.” (*Informant 5*)

At Masjid Kota Kinabalu, respondents noted that architectural appreciation plays a central experiential role, which could be further enhanced through digital interpretation:

“The architecture itself attracts visitors. When explanations are given, they appreciate the mosque more deeply.” (*Informant 6*)

4. Intercultural Meaning-Making and Culturally Sensitive *Da'wah*

Across the analysed documents, Islamic content is consistently framed through shared moral and ethical values such as hospitality, cleanliness, respect, and peaceful coexistence, rather than theological debate (Othman et al., 2025; Sa'ari et al., 2025). Interview participants confirmed that digital materials are intentionally designed to be culturally accessible and non-confrontational.

This orientation is reinforced by mosque administrators' emphasis on balancing digitalisation with human interaction. One respondent articulated this balance clearly:

“Digitalisation can be useful, but at the same time, we must not forget the traditional human touch.” (*Informant 5*)

This reflects adaptive intercultural communication, where meaning is negotiated through familiar ethical reference points rather than doctrinal exposition (Hall, 1990). Prior studies in digital religion and peace communication demonstrate that value-based narratives are particularly effective in reducing stereotyping and fostering intercultural trust in interfaith encounters (Abu-Nimer, 2004; Funk & Gyulkhandanyan, 2019).

5. Operational Constraints and the Limits of Digital Mediation

Despite these benefits, both document analysis and interview data reveal operational challenges in implementing digital *da'wah*, including uneven digital literacy among volunteers, inconsistent content updates, and fragmented digital platforms across mosques (Sa'ari et al., 2025; Sikumbang et al., 2024; Othman et al., 2025).

As one interviewee noted:

“Some mosques have QR codes, others don't. Sometimes the content is outdated, so we still have to explain everything verbally.” (*Informant 3*)

These challenges were strongly echoed in Masjid India Kuching, where reliance on volunteers slowed digital implementation:

“We have many ideas, but execution is slow because most committee members are volunteers.” (*Informant 5*)

The absence of systematic digital data collection was also highlighted:

“At the moment, we do not have proper records of visitors. Maybe in the future, digital systems can help with this.” (*Informant 5, Masjid India Kuching*)

Discussion

The findings affirm that digital technologies in mosque tour programmes function primarily as communicative enablers that support dialogic, educational, and culturally sensitive *da'wah* for non-Muslim tourists, while simultaneously revealing structural and institutional limitations that shape their effectiveness. Rather than replacing interpersonal engagement, digital mediation operates as an infrastructural layer that prepares, supports, and enhances face-to-face encounters within sacred tourism settings (Kent & Taylor, 2002; Gudykunst, 2005; Sa'ari et al., 2025).

Digital Da'wah, Self-Directed Learning, and Dialogic Facilitation

Interpreted through Dialogic Communication Theory, the findings reflect a clear shift away from one-way religious transmission toward dialogic facilitation, where understanding is generated through openness, reflection, and voluntary engagement rather than persuasion or doctrinal instruction (Kent & Taylor, 2002). The role of digital *da'wah* as a pre-engagement learning mechanism aligns with broader scholarship on interpretive media in religious and heritage tourism, which highlights the value of self-directed learning in culturally plural and sensitive environments (Timothy & Boyd, 2006; Timothy, 2023). Digital interpretive tools allow visitors to engage with religious content at their own pace, reducing communicative asymmetry and enabling more balanced and respectful dialogue during guided interactions (Zhu et al., 2023). In this sense, digital *da'wah* functions as a *pre-dialogic infrastructure*, preparing cognitive and emotional readiness for meaningful interpersonal exchange within sacred spaces (Othman et al., 2025; Campbell & Cheong, 2022).

Reducing Anxiety and Managing Uncertainty in Interfaith Encounters

From the perspective of Anxiety/Uncertainty Management (AUM) theory, access to clear, non-threatening, and visitor-oriented digital information significantly reduces both cognitive and affective uncertainty prior to intercultural interaction (Gudykunst, 2005). The findings demonstrate that digital guidance on etiquette, spatial norms, and ritual meanings acts as a psychological buffer that mitigates fear of transgression and social embarrassment—concerns commonly reported in interfaith and sacred site encounters (Abu-Nimer & Smith, 2016). This function is particularly critical in mosques, where symbolic sensitivity and unfamiliar religious practices can heighten visitor anxiety. Consistent with peace communication and interreligious dialogue literature, lowering uncertainty creates communicative conditions that foster openness, trust, and respectful engagement (Abu-Nimer, 2004; Kadayifci-Orellana, 2013; Funk & Gyulkhandanyan, 2019). Digital *da'wah* therefore contributes not only to information delivery but also to emotional regulation and intercultural confidence.

Multimodal Engagement and Experiential Depth in Mosque Tourism

The findings further support Experience Economy Theory, which posits that meaningful tourism experiences emerge through emotional, sensory, and participatory engagement rather

than passive information consumption (Pine & Gilmore, 1999). Multimodal digital content—such as videos, visual displays, and architectural interpretation—enhances experiential depth by enabling visitors to *feel*, *visualise*, and *contextualise* Islamic practices within the mosque environment (Zhu et al., 2023; Sawari et al., 2024). However, consistent with critical scholarship on religious tourism and digital mediation, these benefits are contingent upon careful governance to prevent the commodification of sacred spaces or the dilution of their spiritual atmosphere (Timothy & Olsen, 2006; Berry, 2025). Digital *da'wah* thus enhances experiential value only when it complements embodied presence, spatial reverence, and guided human interaction rather than overshadowing them.

Intercultural Meaning-Making and Value-Based Da'wah

The emphasis on shared ethical values—such as hospitality, respect, cleanliness, and peaceful coexistence—reflects an adaptive model of intercultural religious communication that prioritises moral common ground over theological debate. This approach resonates with Hall's (1990) cultural communication framework and with empirical studies showing that value-based narratives are more effective than doctrinal exposition in reducing stereotyping and fostering intercultural trust in interfaith encounters (Abu-Nimer, 2004; Funk & Gyulkhandanyan, 2019). Within religious tourism scholarship, sacred sites are increasingly recognised as spaces of cultural diplomacy, where communication strategies can promote mutual understanding and peaceful coexistence when designed with cultural sensitivity (Timothy, 2023; Senbeto, 2022). Digital *da'wah*, when framed through shared human values, thus positions mosque tours as platforms for intercultural meaning-making rather than sites of religious persuasion.

Operational Constraints and the Limits of Digital Mediation

Despite these positive outcomes, the findings also reveal significant operational constraints, including uneven digital literacy among volunteers, fragmented digital platforms, inconsistent content updating, and limited institutional capacity for systematic data management. These challenges echo broader critiques in digital religion scholarship, which caution that technological adoption without adequate training, governance, and organisational support can undermine relational depth and sustainability (Campbell & Cheong, 2022; Hoover, 2016). Overreliance on digital tools risks weakening the human dimensions of *da'wah* if technology is treated as an end rather than a means (Berry, 2025). Consequently, the effectiveness of digital mosque tour initiatives depends on institutional readiness, content accountability, and the presence of trained guides who can contextualise digital information through empathetic, dialogic, and culturally attuned interpersonal engagement (Sa'ari et al., 2025).

Synthesis: Digital Technologies as Communicative Enablers

Overall, the discussion confirms that digital technologies in mosque tour programmes operate primarily as communicative enablers rather than substitutes for human interaction. They facilitate self-directed learning, reduce intercultural anxiety, enrich experiential engagement, and support culturally sensitive *da'wah*, while remaining fundamentally dependent on interpersonal dialogue for deeper understanding and relationship-building (Kent & Taylor,

2002; Gudykunst, 2005; Pine & Gilmore, 1999). This reinforces the view that effective digital *da'wah* in religious tourism contexts lies not in technological sophistication alone, but in its thoughtful integration with human presence, ethical communication, and institutional capacity.

Conclusion

This study examined the role of digital *da'wah* in mosque tour programmes as a contemporary communicative interface between Islam and non-Muslim tourists within the context of religious tourism. By integrating document analysis of digital mosque tourism materials—including QR-code systems, interpretive digital signage, multimedia displays, and information platforms—with semi-structured interviews with mosque tour practitioners, the study provides an empirically grounded account of how digital technologies are utilised, interpreted, and negotiated within sacred spaces. The findings demonstrate that digital technologies function primarily as communicative enablers rather than substitutes for interpersonal *da'wah*. Digital tools facilitate self-directed learning by allowing non-Muslim visitors to access Islamic information at their own pace and in culturally accessible formats, thereby preparing them for more meaningful face-to-face engagement during guided mosque tours. Digital mediation also plays a crucial role in reducing anxiety and uncertainty during interfaith encounters by clarifying behavioural norms, spatial boundaries, dress codes, and ritual meanings, resulting in calmer, more respectful, and more dialogic interactions. In addition, the integration of multimodal digital content enhances experiential engagement by transforming mosque visits into interpretive and affective experiences rather than purely informational tours, particularly when digital media complement guided explanation. At the same time, the study identifies significant operational constraints, including uneven digital literacy among mosque personnel and volunteers, fragmented digital platforms, inconsistent content updates, and challenges related to theological accuracy and interpretive coherence. These constraints underscore the importance of institutional capacity, governance, and coordination in shaping the effectiveness of digital mosque tourism initiatives.

Theoretically, this study contributes to scholarship on religious tourism, *da'wah*, and intercultural communication by empirically demonstrating how digital technologies operationalise key communication theories within sacred tourism contexts. The findings extend Dialogic Communication Theory by showing that digital *da'wah* supports dialogic facilitation rather than one-way religious transmission, enabling reflective and voluntary engagement without imposing doctrinal authority. Through the application of Anxiety/Uncertainty Management Theory, the study demonstrates that digitally mediated information functions as a pre-interaction mechanism that reduces intercultural anxiety in encounters with unfamiliar religious environments, extending AUM theory into digitally mediated religious tourism settings where symbolic sensitivity is particularly high. Drawing on Experience Economy Theory, the study further shows that digital *da'wah* enhances experiential depth and memorability when integrated with embodied and interpersonal dimensions of mosque tours, enriching religious tourism experiences without commodifying sacred spaces. Conceptually, the study validates a process-oriented framework that positions mosque tour programmes as dynamic communicative spaces shaped by digital practices, interpersonal interaction, and institutional conditions rather than linear cause-effect relationships. Practically, the findings highlight the need for digital tools to be implemented as supportive infrastructures that

complement, rather than replace, face-to-face interaction with trained mosque tour guides, alongside stronger content governance to ensure multilingual accuracy, theological consistency, and cultural sensitivity. Investment in digital literacy and capacity-building among mosque personnel is essential to prevent fragmentation and underutilisation of digital initiatives. While the qualitative focus on selected mosque tour programmes limits generalisability, future research could adopt comparative, mixed-method, or quantitative approaches across different cultural and religious contexts, as well as explore the ethical boundaries of digital mediation in sacred spaces, particularly regarding authenticity, commodification, and spiritual integrity. Overall, this study underscores that the transformative potential of digital technologies in mosque tour programmes lies not in replacing traditional *da'wah*, but in enhancing communication, understanding, and experience through thoughtful and culturally sensitive integration, contributing to more inclusive religious tourism and constructive interfaith engagement in an increasingly digitalised world.

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SCHOOL ADMINISTRATORS' PERCEPTION OF PROFESSIONAL COMPETENCY LEVEL AMONG SPECIAL EDUCATION GRADUATES FROM TEACHER EDUCATION INSTITUTE MALAY WOMEN'S CAMPUS, MALACCA

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Abstract: *Institutes of Teacher Education (ITE) must conduct evaluations of their graduates to meet the demands of the school market. This study aims to assess administrators' perceptions of the competency of special education graduates from the Institute of Teacher Education, Malay Women's Campus (ITE WC), Malacca, and to analyze the critical gaps in behavior management for Students with Special Educational Needs (SEN). Furthermore, it evaluates administrators' recommendations for improving the curriculum or practicum training. Using a qualitative approach, this study analyzed the perceptions of four administrators through semi-structured interviews. The research framework is grounded in the Malaysian Teacher Competency Framework (MTCF) and the Kirkpatrick Model to evaluate the effectiveness of the training program. Thematic analysis results indicate that administrators are highly satisfied with graduate competencies in terms of pedagogy, etiquette and discipline, as well as leadership and teamwork. Graduates successfully addressed critical gaps in behavior management for MBPK through sustainable innovative pedagogy and character mentoring. Additionally, administrators proposed several improvements, including the enhancement of practicum training, emotional management workshops, and industry-academia collaboration. This study contributes to the literature on special education teacher competency assessment from the perspective of school administrators and offers practical implications for the improvement of IPG training programs.*

Keywords: *Teacher Competency, Special Education, Administrator Perceptions, Kirkpatrick Model, Malaysian Teacher Competency Standard*

Introduction

Special Education in Malaysia has undergone rapid transformation in alignment with the Malaysia Education Blueprint (MEB) 2013-2025. In Malacca, institutions producing special education graduates bear a significant responsibility in nurturing teachers who are not only proficient in pedagogy but also possess high emotional resilience to navigate the complex challenges of inclusive classrooms. This study focuses on the extent to which these graduates meet the expectations of school administrators, who serve as the primary 'customers' within the educational ecosystem.

While graduates are equipped with robust academic theories, a gap exists between their current competencies and the realities on the ground. Administrators frequently report that fresh graduates encounter difficulties in several critical areas that necessitate immediate attention.

Challenges faced by fresh graduates include:

- Pedagogical competence for diverse students with special needs.
- Professional etiquette and discipline.
- Leadership adaptation and teamwork.
- Behavioral management of Special Educational Needs (SEN) students with complex requirements.

Research Objectives

The objectives of this study are to:

1. Evaluate administrators' perceptions of the competency of special education graduates from the Institute of Teacher Education, Women's Malay Campus, Malacca, based on the Malaysian Teacher Competency Framework (MTCF).
2. Analyze critical gaps in the management of behavior for Students with Special Educational Needs (SEN) faced by new graduates.
3. Propose an action plan for curriculum or practicum training enhancement based on administrator feedback.

Literature Review

According to studies by Azman et al. (2023), Norian et al. (2025), and Mustaffa et al. (2025), the quality of special education teachers is measured not only by academic grades but also through competencies in pedagogy, decorum and discipline, as well as leadership adaptation and teamwork. Furthermore, the quality of these teachers is evaluated based on their ability to manage student behavior within the classroom. Siti and Rohani (2024) further emphasize that school administrators in the southern zone (including Malacca) expect "work-ready" teachers, particularly in navigating digital pedagogical competencies (Lee, 2025; Ahmad & Ismail, 2025) and being prepared to face the challenges of managing the behavior of Students with Special Educational Needs (SSEN) (Sulaiman, 2023).

Theoretical Framework and Research Model

This study employs two primary frameworks to analyze the competencies of special education graduates:

Malaysian Teacher Standard Competency Framework (MTSCF)

The Malaysian Teacher Standard Competency Framework (MTSCF), developed by the Ministry of Education Malaysia (2017), outlines three primary domains of teacher competency which serve as the foundation for this study's assessment:

- **Pedagogical Competency Domain:**

Encompasses Pedagogical Content Knowledge (PCK), the ability to plan and implement effective instruction, and student learning assessment skills. In the context of special education, this domain includes the capacity to perform curriculum modification and instructional adaptation in alignment with the students' Individualized Education Program (IEP).

- **Professional Decorum and Discipline Domain:**

Covers the values of teacher professionalism, professional ethics, decorum in interactions, and self-management. This aspect is critical for special education teachers, who are required to demonstrate a high degree of patience and empathy.

- **Leadership and Teamwork Domain:**

Includes classroom leadership skills, collaboration with multidisciplinary teams, effective communication with parents, and involvement in school development. Special education teachers must work collaboratively with therapists, sign language interpreters, and various support professionals.

The Kirkpatrick Model for Training Program Evaluation

This study adopts the Kirkpatrick Model (1994), as updated by Kirkpatrick & Kirkpatrick (2016), to evaluate the effectiveness of teacher training programs at the Institute of Teacher Education, Ministry of Education. The model consists of four levels of evaluation relevant to this study:

Level 1 – Reaction: Measures participants' satisfaction with the training program. In this study, it refers to the graduates' initial reception of the training received at the ITC.

Level 2 – Learning: Measures the increase in knowledge and skills. This is assessed through the graduates' academic achievements during their tenure at the ITC.

Level 3 – Behavior: Measures the application of knowledge and skills in the workplace. This study focuses on this level by evaluating administrators' perceptions of graduates' performance within the actual school context.

Level 4 – Results: Measures the organizational impact. In the context of this study, it refers to the effectiveness of behavioral management for Students with Special Educational Needs (SSEN) and student learning outcomes.

Integration of MTCF and the Kirkpatrick Model

This study integrates MTCF as the competency framework being assessed, while the Kirkpatrick Model is employed to evaluate the effectiveness of ITC training programs in developing these competencies. The administrators' perceptions in this study represent Level 3 (Behavior) of the Kirkpatrick Model, measuring the extent to which graduates apply MTCF competencies in their daily teaching practices.

Research Methodology

Research Design

This study employs a qualitative research design with a phenomenological approach to gain an in-depth understanding of administrators' perceptions. This approach is well-suited for

exploring the experiences and perspectives of administrators regarding graduate competency within the actual school context.

Research Participants

The participants of this study consist of four school administrators (Principals/Headmasters or Senior Assistants of Special Education) from three schools that have received IPG KPM graduates specializing in Special Education. Participants were selected using a purposive sampling method based on the following criteria:

- Have at least one ITC WC graduate serving at their school.
- Be directly involved in the administration of special education programmes.
- Possess at least three years of administrative experience.
- Be willing to provide honest feedback regarding the graduates' performance.

Research Instrument

Semi-structured interviews were employed as the primary data collection instrument. The interview protocol was developed based on the three domains of KGSM and the four levels of the Kirkpatrick Model. The interview questions encompassed the following areas:

- Assessment of graduates' pedagogical competence.
- Perceptions of graduates' professionalism and etiquette.
- Effectiveness of leadership and teamwork.
- Critical gaps in the behavioral management of Students with Special Educational Needs (SEN).
- Recommendations for the improvement of training programs.

Data Collection Procedure

Interviews were conducted online via video conferencing platforms. Each session lasted between 45 to 60 minutes and was recorded (with the participants' consent) for transcription and analysis purposes. The researcher employed probing techniques to elicit more detailed information when necessary.

Data Analysis

Qualitative data were analyzed using thematic analysis (Braun & Clarke, 2006) alongside a constant comparative method. The analysis process involved the following steps:

- i. Verbatim transcription of interview recordings.
- ii. Repeated reading to ensure data familiarization.
- iii. Initial coding to identify units of meaning.
- iv. Development of themes and subthemes.
- v. Reviewing and refining themes.
- vi. Production of the final report featuring relevant verbatim quotes.

Validity and Reliability

To ensure the **validity and reliability** of the study, several strategies were implemented:

- Triangulation: Data was collected from multiple sources (different administrators and different schools).
- Member checking: Transcriptions and themes were returned to the participants for verification.
- Audit trail: Complete documentation of the research process was maintained.
- Researcher reflexivity: The researcher acknowledged potential biases and practiced critical reflection throughout the research process.

Findings and Discussion

The thematic analysis of the interview data revealed three main themes related to the research objectives: (1) Administrators' Perceptions of Graduate Competency, (2) Critical Gaps in Behavioural Management of Students with Special Educational Needs (SEN), and (3) Recommendations for Training Programme Improvements.

Administrators' Perceptions of Graduate Competency

Analysis reveals that administrators are highly satisfied with graduate competency across the three assessed MTCF domains:

Pedagogical Competency Domain

Pedagogical competency transcends the mere delivery of knowledge; it encompasses the graduates' ability to implement curriculum modifications and instructional adaptations tailored to the needs of Students with Special Educational Needs (SEN). Competent graduates are perceived as capable of integrating Individualised Education Plans (IEP) into mainstream teaching and learning (T&L) within inclusive settings.

An administrator shared:

"I feel that the primary challenge lies not within the subject matter itself, but in how to adapt activities so that students with autism and Down syndrome in the same classroom can understand. Creativity in teaching aids is highly critical."

These findings align with the views of Musa & Mohd (2023), who state that the effectiveness of special education teachers depends on differentiation skills capable of narrowing student learning gaps. IPG KPM graduates demonstrate the ability to develop multi-sensory teaching aids, integrating visual, kinesthetic, and auditory approaches within a single learning activity.

Domain of Politeness and Professional Discipline

Administrators provided highly positive evaluations regarding the graduates' level of politeness and professional discipline. They stood out in terms of:

- Patience and empathy when dealing with Students with Special Educational Needs (MBPK)
- Time commitment and dedication
- Professional ethics in communication
- Self-management and continuous learning

One administrator noted:

'Graduates from the Ministry of Education's Institute of Teacher Education (ITC WC) demonstrate high levels of commitment. They are willing to arrive early to prepare materials and remain after school hours to provide additional guidance to students. This level of dedication is not universal among all teachers and warrants formal recognition'.

These findings support the study by Abdullah et al. (2024), which emphasises that emotional intelligence and resilience are key determinants of success for special education teachers. The politeness demonstrated extends beyond interactions with students, encompassing engagements with parents and colleagues as well.

Leadership and Team Collaboration Domain

Graduates demonstrate strong capabilities in leadership and collaboration. They are proactive in:

- Leading early intervention programs;
- Collaborating within multidisciplinary teams (therapists, sign language interpreters);
- Establishing rapport with parents;
- Sharing expertise with colleagues.

"What impresses me is that these graduates lack the ego to work with other teachers, including those in the mainstream. They are active in IEP (Individualized Education Program) meetings and frequently provide constructive input. This is vital for a collaborative culture in schools."

These findings align with the study by Hassan & Razak (2025), which emphasizes the importance of collaborative leadership in transforming the roles of special education teachers. ITC WC graduates demonstrate the ability to work within multidisciplinary teams, a key characteristic of 21st-century special education teachers (Siti & Ahmad, 2025).

Critical Gaps in the Behavioral Management of Students with Special Educational Needs (SSEN)

The analysis reveals that graduates successfully addressed critical gaps in the behavioral management of SEN students through two primary approaches:

Sustainability of Innovative Pedagogy

Graduates are proficient in employing innovative pedagogies that serve as proactive behavioral intervention tools. The 'edutainment' approach and the integration of digital pedagogy help mitigate disruptive behaviors within the classroom.

An administrator stated:

"These graduates no longer rely on 'stern' methods to maintain classroom control. Instead, they utilize interactive applications and gamification, which instinctively engages students in learning and diverts them from exhibiting tantrums. This is what we define as behavior management through enjoyable pedagogy."

The use of innovative elements is not merely intended for knowledge delivery but also functions as a proactive behavioral intervention tool. According to the Ministry of Education Malaysia (2023), the sustainability of teacher quality is measured by their ability to adapt instructional methods to the diverse cognitive and emotional levels of students.

Character Building and Guidance

Graduates demonstrate a high level of attentiveness in assisting students to master motor skills (such as pencil gripping and cutting) and emotional stability through empathetic rapport. The character guidance implemented is aligned with the concept of student aspirations (student outcome) as outlined in the Malaysia Education Blueprint.

An administrator shared:

"What I commend is their high level of patience and their constant effort to guide student character through role modeling. They do not merely focus on academics; the positive reinforcement techniques they introduce feel fresh and innovative."

However, administrators noted that sustainability remains a challenge, requiring continuous support to ensure such innovations do not stagnate after the initial phase of service (Nurul & Bakar, 2024).

Proposed Improvement Action Plan

Based on the perceptions of administrators, several concrete recommendations have been identified to enhance the ITC WC training programs:

Strengthening Industrial Training

Administrators suggest extending the duration of practicum exposure and diversifying training locations to include not only government schools but also early intervention centers, private schools, and special education organizations. This expansion would provide graduates with more comprehensive exposure to various service delivery models within special education.

Emotional Management and Resilience Workshop

The introduction of resilience modules into the curriculum aims to reduce the risk of burnout among novice teachers. Administrators emphasize the significance of teachers' mental health in addressing the high emotional demands within special education. This is consistent with the study by Mohd Zaki et al. (2024) regarding burnout among special education teachers.

Industry-Academia Collaboration

Institutions in Melaka should frequently invite school administrators—such as Headmasters and Senior Assistants of Special Education—to serve as external evaluators for their curricula. This engagement ensures that the Institute of Teacher Education (ITE) curriculum remains consistently relevant to the actual requirements on the ground and effectively bridges the gap between theory and practice.

Conclusion

This study demonstrates that special education graduates produced by the Ministry of Education's Institute of Teacher Education (ITE WC) are on the right track in meeting the MTCF competency standards. Administrators reported high levels of satisfaction regarding the graduates' pedagogical competence, professional etiquette, and collaborative leadership. The integration of the KGSM Framework and the Kirkpatrick Model in this study facilitated a systematic and comprehensive evaluation of the training program's effectiveness.

The findings indicate that graduates have successfully addressed critical gaps in the behavior management of Students with Special Educational Needs (SEN) through the sustainability of innovative pedagogy and character building. Nevertheless, recommendations for improvement from administrators—specifically the enhancement of practicum training, emotional management workshops, and industry-academia collaboration—highlight the need for a 'final touch' in practical and technical skill sets.

Feedback from administrators serves as a vital asset in ensuring that the graduates produced are not merely degree holders, but effective agents of change for SEN. This study contributes to the literature on the competency assessment of special education teachers from the perspective of key stakeholders and provides practical guidance for the continuous improvement of teacher training programs.

Implications of the Study

Theoretical Implications

This study contributes to the literature by demonstrating the practical application of the MTCF within the context of special education and the utilization of Kirkpatrick's Model to evaluate the effectiveness of teacher training programs. The integration of these two frameworks provides a comprehensive model for assessing teacher competency, which can be adapted for future research.

Practical Implications Implications for ITC WC

The research findings provide empirical data regarding the strengths and weaknesses of the existing curriculum. ITC WC can utilize these findings to review training modules, particularly in enhancing practicum training and emotional management. The recommendations provided by administrators can serve as a foundation for the continuous improvement of training programs.

Implications for SSEN Management

With graduates who are competent in behavior management through innovative pedagogy, the learning environment becomes more conducive. This directly enhances the academic potential and life skills of SSEN. A holistic character development approach also contributes to the overall development of student outcomes.

Implications for School Administrators and the MoE

This study bridges the communication gap between training providers (IPG) and 'clients' (schools). The findings instill confidence in administrators regarding the credibility of ITC MC graduates and assist the MoE in identifying the specific in-service training needs required by new teachers.

Limitations of the Study and Recommendations for Future Research

This study has several limitations that should be taken into consideration:

- **Limited Sample Size:** The study only involved four administrators from three schools. Future research should include a larger sample size spanning diverse geographical zones.
- **Single Methodology:** This study relied solely on qualitative methods. It is recommended that future research employ a mixed-methods approach to measure various dimensions of competency both quantitatively and qualitatively.
- **Single Perspective:** The findings are based only on the perceptions of administrators. Future studies could incorporate the perspectives of the graduates themselves, parents of students with special needs (MBPK), and colleagues to obtain a more holistic overview.
- **Cross-sectional Design:** This study measured perceptions at a single point in time. A longitudinal study is suggested to observe the development of graduate competencies over an extended period.

Future research is also recommended to evaluate the actual impact of the proposed improvement programs and to expand this study to other TEI for a cross-institutional comparison of graduate competencies.

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THE DARK SIDE OF ARTIFICIAL INTELLIGENCE AND ITS IMPACT ON ACCOUNTING STUDENTS

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Abstract: *This study aims to review a particular obstacle and its consequences in the accounting students' experience, specifically related to using artificial intelligence (AI). As a secondary qualitative approach, this research investigates previous findings on skills displacement, ethical dilemmas and career insecurity. Studies show that AI affects the delivery of accounting education by emerging learning gaps which in turn enhances ethical issues; and results in increased career stress among the students. The study concluded with the recommendation of revamping accounting curricula, incorporating ethics for artificial intelligence, career and psychological support, and continued education to prepare students for an artificial intelligence-inclined future.*

Keywords: *Artificial Intelligence, Accounting Education, Skill Displacement, Ethical Challenges, Career Anxiety, AI Integration*

Introduction

Artificial Intelligence (AI) is gradually changing its status from an innovation-driving force to a revolutionizing factor in the course of most businesses and industries. The accounting profession is not immune to these changes either given the AI's advanced ability to perform all sorts of repetitive tasks such as data entry, tax computations, and even forensic auditing. AI has brought its "black sheep" can we expand and put more in it into the world, which presents considerable difficulties for accounting students entering the job market (Ivanov, 2023). These students are now expected to meet ever-increasing technological requirements which brings into question if the current education in accounting prepares them well enough for the AI Advances Future Profession. According to a report from CFO.com, 73% of accounting firms do not adopt AI technology, which is a major fear including incorrect results (58%) and data privacy (55%) (CFO, 2024). About 85 million jobs will be lost worldwide by 2025 due to automation; this has greatly increased the concern of students about their roles in the profession (Hossain, 2023). AI has penetrated the accounting profession at an alarming rate and raised several important questions that are pertinent to students, institutions, as well as the entire profession. The first was dealing with the imbalance that AI brings to the organization about the capability of delegates (Rawashdeh, 2023). Accounting programs have long been structured to cover concepts and actual manual computations and today's accounting profession calls for AI applications, big data analysis, and machine learning algorithms. It is important to note that many students do not have an opportunity to use these advanced technological tools during their studies and thus they do not meet the employer's expectations (Mansor *et al.* 2022). Some

of the universities teach only basic theories of AI which can be of no benefit to the students when they start their careers. This divergence is aggravated by ethical and data privacy issues as many AI systems involve dealing with financial data. It means that without proper preparation for these topics future accountants can fail to address the potential ethical controversies and security risks related to artificial intelligence uses. In addition, new technology has impacted employment focusing on automation and making accounting clerk routine work become a thing of the past. Those small jobs that in the past were seen as the first step in a young person's career are now under threat from automation from Artificial Intelligence, which has left students unsure of the jobs available when they graduate (Holmes & Douglass, 2022).need more reference as this is important.

In dealing with this research problem, this study seeks to fill the existing gap in the literature by providing a critical evaluation of the negative effects of AI implementation on students, especially in the field of accounting. Thus, this type of research study seeks to define specific issues in current accounting education and the challenges arising from AI integration by using published sources and secondary qualitative data. It aims to understand how students perceive the new skill requirements as different; whether they are willing to change their relationships with work as a result of these new skills; and whether they are worried about their employment security amid the impacts of AI. Besides, the investigation will also touch on some of the ethical dilemmas of AI things such as bias in algorithms and data privacy risks, in the process how these aspects will affect the training of future accountants. In the end, the study aims to come up with practical recommendations that can help education organisations transform the existing curriculum to meet the new challenges of the profession. As such, this research focuses on the "dark side" of AI in accounting to make a balanced contribution to the extant literature so that students are not only technically skilled but also knowledgeable about various ethical and professional issues emerging from AI-integrated accounting environments.Need reference for this

Literature Review

AI is now fast becoming the all-pervasive enabler in industries such as accounting, which presents liberating effects about work automation, improved productivity, and decision-making. However, the literature suggests that there are two stories regarding the implementation of AI in the accounting field. Despite the numerous possibilities for achieving the goals presented in this paper, there is a gradually increasing concern about the negative impacts of AI, focusing on accounting students who have to face the changing world of their profession. This review assesses the current state of literature on what AI entails for accounting education particularly as it pertains to skills, ethics, and career paths.Need reference, Is this from Journal?

AI and the Transformation of Accounting Education

Thus, the accounting education process was enriched with the usage of AI, and at the same time, it became Methodologically challenging. Though advocates consider AI more effective than human performance and minimizes mistakes, Al Najjar et al. (2024) opine that the current conventional accounting curriculum lacks input to address the technological aspects of AI. Lost

in most accounting programs is how to use the tools and incorporate a grounding in simple AI and even machine learning. Thus, the roles and responsibilities of students shift while career opportunities decrease in line with the automation of routine accounting functions. Concerning this, the critics claim that the educational system, at its best, is reactive, rather than proactive. A study by Abdullah & Almaqtari (2024) shows that out of the existing accounting programs from all over the world, only a quarter of them offer AI or data analytics as part of their basic courses, which means that most of the learners do not have an idea of the existing real-world demands. This lack of preparedness is especially disconcerting given a recent study by Almaiah *et al.* (2022) that argues that, while current uses of AI will automate repetitive tasks, the technology is in the process of transforming accountants into business strategists. Failure to make the changes students want can mean that they will be left behind in a career that is fast embracing information technology. The fresh graduates become so dependent on AI making them lack thinking skills.

The Skill Gap and the Need for Adaptation

The introduction of AI into accounting also has a blatant impact on the ability requirements of the job.??? Doing entries and other perfunctory??? bookwork that has been the traditional preserve of the professional accountant is slowly becoming irrelevant since AI performs them more methodically and accurately. A study by Hossain (2023) has it that future jobs involve data analytics, predictive analytics, and AI governance. Still, these skills are not often stressed in the classical accounting curriculum, which puts students in a weak position. Practical and hands on skills needs to be stressed during their course. Another group of writers states that this change in skills demands can allow learners to perform more valuable tasks. George (2024) appreciates the potential to limit AI work automation, making the accountant available for roles involving critical decision-making and consultation. That is why this perspective can be considered optimistic although it does not take into account how students can develop these skills. Education is the backbone of AI where individuals need to have resources, training, and updated curriculum, and these are qualities that are not well incorporated by most faculty institutions. Therefore, students are not ~~only not~~ ready to cover the technology aspects required in the field but also experience considerable stress regarding their future roles.

Ethical Challenges and AI Bias

AI ethics deepen its controversy and add to its adaptation in accounting. Unfortunately, even algorithms, which are very efficient in their functioning, are not protected from actual stimuli existing in the training data. According to Slimi & Carballido (2023), the consequences of using biased algorithms are that decisions are unfair, which is a worry for accountants who are expected to promote fairness. To students such ethical questions raise the bar of difficulty for their learning and make education much broader. Also, AI systems call for pertinent data and especially, financial information making data protection a big issue, as commented by Holmes (2023). Data privacy was a significant factor impacting organizations when adopting AI solutions in accounting, as revealed by Boulianne, Fortin & Lecompte (2023). All these issues are significant well-being of students, as people must learn how to work with the moral issues arising from the implementation of artificial intelligence technologies. Some academics and practitioners claim that the current flow of accounting education does not sufficiently address

these concerns as it ignores many concerns of AI and overrides its ineffectiveness for studying them all yet the technicalities of AI.

Career Uncertainty and Job Displacement

AI has also brought challenges in automating existing roles with the most risks for entry-level accountants being job replacement. They contend that automation is likely to subsume tasks traditionally requiring human interference, especially at the early stages of the career progression ladder where those involved in such Occupations as bookkeepers and tax preparers are hired. McCollough, Wallace & Luttrell (2022) commented that rated jobs for automatability, major portions of accounting tasks can be automatable, which only fuels students' stress over the future job market. AI defenders state that it generates the possibilities of new positions that will require such abilities as management and analysis. However, Hossain *et al.* (2024) argued that such positions require much experience and accumulation of expertise; something new accountants lack. For students, this creates a paradox, while AI provides an opportunity to enter a new level of work with higher added value, it simultaneously wipes out the initial rungs traditionally used to engage and learn, as presented by Hu (2022). These two effects of AI on jobs show that it is high time accounting education provided learners with a balanced view of AI's effects in the workplace.

Divergent Perspectives on AI Integration

Writing in the literature also contradicts how AI should be incorporated into accounting education. Kamalov *et al.* (2023) maintain that the skills needed by advocates include technical skills, as well as ethical and strategic skills. They recommend that ever-increasing education institutions must embrace and offer courses on artificial intelligence and its applications, data analysis and moral dilemmas. Tavares *et al.* (2023) explained the technical difficulties associated with the implementation of these reforms. As such they claimed that there are constraints to resources, faculty knowledge and organisational resistance as key factors which militate against the reform processes of accounting education. These problems are rather acute in developing nations, which do not have access to AI applications and training, according to Damerji & Salimi (2021). Therefore, students in these regions which regions are at a disadvantaged angle in the global employment market even more.

Addressing the Gaps in Research

Although the literature review underlines the importance of understanding the impact of AI on accounting students, there are still some research gaps. Relatively few of these investigations probe beyond the mechanical features of AI and consider the social and psychological consequences of the technology. Not much is known about how fear of job loss negatively impacts students' mental well-being and their careers. There are limited research works that focus on the future consequences of AI about diversity and the social equity of the accounting workforce, including educational opportunities as well as availability to employment. This research intends to fill these gaps by elucidating the negative effects of AI on accounting students. It attempts to offer a conceptual framework for how AI reconfigures learning and

work environments, highlighting issues of skill development, decision-making about what constitutes appropriate behaviours, and expectations from careers. Who said so need source

Theoretical Framework

Technological Determinism Theory is used in this research to assess the effects of artificial intelligence (AI) on accounting students. Usually associated with Thorstein Veblen and expanded by Marshall McLuhan, this theory emphasizes the pre-eminence of technology in shaping society and individuals, including their professional activity (Pateva, 2024). When it comes to accounting in particular, integrating AI changes education and positions from routine and repetitive tasks to specialized abilities such as analysis skills and machine learning. Thus, technological advancement comes with pull factors, including skill divide, ethical issues; and job insecurity, or students (Kolade & Owoseni, 2022). Since the concept of the framework implicitly discusses the impact of AI on students as they enter the profession and the ability of institutions to address such challenges, the framework enables a critical analysis of this impact. The research applies technological determinism to analyse how AI reconfigures the accounting education and professional landscape and lays a strong theoretical framework to reveal the negative side of AI on students.

Research Methodology

This study incorporated a secondary qualitative research method to investigate the negative aspects of artificial intelligence (AI) and its implications on accounting students. Secondary qualitative research means a collection of secondary data that can be used to analyse the topic of the research (Sharma, 2022). The samples used in this study include reviewed articles, journals, and reported data within a period of the last five years. The selection focused on sources which deal with the subject of AI in accounting education, ethical considerations, the need for certain abilities, and professional prospects. The data collected for this study was analysed using thematic analysis (Squires, 2023). This method enabled the researcher to categorize, differentiate and analyse patterns and themes as presented below. Thematic synthesis is most appropriate in the context of secondary qualitative research since it enhances the organization of findings derived from different materials. Some of the issues identified during the analysis include the lack of preparedness of accounting curricula in preparing learners for AI skills, the ethical question that arises from biased AI, and the concern that accountancy students have regarding the future job market. Explaining the method adopted in this study, meant that there was enough understanding of the topic, as well as noting the literature gap. Selecting secondary qualitative research design and thematic analysis applied to this study for the following reasons (Braun & Clarke, 2023). It provided the researcher with a wider range of views and information from reliable sources that helped enhance the study's richness. By limiting the study to works published within the last 5 years, the research covered the present issues and opportunities of AI development, making the results flexible to the growing rate of innovations in the accountancy field. Thematic analysis has been uniquely useful to support this study since it offered the strength of a well-defined structure while at the same time allowing the researcher to be very creative in analysing data and making conclusions related to how AI affects accounting students. This is suitable for the objective of this study as it seeks to give a critical analysis of the negative aspects of AI in accounting education.

Results

Skill Displacement and Educational Inequities

The application of artificial intelligence in accounting is revolutionizing the training of the accounting profession which causes a negative skill gap whereby accounting students appear more often ill-equipped to meet the emerging technologies and challenges in the accounting workplace. Damerji & Salimi (2021) explains that artificial intelligence creating mass automation of repetitive procedures, including data entry, has moved the requirement to more advanced skills in fields including data analysis, machine learning, and artificial intelligence-based financial systems. Anh *et al.* (2024) presented; that the technical competencies outlined in this paper are needed for accounting students to succeed in an AI environment. However, at the moment, most accounting programs and curricula still do not pay sufficient attention to current practices, emphasizing technical skills for future-demanding positions. Hasan (2021) sees much of the accounting programs, still using old approaches, and providing very limited exposure to Artificial Intelligence or data analytics. This gap compromises students' fairness within institutions, especially putting those in underprivileged institutions at a very low educational standing, as per Katsamakos, Pavlov & Saklad (2024). For instance, well-endowed school students can be able to use AI tools as well as enrol in programming classes, however, students from less privileged backgrounds are unable to access such training opportunities. This disparity leads to a growing career readiness divide, in which students from less prestigious universities are unable to secure AI-related jobs.

Ethical Challenges and Professional Accountability

AI, incorporated into the accounting profession has introduced numerous ethical issues with major impacts to the accounting students and future profession. As Emetaram & Uchime (2021) note, there remain worrying questions about biases built into AI implementation in the financial sector. Such biases if not addressed can lead to discrimination in areas such as credit scoring or auditing which adversely impact minority groups. Vasarhelyi *et al.* (2023) presented, that these problems concern the practical application of AI and the infosphere and bring questions concerning the fairness and responsibility of AI systems, which means that the accountants must influence the effectiveness of these instruments, as well as look at the ethical aspect. However, to the disappointment of many, several accounting programs cannot flesh out these ethical issues adequately and so leave the students face-to-face with these ethical concerns in their practice. Ivanov (2023) claimed, that due to poor training in artificial intelligence ethics, students continue to work at or behind high-level AI decision-making processes poorly equipped to assess the moral implications of such systems. This lack of training means that students can complete their education with very little preparation to address, let alone question, the effects of bias built into an algorithm, particularly in situations involving critical financial decisions, as highlighted by Mansor *et al.* (2022). The literature postulates that accounting students as the leaders in the guard of business ethics ought to be well armed with the knowledge and unique ethical acumen to address these issues. While the advocates of AI in accounting state that these tools increase productivity, reliability, and effectiveness of decision-making in accounting practices, on the same note, Rawashdeh (2023) asserted that these advantages are accompanied by ethical issues. These challenges if not addressed in accounting curricula can in future produce a generation of technically sound

accounting professionals, with ethical tunnel vision on the dangers of AI. With Artificial Intelligence continuously encroaching on the accounting profession, it only makes sense that ethical issues are incorporated into the teaching curriculum so that students are prepared to handle future developments.

Career Anxiety and Psychological Impacts

Accounts education has been enhanced by the incorporation of artificial intelligence (AI); however, this innovation has caused a high level of psychological internalization of threats among students to their employment opportunities in accounting due to increased job loss risks offered by this technology. With technologies such as bookkeeping, data entry and auditors all being offered by AI there is a question on where junior accounting positions are safe. According to Holmes & Douglass (2022), this automation has made the learners feel that AI is a competitor such that they feel insecure about their future employment. This seems prevalent more so in students who mostly have the notion of accounting as a relatively secure profession. The psychological effect of this fear is severe as most students feel stressed and doubt if they can succeed in the profession. Al Najjar *et al.* (2024) have similarly shown that schools and universities specifically are usually unprepared to offer the career guidance counselling or mental health services required to assist students in managing those fears. While AI is an increasingly relevant part of accounting, students are on their own regarding the emotional toll, even from their educational establishment. AI advocates claim that automation creates new roles for accountants, offering opportunities in consultancy or decision-making, but this is not true or tends to occur automatically, according to Abdullah & Almaqtari (2024). A significant number of students are still groping in the dark as far as the reorientation of these new career paths is concerned; the new paths certainly call for new skills, yet even more importantly, they require new ways of thinking. Opponents note that this gap between changing requirements for occupations and students' readiness escalates career stress. The students are unable to find how they can transition to other opportunities in an accounting profession augmented with AI technology and thus suffer from more severe psychological problems, as commented by Almaiah *et al.* (2022). Therefore, it is a crisis for educational institutions to engage with these psychological worries by providing support in career transition and students' ability to cope with new transformations powered by AI.

Discussion

Skill Displacement and Educational Inequities

However, several studies drawn from this research reveal that there exists a unique skill gap emerging from the integration of artificial intelligence in accounting education. As AI applications advance in enhancing routine accounting tasks, common and technical skills that accounting students must contend for include data analytics, machine learning and other AI applications in financial systems. Nevertheless, the contemporary accounting curricula that are still teaching traditional disciplines such as accounting records, and financial statements do not provide students with sufficient preparation for such novelties. Hossain (2023) supports this discovery, indicating that AI helps to automate accounting practices, however, translates new requirements for students. George (2024) insists that current curricula perpetuate educational disparities as learners in poorly equipped institutions can have limited access to current AI

technologies and training. This is particularly disadvantageous since the students, especially those learning in these environments, are in a weak position to develop the technical skill set characteristic of the emerging new world of accounting, as commented by Slimi & Carballido (2023). An unintended and potentially dangerous side effect of the use of AI as a driver of efficiency and productivity in education is that it can expand the gap between teaching professionals and enhance its impact as a career for the even longer term. In light of this gap, accounting programs will have to align with the developments in AI and include classes in data analytics, machine learning, and the mechanics of ethical AI utilisation in the accounting field.

Ethical Challenges and Professional Accountability

The insight provided in this study into ethical issues in the adoption of AI in accounting is also an important consideration. As mentioned earlier, AI systems used in auditing and other financial decision-making shall also mimic these biases since they are programmed in that manner, setting up conditions for stereotyping in aspects such as credit scoring or outcomes of auditing among others (Holmes, 2023). This study brings out the absence of effective teaching in AI ethics hence accounting students are so weak in detecting these challenges. Future professional accounting students must ensure that intelligent systems applied to accounting processes are utilised properly and do not distort professional accounting practices. However, if students are not given clear directions as to the ethical issues arising from the use of AI, the students are likely to have a pretty tough time when it comes to ethical decision-making if the AI they are using churns out biased results. The implications from Boulianne, Fortin & Lecompte (2023) are also relevant to this issue in terms of identifying the problem of promoting ethical responsibility in accounting students. The absence of AI ethics in accounting education makes the corresponding spheres' future professionals ready to face these matters, as per McCollough, Wallace & Luttrell (2022). Despite the overall successful examples in this column, it is also important to bear in mind the existence of algorithmic prejudices and possible future unscrupulous operations. To attend to this, accounting programmes ensure that the students are not only technically equipped with the tools and knowledge in AI but also, equipped with the values and principles on how to handle and implement AI technology.

Career Anxiety and Psychological Impacts

Another shocking observation that comes out of this study is the psychological trauma several accounting students are going through, mainly due to the loss of employment to AI. Students are given automated accounting solutions to complete their assignments, and most of them fear that AI will take their jobs in the future. Hossain *et al.* (2024) continue and claim that more and more entry-level accounting positions are taken over by AI and human students wonder whether they are needed at all. Such an indication of job insecurity negatively impacts students' well-being and self-assurance of their employment opportunities. The conclusions drawn from this study are consistent with Hu's (2022) observation that schools and universities remain woefully insufficient in addressing students' mental health problems or offering career guidance to enable them to deal effectively with those uncertainties. With the growth of AI, more traditional accounting positions are being replaced by computer programs so students can lack an understanding of a place in the field. Although opening doors in advisory and strategic opportunities, these jobs are not open to everyone directly after getting out of school. Graduates

have to have working experience to make sure they are ready to take on the roles. Few are equipped with the skills or experience required to move into these higher-level positions, thereby amplifying their job stress.

Addressing the Dark Side of AI in Accounting Education

Impacts of AI on accounting for students give rise to opportunities and threats, changes in education modalities, generation of skill gaps and domains of ethical dilemmas. In response to these challenges, members of accounting programs are forced to initiate efforts to incorporate content referring to AI and strongly focus on AI ethical issues to equip students with skills that would enable them to meet this evolving profession. However, eliminating social consequences such as career anxiety caused by AI needs interventions such as career direction counselling, and therapy. Accepting these changes, accounting programs will ensure students develop adequate technical skills to work with the tool, as well as faculties help the students handle the ethical and psychological ramifications of AI. No Literature

Conclusion & Recommendation

The study raises concerns about the effects of artificial intelligence (AI) on accounting students and the problems of skill substitution, an ethical dilemma coupled with career stress. AI in accounting education has exposed large deficiencies in accounting curricula, which prepare students for the challenges in the profession. The survey also reveals a lack of preparedness among students to address ethical issues of AI, for example, algorithmic bias, and a general increase in anxiety of students as a result of facing the risk of job automation. The fact that they point to different problems and issues that strain the need to transform accounting education at its very core. It is through such interventions, meant to review the curriculum and provide mental health services, that can go a long way in ensuring that future accountants, who will have to live and work in this kind of world, are well prepared. These gaps are bridged to make certain that accounting programs offer students the appropriate and adequate education that will help them succeed despite this concern of technological disruption.

Based on the findings of this study, several recommendations emerge to address the issues raised by AI's growing role in the accounting profession.

Revamping Accounting Curricula to Integrate AI Skills

One important implication is that accounting curricula should be updated to include AI topics. When it comes to the practical aspects of accounting, students face essential technical requirements or competencies resulting from AI automation of traditional accounting: data analysis, machine learning, and AI-based tools. Accounting programs should engage with technologists as a way of developing courses that would impact these skills (Tavares *et al.* 2023). Data analysis will prepare the students to understand AI financial systems. The use of practical training on AI tools will also enhance the preparedness of institutions and students for the real market with many professionals getting prepared for the tech market.

Ethical Training in AI Usage

Taking into consideration the increasing engagement of AI in accounting, there are ethical issues that should be dealt with. Accounting programs must integrate courses that present topics of AI ethics including, but, not limited to; algorithmic bias, data privacy, and automated decision-making. Education should also teach students when using AI systems and how to address any of the biases that are inherent in their results. Ethical questionnaires based on accounts of actual-life case issues involving AI in accounting can offer great learning opportunities (Damerji & Salimi, 2021). Accounting programs should see to it that when the technology of AI is being incorporated, they embrace ethics so that future professionals will be equipped to handle the moral issues arising out of the field.

Providing Career Counselling and Mental Health Support

The fear about the effects of AI on employment should be discussed. Universities must ensure they use high-quality mental health services and career advisories as a way of addressing student concerns regarding employment insecurity. Career counselors can inform students of new job opportunities that arise with AI, for example, as advisors (Anh *et al.* 2024). The development of mental health services will also help those students striving to adapt to the predominantly psychological demands of AI-focused employment. Additionally, working with industries helps students realize that AI is an assistant, not an opponent. By using the AI tools available in the accounting industry, students will learn how it can assist in the completion of specific tasks or responsibilities.

Promoting Lifelong Learning and Professional Development

AI still has its challenges and it requires learners and this implies that continuous learning is required for the accountants. Consumer education should be emphasized to encourage students to continue engaging with AI-related programs after completing their studies. Many of these opportunities can be cultivated through partnerships with technology firms and professional associations interested in offering certification courses and workshops related to AI (Vasarhelyi *et al.* 2023). This approach will assist accounting students in coping with the kind of market that is ever-dynamic and encourages innovation and creativity.

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TEMPERATURE AND TIME EFFECTS ON COPPER ELECTROPLATING PERFORMANCE ON CU-ZN ALLOYS: THICKNESS, CONDUCTIVITY AND CORROSION ANALYSIS

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Abstract: *In this work, the effects of bath temperature and plating duration on copper (Cu) electrodeposition onto brass (Cu-Zn) substrates from an acidic copper sulfate electrolyte were studied systematically in terms of buildup thickness as well as the electrical conductivity and corrosion resistance by means of depth profiling to identify quantitative processing-property relationships for optimization purposes in industrial settings. Copper electroplating at three temperature levels (25°C, 35°C, 45°C) and three plating times (2, 4, 6 minutes) was conducted using constant electrolyte composition (160 g/L CuSO₄·5H₂O, 70 g/L H₂SO₄) and applied current (1.5 A), allowing for systematic separation of temperature and time effects. Validation tests showed temperature greater than approximately 35°C were also associated with slightly higher susceptibility to corrosion, as indicated by an increase in the rate of corrosion penetration from salt spray exposure test (ASTM B117) after 72-hour period at temperatures between 25–35°C (4.157 mm/yr), versus 45°C (5.820 mm/yr). In addition, the longer 6-minute plating time led to excellent electrical conductivity with a resistivity of 4.082 mΩ/cm, indicating excellent electronic transport properties for electrical applications, while deposition efficiency decreased with extended plating times due to the onset of mass transport limitations in static bath conditions. The intermediate temperature of 35°C was identified as the optimal operating point, exhibiting suitable performance across various properties, obtaining considerable thickness while maintaining excellent corrosion resistance and conductivity at moderate energy consumption. The comprehensive dataset offers definitive process optimization recommendations, such as maximum productivity at 45°C, ideal corrosion resistance at 25–35°C, a 6-minute duration for optimal conductivity, and a combination of 35°C for 4 minutes for maximum versatility and general-purpose applications that provide balanced overall performance.*

Keywords: *Copper electroplating; brass substrate; temperature effect; plating time; electrical conductivity; corrosion resistance; salt spray test; process optimization*

Introduction

Copper electroplating on brass (Cu-Zn alloy) substrates is an extensively used technique in a variety of industries to create decorative hardware, connectors, and corrosion-resistant elements (Maciej et al., 2021). Despite its widespread popularity, systematic research continues to concentrate on the optimization of critical deposition parameters, such as bath temperature and deposition duration, for copper electroplating on brass substrates (Maciej et al., 2021; Siena et al., 2023). In numerous instances, the operators' insufficient control over the kinetics of these

processes is a result of a lack of knowledge or information regarding the effective parameters that result in optimal coating quality and performance in relation to the operational cost (Šolić et al., 2025). Consequently, there is a necessity to gain a more comprehensive understanding of these processes.

Having a copper-to-zinc ratio of 55-95% makes brass alloys particularly challenging to electroplate (Chakir et al., 2025). According to Mohanty et al. (2025), the electrochemical activity of zinc ($E^0 = -0.76$ V) and copper ($E^0 = +0.34$ V) can lead to the preferential dissolution of zinc in acidic electrolytes (Mohanty et al., 2025). This approach differs from the strategy for incorporating corrosion protection into coatings but may compromise adhesive interfacial bonding strength. Additionally, the exposure to the atmosphere results in the formation of a surface layer of zinc oxide that must be sufficiently removed to guarantee proper metallurgical bonding (Niverty et al., 2025). In addition, the crystallographic orientation and morphology of the electroplated layer will be affected by substrate composition as well as plating parameters like temperature and current density (Thompson & Mahtabi, 2025).

Temperature influences electrodeposition in multiple ways. This is facilitated on account of the Stokes-Einstein equation, whereby activation overpotentials and mass transport rates are accelerated (Gonçalves et al., 2021). Higher temperatures produce an increased Arrhenius-type behavior and exchange current density that dominates activation overpotential (Parida et al., 2023). Ghelichkhah et al. (2024) show that this lowering of current efficiencies could help to enable hydrogen evolution under extreme conditions. Liu et al. (2023) revealed that copper electroplating temperatures varies based on the substrate material, usually ranged from 20 to 60°C. Similarly, the deposition time is a critical factor in determining the final coating thicknesses and morphologies. Longer deposition periods result in thicker deposits, which may not enhance desirable characteristics, such as optimal grain structures or minimal internal tension (Su et al., 2025).

As a result of the kinetic mechanisms that govern temporal dimensions, such as the diffusion layer formation, nucleation kinetics, and surface morphology evolution, the coating properties are affected by the time of plating in an analogous way (Li et al., 2024). The surface chemistry of zinc may complicate the initial deposition on brass substrates, which are generally limited by nucleation (Xia et al., 2025). As the Nernst diffusion layer gets thicker during prolonged plating, the deposition rate will drop according to Fick's laws of diffusion (Cvetković et al., 2024; Xia et al., 2025). This is because to problems with mass transport, like concentration polarization. Additionally, prolonged plating durations can lead to the development of dendrites or coarser deposits, especially at elevated current densities when growth is limited by charge transfer kinetics and diffusion (Cvetković et al., 2024).

Even though there is a lot of information on copper electroplating in the literature, researchers have not done any systematic research to look at how temperature and time interact with brass (Zhang et al., 2025). Moreover, to ascertain optimal processing intervals, it is essential to concurrently assess the cumulative effects of temperature and time on deposition efficiency and adhesion quality, even though most studies focus on pure copper or stainless-steel substrates (Zhang et al., 2025).

This study investigates the copper electrodeposition from an acidic sulfate electrolyte (160 g/L CuSO_4 , 70 g/L H_2SO_4) onto brass at three distinct temperatures (25°C, 35°C, and 45°C) and three plating durations (2, 4, and 6 minutes). This study seeks to elucidate the intricate interplay of the physicochemical characteristics of copper coatings applied to brass, temperature, and plating duration. This research will be pivotal in the designing of ideal electroplating processing lines for industrial applications. This systematic approach provides empirical data as well as mechanistic insights into the optimal processing conditions for applications in industry, filling a gap in our current knowledge.

Materials and Methods

Substrate Preparation and Pre-Cleaning Process

The substrates were trimmed to 9.0 cm x 3.5 cm x 0.1 cm (height x width x thickness). Before the plating process began, the whole substrate went through pre-cleaning process to get rid of the oxide and make the copper alloy surface ready to be plated. This approach involves immersing the parts in de-oiling solution with 25 g/L each of NC-2cleaner (I) and NC-2cleaner (II), and the parts were subsequently rinsed with distilled water. The parts are then immersed in an activator solution consisting of $15 \pm 5\%$ H_2SO_4 and 160 ± 50 g/L Methanesulfonic Acid (MSA) and then again rinsed with distilled water to ensure the removal of residual chemicals prior to further processing.

Bath Composition

Electroplating of copper was performed on brass (Cu-Zn alloy) substrates in acidic sulfate electrolyte (160 g/L $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, 70 g/L H_2SO_4). Brass substrates were standardized in terms of surface preparation prior to plating, which included alkaline degreasing (60-70°C, 5-10 minutes), water rinsing, and acidic pickling (10% H_2SO_4 , 30 to 60 s), followed by a final deionized water rinse and immediate transfer into the plating bath.

Electroplating Procedure

Electroplating was performed using DC current in controlled-temperature bath (0.0015-0.0021 A/cm²). During plating (2, 4 or 6 minutes), the bath temperature was maintained at target values 35°C while during varies plating temperature (25°C, 35°C or 45°C) time was constant at 2 minutes with maintain the composition of sulfate solution 160 g/L $\text{CuSO}_4 \cdot 70$ g/L H_2SO_4 . The setup comprised pre-treated brass cathodes (sample) and pure copper anodes deposited at a fixed distance from each other as shown in Figure 1. After drying, the samples were immediately rinsed with deionized water and air-dried.

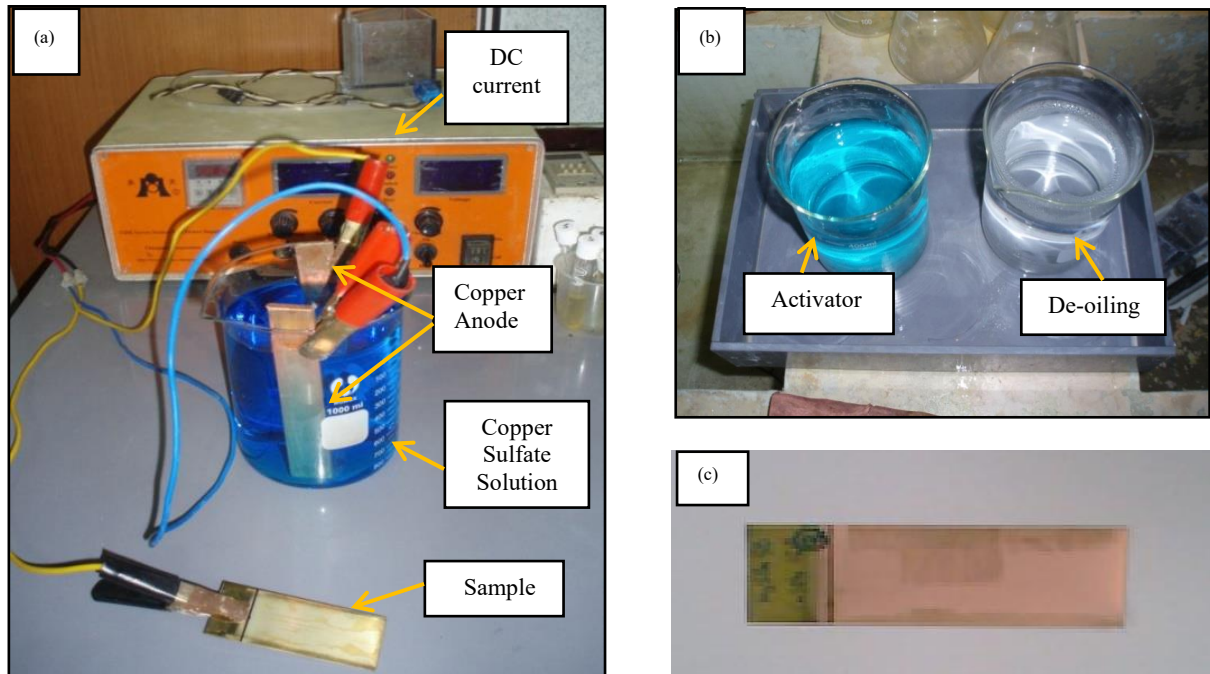


Figure 1: (a) Setup equipment for copper electroplating (b) Pre-Treatment Composition
(c) Sample after electroplating process

Characterization Methods

The coating thickness was measured using cross-sectional imaging with an optical microscope equipped with image analysis software. EDS spectroscopy was used to validate the elemental composition and to confirm the copper was pure and find any other elements that were deposited at the same time. Electrical conductivity measurements for both copper coatings were recorded using a digital multimeter (Fluke) to measure the voltage and current supplied.

Corrosion Resistance Evaluation Through Salt Spray Testing

The corrosion resistance of the electrodeposited copper coatings was assessed in accordance with ASTM B117, wherein samples were subjected to a 5% sodium chloride fog at a temperature of 35°C (Elshahawi et al., 2022). A 72-hour salt spray exposure test, which is the standard length of exposure time just enough for corrosion mechanisms to initiate and evolve but still practical for routine quality control or process optimization, was performed on samples. This fast access test emulates severe marine or industrial environments (Chen et al., 2025). Weight loss measurement, calculation of corrosive penetration rate, and change of coating thickness are three methods for determining corrosion.

Weight loss measurement

The weight loss method quantifies material degradation by measuring mass before and after exposure to evaluate corrosion resistance through saline spray testing (Dariansyah & Arifin, 2023).

$$\Delta \text{Weight Loss} = W_{\text{before}} - W_{\text{after}} \quad (1)$$

where:

- W_{before} = Initial weight before salt spray exposure
- W_{after} = Final weight after exposure and corrosion product removal

Corrosion penetration rate

The corrosion penetration rate was determined using the following standardized equation (Zhang et al., 2024):

$$\text{CPR} = (K \times W) / (\rho \times A \times t) \quad (2)$$

where:

- CPR = corrosion penetration rate (mm/yr)
- K = constant for unit conversion (87.6 when using SI units to obtain CPR in mm/yr)
- W = weight loss after exposure time (grams)
- ρ = density of copper (8.96 g/cm³)
- A = exposed sample surface area (cm²)
- t = exposure time (72 hours)

This formula converts the measured weight loss into an equivalent depth of uniform corrosion (mm/yr), accounting for material density, sample geometry, and exposure duration.

Results and Discussion

Effect of Temperature on Coating Thickness

Figure 2 displays quantitative thickness measurements and cross-sectional microscopy of copper electroplated Cu-Zn alloys at varying temperatures (25, 35, and 45 °C). The immersion solution needs to have a current of 1.5 A, a plating period of 2 minutes, H₂SO₄ concentration of 70 g/L, and CuSO₄ concentration of 160 g/L. There are two separate parts that show the results. The top row includes optical microscopy images and EDS elemental analysis charts, while the bottom row displays bar charts that illustrate the measured values for each copper layer thickness across specimens, which were sampled at three marker locations from the top to the bottom. The EDS spot analysis data confirm elemental profiles for both coating and substrate regions, with abundant copper in the deposit and heightened levels of zinc are found to be localized within the Cu-Zn substrate area, as would be expected from a copper plating brass alloy system.

The uniformity of the deposition process is compromised as the bath temperature increases. At 25°C, the thickness values of the specimens varied from approximately 3.6 to 4.5 μm , suggesting a moderate degree of spatial uniformity across all observed surface areas. The thickness varies the most at 35 °C, where there is a transition from 2.3 μm (point 2) to 3.5 μm (1st and 3rd point). This variation indicates non-uniform deposition, suggesting the influence of ion transport properties specific to this intermediate temperature region and localized changes in current density distribution. On the other hand, higher average thickness values were displayed by sample prepared at 45°C, on account of a small variety of less than 4.44 μm - 4.57 μm . This indicates better homogenous deposition of copper over the surface of specimen with higher immersion temperatures.

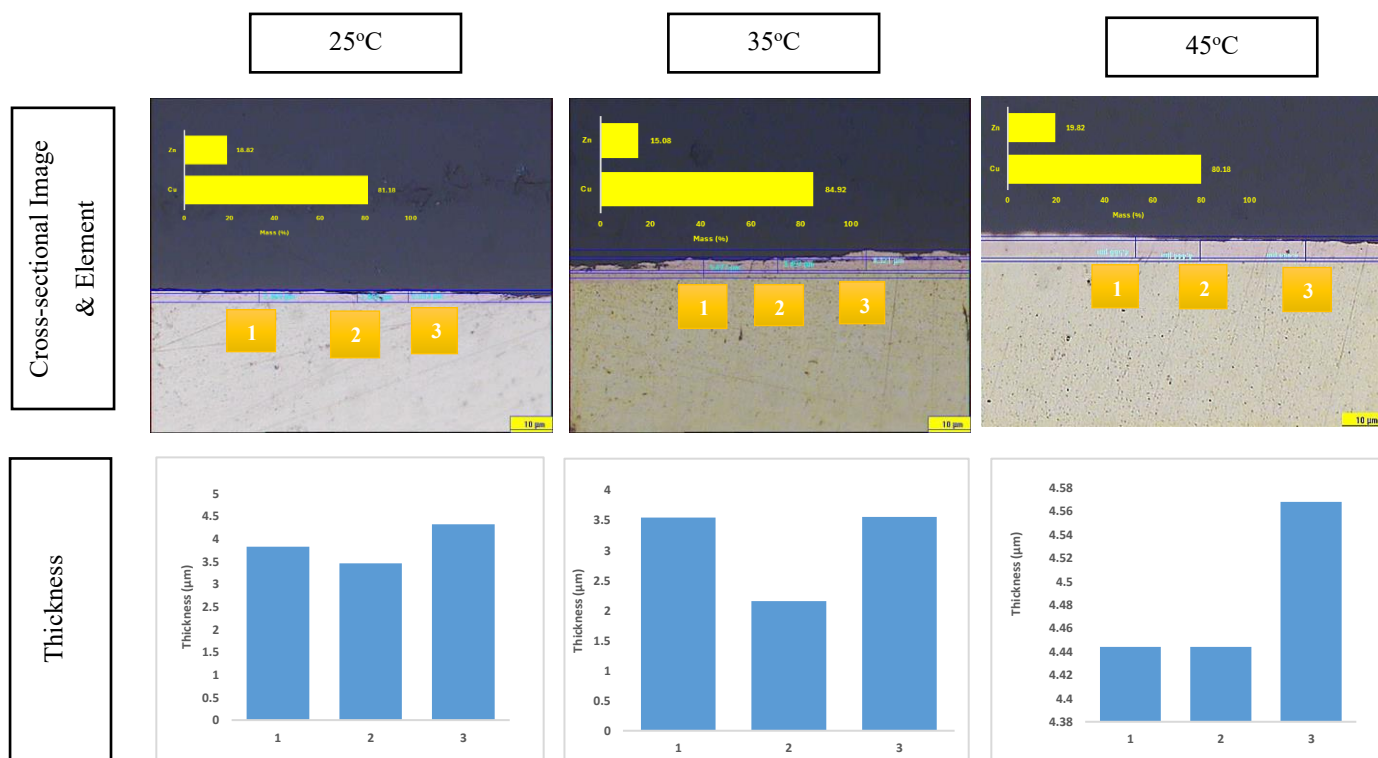


Figure 2: Cross sectional with element and thickness for temperature varies

The elemental composition analysis reveals distinct variations in copper and zinc distribution across the three temperature conditions studied. At 25°C, the coating exhibits a copper content of 81.18% with corresponding zinc at 18.82%, indicating substantial zinc incorporation from the brass substrate or electrolyte during the lower-temperature deposition process. Increasing the bath temperature to 35°C produces the highest copper purity at 84.92% and lowest zinc content of 15.08%, suggesting optimal conditions for selective copper deposition with minimal substrate dissolution or zinc co-deposition. At the maximum temperature of 45°C, copper content decreases slightly to 80.18% with correspondingly higher zinc levels, potentially reflecting enhanced thermal activation that promotes minor dezincification of the brass substrate or increased zinc ion mobility in the electrolyte. These compositional variations, while relatively modest across the temperature range studied, indicate that the intermediate temperature of 35°C provides the purest copper deposits with maximum selectivity, which

correlates with superior electrical conductivity and optimal electrochemical efficiency observed at this condition.

Bath temperature, a very vital factor affecting the ability of copper electrodes to stick onto substrate Cu-Zn alloy. Figure 2 demonstrates this by displaying how the thickness varies with temperature. This intermediate temperature is transitional; at 35°C, the deposited copper exhibits non-uniformity as performance tends to be interrupted by competing electrochemical processes that prevent uniform nucleation and growth of the metal. And, because copper ions can move about more easily at elevated temperatures, deposition at 45°C was even more uniform than previously. This alleviates certain concentration polarization conditions on the electrode surface and accelerates electrocrystallization, resulting in a more homogeneous deposition (Su et al., 2025).

Effect of Plating Time on Coating Thickness

As demonstrated in Figure 3, copper electrodeposition is also effective when deposited on a Cu-Zn alloy substrate over plating times of 2, 4 and 6 minutes at $I = 1.5 \text{ A}$, $T = 35^\circ\text{C}$, $\text{H}_2\text{SO}_4 = 70 \text{ g/L}$ and $\text{CuSO}_4 = 160 \text{ g/L}$ despite gradual expansion of the copper coating with increasing deposition time as seen from the cross-section micrographs. A thin and relatively uniform Cu liner is observed at 2 minutes. The coating is substantially thicker and more compact at 4 minutes, and the maximum thickness of the layer can be observed with complete surface coverage of the substrate at 6 minutes. This observation suggests that the kinetics of electrochemical deposition are consistent with the fact that coating accumulation is directly regulated by deposition time at a constant current density (Lee et al., 2022).

This time-dependent evolution of the coating is also corroborated by elemental analysis (EDS). At 2 minutes, the coating contains approximately 82 wt% Cu and 18 wt% Zn, indicating that a portion of the established Cu-Zn substrate is involved. At 4 minutes, the copper content rises to 91 wt% Cu, with a reduced contribution from Zn (9 wt%), indicating that the coating's purity and surface coverage have been improved. Nevertheless, the copper content decreases slightly to 85 wt%, while the zinc content rises to 15 wt% after 6 minutes. This variation may be the consequence of diffusion effects, localized microstructural heterogeneity, or measurement interaction with the substrate (Mohanty et al., 2025).

Three distinct locations illustrate a marked increase in coating thickness with time. The thickness for the 2-minute sample varies from range of 2.2 to 3.5 μm , at the 4-minute mark, it increases significantly to a range of 6.7 to 7.8 μm and continues with maximum coating thickness (8.2–8.5 μm) reached at the end of electrolysis. The linear correlation between time and thickness comes in accordance with Faraday's law as this relationship depicts deposition mass (or thickness) versus current flow during electrolysis. The key factor in this relationship is the constant current supply period for electrolysis (Behagh & Tehrani, 2023).

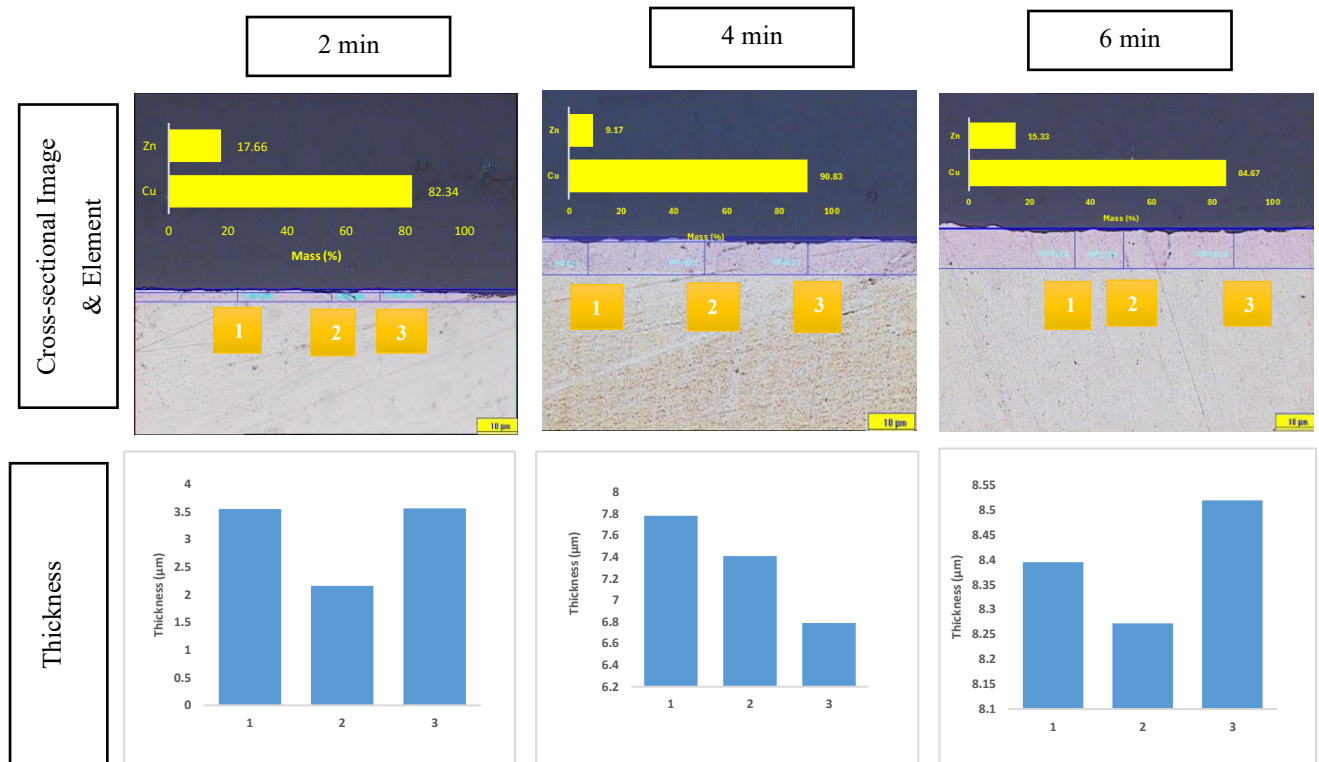


Figure 3: Cross sectional with element and thickness for time varies

Therefore, the results suggest that the plating duration is a critical parameter that affects the compositional purity, coating thickness, and application performance. The 4-minute deposition produces the highest purity of copper and the most uniform thickness distribution, while the 6-minute deposition produces the densest copper layer. As a result, the 4-minute deposition appears to offer a more balanced electroplating condition in terms of coating integrity, conductivity potential, and thickness than other conditions.

Electrical Conductivity of Copper Coatings

Table 1 shows the results of the conductivity test for the copper electroplated Cu-Zn alloy sample in two different sets of experimental settings. The buffer temperatures (25°C, 35°C, and 45°C) and the plating periods (2, 4, and 6 minutes) are some of these circumstances. To get a full picture of how well the electroplated specimens worked electrically, we measured voltage (V), current (I), resistance (Ω), and resistivity ($\text{m}\Omega/\text{cm}$). The current used in the tests stayed at 0.022 A the whole time. So, any changes in voltage, resistance, or resistivity that happened are to blame for the quality and properties of the copper layer that was deposited, not changes in the applied current.

Table 1: Conductivity test result for temperature and time varies

Condition	Temperature Varies			Time Varies		
	25 °C	35 °C	45 °C	2 min	4 min	6 min
V(mV)	2.2	2.1	2.1	2.1	2.1	2.3
I (Amp)	0.022	0.022	0.022	0.022	0.022	0.022
Ω (ohm)	0.1	0.095	0.095	0.095	0.095	0.1
Resistivity (mΩ/cm)	4.082	3.878	3.878	3.878	3.878	4.082

The optimum resistivity of sample was observed as 4.082 mΩ/cm with a resistance of 0.1 Ω and maximum voltage value of 2.2 mV at 25 °C which is acceptable for all studied temperatures. The data shows a clear increase in electrical conductivity as the immersion temperature increases from 25 °C to 35 °C and from 35°C to 45°C, with resistance and voltage decreasing when the temperature of water is increased further to 35 °C and then up to second stage (up to 45 °C), for which it was drop down at the values of resistance (0.095Ω)and voltage Vector (2.1 mV). It also resulted in a decrease of the resistivity by 3.878 mΩ/cm. The thickness and morphology results correlate well with the improved electrical performance, since a more uniform and dense copper deposits itself at higher temperatures. This reduces the overall resistance of the deposited layer in that it decreases the length each electron has to travel (Bragaglia et al., 2024).

The length of time the copper-plated specimens are coated also affects their electrical characteristics, which shows an interesting trend. The specimens that were plated for 2 minutes and 4 minutes had the same electrical properties such as a resistivity of 3.878 mΩ/cm, a resistance of 0.095 Ω, and a voltage of 2.1 mV. This means that the deposition of conductive copper was strong within two minutes of plating each unit with metal. Still, a resistivity of 4.082 mΩ/cm and a small voltage rise to 2.3 mV were reached within 6 minutes of plating, and the resistance rose to 0.1 Ω. The higher resistivity seen over longer plating times may be due to thicker deposits building up, which are linked to non-ideal microstructures or flaws, like grain development and internal tensions. These flaws can make conductance higher and make it harder for electrons to move through plated layers (Peng et al., 2022). These findings indicate that there is an optimal time to plate. The electrical characteristics of the copper deposit are not improved by subsequent deposition, and they may even be marginally degraded.

Weight Loss Analysis

The weight loss of the copper electroplated Cu-Zn alloy specimens was measured to determine their corrosion behavior, as illustrated in Figure 4. Using weight loss data is a good way to figure out how resistant something is to corrosion (Ikpeseni et al., 2023). This is because lower values mean that an electroplated layer is better at protecting against corrosive attacks from H₂SO₄ and CuSO₄ electrolyte solutions.

Each specimen weighed approximately 0.0015 g, and the weight loss values of the plated specimens were very similar at 25°C and 35°C. This implies that the copper deposits are formed at these two temperatures exhibit comparable corrosion resistance properties (Figure 4a). At

45 °C, there was a weight loss of only ~0.0021 g, which is a huge discrepancy between the weight losses. In other words, although at this temperature the homogeneity and thickness improved during sintering, the corrosion resistance decreased. This bizarre statistic is likely due to the residual stress inside or alteration in the microstructure of the copper deposit at its high temperature. This is responsible for local cracks or defects rapidly appearing, allowing corrosive media to penetrate the mounds and reach the underlying Cu-Zn substrate (Benzarti et al., 2024).

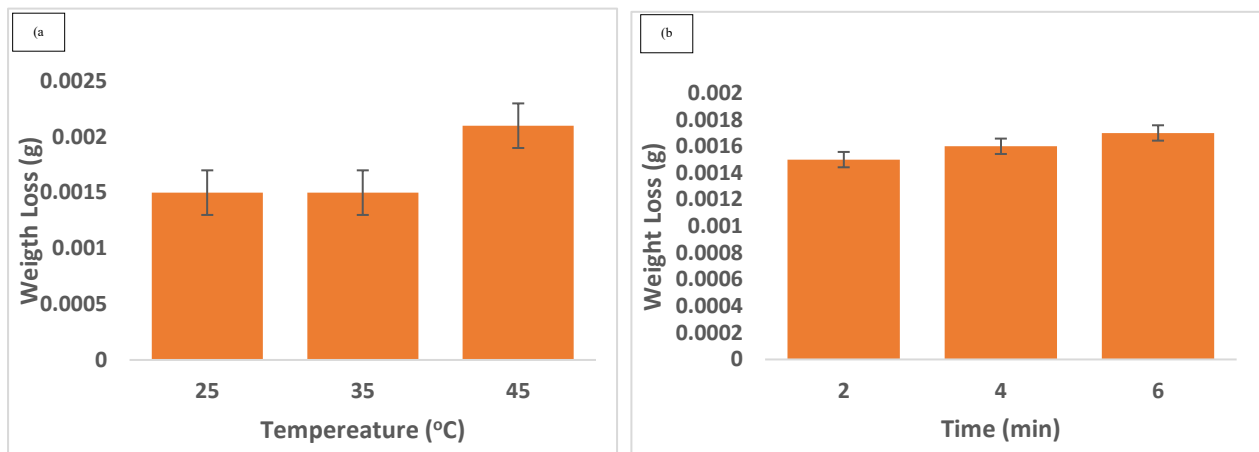


Figure 4: (a) Graph weight for temperature varies and (b) Graph weight loss for time varies

Figure 4(b) shows that there is a link between weight loss and plating time. This means that the corrosion weight loss is slowly going up and matches a longer deposition time. At the 2-minute post-plating timepoint, this was approximately 0.00155 g. At 4 minutes, there were moderate gains, which increased to 0.00163 g. At 6 minutes, the trajectory remained consistent, ultimately reaching approximately 0.00168 g. The consistent increase in the values of the three-time conditions, despite the minor variations, indicates that extended plating periods may not always improve corrosion protection; rather, they may cause a subtle deterioration in the barrier property of copper. This effect is also corroborated by the conductivity results, as the 6-minute sample exhibited a lower conductivity than its antecedents. This means that copper-electroplated Cu-Zn alloy parts would have a balanced resistance to corrosion and electrical response within 2 to 4 minutes after plating.

Corrosion Penetration Rate Analysis

The Corrosion Penetration Rate (CPR) of copper electroplated Cu-Zn alloy specimens is depicted in Figure 5 in response to two experimental variables: buffer temperature (25°C, 35°C, and 45°C) and plating time (e.g., 2 minutes, 4 minutes, and 6 minutes). The Corrosion Penetration Rate (CPR) is a unit of 10^{-6} that makes it possible to estimate the speed at which corrosive attacks go through materials. Higher values are directly linked to a drop in the protective performance of electroplated layers and more aggressive penetration. The combination of CPR and weight loss could give us a better and more quantitative understanding of how electroplated samples corrode under different processing conditions. This would show

that they are a better way to make stable structures than copper plating on the Cu-Zn component.

The weight loss results presented in Figure 4 are in excellent accord with these results, which exhibit very similar trends, as illustrated in Figure 5(a). In particular, the CPR decreases as the electroplating immersion temperatures rise. The correlation coefficients (R^2) at both 25°C and 35°C show that copper deposits developed throughout the range are similarly resistant to corrosive penetration. The results stay rather steady around 4.2×10^{-6} mm/yr. At 45°C, the CPR goes up by 38%, to about 5.8×10^{-6} mm/yr. This is way too much compared to the lower temperature conditions. Thus, the increase of penetration rate at 45°C suggests that a higher bath temperature can aid in thicker and more homogeneously copper deposits, but at the same time it can bring microstructural modifications to the deposit such as larger grains or pores and residual stress that could negatively affect the quality of metallic protective layer. Such rapid corrosive penetration of the underlying Cu-Zn alloy from heating (Hu et al., 2024).

The graph in Figure 5(b) supports the conclusions drawn from the weight loss study by showing a clear, steady rise in CPR as the plating time goes up. CPR was detected at an approximate value of 4.15×10^{-6} mm/yr after 2 minutes of plating. This value steadily increases to approximately 4.42×10^{-6} mm/yr and reaches a value of approximately 4.70×10^{-6} mm/yr after the plating duration is extended to 6 minutes.

In contrast to temperature, where the impact was significantly more rapid and was clearly observed at 45°C, the time-dependent progression of increased CPR is linear. This further implies that the cathodic barrier properties of the copper layer degrade gradually as the plating duration increases, as evidenced by this study. This may also be attributed to the accumulation of internal stresses and the development of a columnar or coarsened structure in thicker deposits, which generates preferential pathways for corrosive species to permeate the layer (Slager et al., 2025). The CPR data collectively demonstrates that the corrosion barrier performance of Cu-Zn alloys is inferior when plated at high temperatures or for an extended period. Conversely, the protective functionality is enhanced when the plating is conducted at moderate temperatures and for a lesser duration.

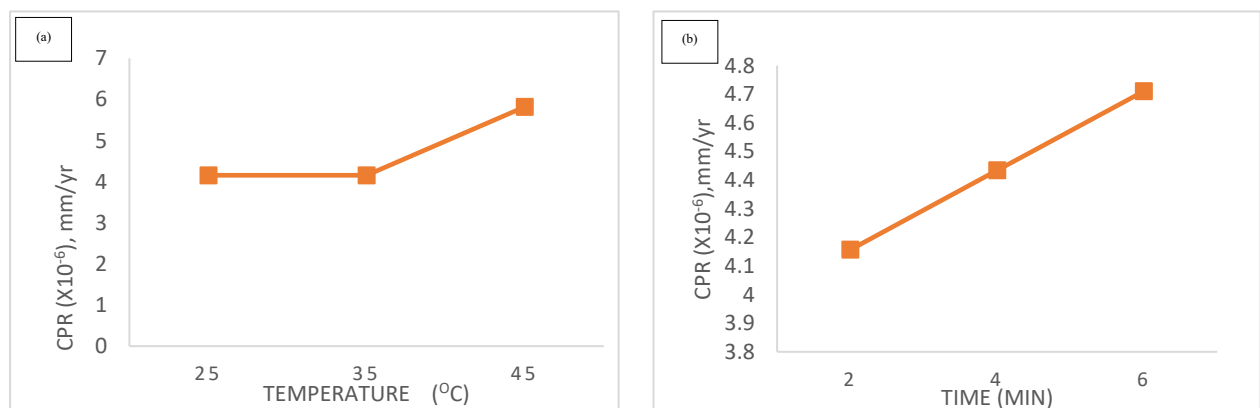


Figure 5: (a) Corrosion Penetration Rate (CPR) for temperature varies (b) Corrosion Penetration Rate (CPR) for time varies

Coating Thickness Reduction After Corrosion

When the copper electroplated Cu-Zn alloy is exposed to accelerated corrosive conditions, the primary goal of Figure 6 is to demonstrate the degree of degradation that it undergoes. To accomplish this, cross-sectional microscopy images are presented from specimens that were subjected to varying conditions, while maintaining constant $I = 1.5 \text{ A}$, $T = 35 \text{ }^{\circ}\text{C}$, $\text{H}_2\text{SO}_4 = 70 \text{ g/L}$, and $\text{CuSO}_4 = 160 \text{ g/L}$. The corresponding thickness measurements are obtained after the salt spray corrosion test. The plating time of the specimens was 4 minutes. The accelerated corrosion evaluation method known as the salt spray test is widely accepted (Kumar, 2022). Specimens are placed in a saline environment that is very corrosive and is controlled by temperature and humidity (Chen et al., 2025; Kumar, 2022). This test replicates a long-term corrosive attack to see how well the electroplated layer protects a wide range of materials.

Figure 3 shows that the average value before the salt spray test is about $7.3 \text{ }\mu\text{m}$. The cross-sectional microscopy and the bar chart photos show that the copper coating become a lot thinner after the salt spray test. After the test, the thickness values at points 1, 2, and 3 were $4.1 \text{ }\mu\text{m}$, $3.6 \text{ }\mu\text{m}$, and $3.0 \text{ }\mu\text{m}$, respectively. This means that the bad conditions that were seen throughout operation caused the original coating thickness to drop to an average of about $3.24 \text{ }\mu\text{m}$. The cross-sectional examination demonstrates that the coating interface was less distinct and more irregular compared to the pretest, suggesting that localized corrosive attack and simultaneous dissolution of copper transpired during saline spray exposure. Surface degradation was evident in these observations in Figure 6. The results thus indicate that the copper electroplated coating can indeed offer a significant degree of corrosion protection to a Cu-Zn substrate. Long-term exposure to very salty settings can cause a lot of material loss (Seghier et al., 2023). To get the best density, homogeneity, and thickness, the electroplating parameters must be tuned. This will make the product last longer (Sequeira, 2024; Su et al., 2025).

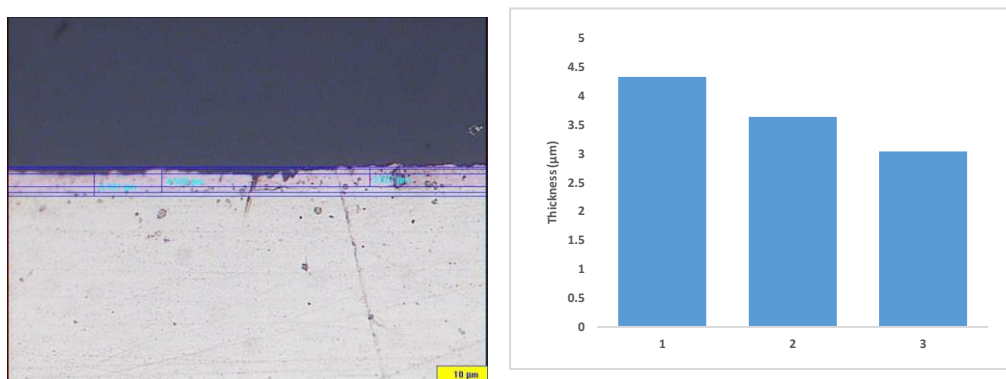


Figure 6: Thickness after salt Spray Test for 4 minutes time varies with $I = 1.5 \text{ A}$, $T = 35 \text{ }^{\circ}\text{C}$, $\text{H}_2\text{SO}_4 = 70 \text{ g/L}$, and $\text{CuSO}_4 = 160 \text{ g/L}$

Conclusion

This study employed an acidic copper sulfate electrolyte to conduct a systematic investigation of copper electroplating on brass substrates over a range of temperatures (25–45°C) and plating durations (2–6 minutes). The results indicated that 45°C was the most effective temperature for maximizing coating thickness and productivity, while 35°C achieved an optimal balance of thickness, conductivity, and corrosion resistance. Superior electrical conductivity of 4.082 mΩ·cm was attained through extended plating for 6 minutes; however, the returns were diminishing as a result of mass transport constraints. Across all conditions, salt spray testing confirmed satisfactory corrosion resistance, with a CPR of 4.157–5.820 mm/yr. The results indicate that 35°C with a 4-minute plating time is the most suitable general-purpose condition. However, the parameters can be modified to accommodate application-specific priorities, such as productivity, conductivity, or corrosion protection.

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THE IMPACT OF DIGITAL TOOLS ON STUDENT ENGAGEMENT IN HIGHER EDUCATION INSTITUTIONS

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Abstract: *Student engagement is a critical determinant of academic success in higher education, influencing persistence, achievement, and overall learning quality. However, sustaining meaningful engagement within increasingly technology-driven environments remains a significant challenge for higher education institutions. Although digital tools such as learning management systems, collaborative platforms, and interactive applications are widely embedded in instructional practices, much of the existing research relies on descriptive or correlational evidence. Limited empirical studies have examined the predictive influence of digital tool use on the multidimensional nature of student engagement. This study investigates whether digital tool use predicts behavioral, emotional, and cognitive engagement among students in higher education institutions. A quantitative cross-sectional survey was conducted with 404 students from a Malaysian public higher education institution. Data were analyzed using descriptive statistics, Pearson correlation, and multiple regression analysis to test the proposed relationships. The findings reveal that digital tool use significantly and positively predicts all three dimensions of student engagement. The strongest predictive effect was observed for emotional engagement, followed by cognitive and behavioral engagement. These results indicate that digital tools not only enhance participation and learning strategies but also strengthen students' motivation and sense of connection within academic environments. By providing predictive evidence rather than solely descriptive insights, this study advances the educational technology literature and highlights the importance of strategically integrating digital tools to foster multidimensional engagement in higher education.*

Keywords: *Digital Tools; Higher Education; Predictive Analysis; Student Engagement; Technology-Enhanced Learning*

Introduction

Student engagement remains a central concern in higher education, as it is closely associated with academic achievement, persistence, and overall learning quality. Engaged students are

more likely to participate actively in learning activities, sustain motivation, and demonstrate deeper understanding of course content (Redmond et al., 2020; Lei et al., 2021). Beyond academic performance, engagement is also linked to students' sense of belonging and satisfaction with their educational experiences. Despite its recognized importance, maintaining consistent and meaningful engagement continues to challenge higher education institutions, particularly within increasingly complex and technology-driven learning environments. The rapid expansion of digital tools, including learning management systems, collaborative platforms, and interactive applications, has transformed instructional practices across higher education. These technologies offer new opportunities for interaction, flexibility, and personalized learning experiences (Bond et al., 2020; Pagutayao & Paglinawan, 2024). Digital environments allow students to access resources beyond physical classrooms, collaborate in real time, and receive immediate feedback, potentially enhancing both participation and deeper learning. While prior studies have reported positive perceptions and frequent usage of digital tools (Martín-Gutiérrez & Fernández, 2021; Uzorka & Odebiyi, 2025), much of the existing research remains descriptive in nature. Limited empirical evidence has examined the predictive influence of digital tool use on the multidimensional aspects of student engagement.

This gap is particularly relevant in the post-pandemic context, where higher education institutions have invested heavily in digital infrastructures and hybrid learning models. Although technology adoption has accelerated, questions remain regarding whether increased digital tool use translates into stronger behavioral, emotional, and cognitive engagement among students. Furthermore, the effectiveness of digital tools may vary depending on how they are integrated into pedagogical practices and how students interact with them. Thus, empirical investigation is necessary to determine the extent to which technology use meaningfully contributes to engagement outcomes. To address this gap, the present study employs multiple regression analysis to examine whether digital tool use predicts student engagement in higher education institutions. Specifically, it investigates the predictive relationships between digital tool usage and three dimensions of engagement: behavioral, emotional, and cognitive. By moving beyond descriptive trends to predictive analysis, this study contributes to the literature on technology-driven learning and provides evidence-based insights to inform the strategic integration of digital tools in higher education.

Literature Review

This section reviews the literature on student engagement and the integration of digital tools in higher education. It outlines the conceptual foundations of student engagement and examines how digital technologies have been used to enhance participation, motivation, and deeper learning. Existing empirical findings are synthesized to highlight current understandings and remaining gaps, particularly regarding the predictive influence of digital tool use on multidimensional engagement. This review provides the theoretical and empirical basis for the development of the study's hypotheses.

Conceptualizing Student Engagement

Student engagement is broadly understood as the degree of attention, interest, effort, and psychological investment students direct toward their learning (Fredricks et al., 2004; Kahu &

Nelson, 2018). It is widely conceptualized as a dynamic process shaped by interactions between students, instructional practices, and the learning environment (Redmond et al., 2020; Lei et al., 2021). High levels of engagement are consistently associated with stronger academic performance, persistence, and satisfaction, making it a key indicator of educational quality. Among the most influential frameworks is the multidimensional model proposed by Fredricks et al. (2004), which conceptualizes engagement across three interrelated domains: behavioral, emotional, and cognitive engagement. Behavioral engagement refers to students' active participation in academic activities, such as attending classes and completing assignments. Emotional engagement captures affective responses to learning, including interest, enthusiasm, and sense of belonging. Cognitive engagement reflects deeper psychological investment in learning, characterized by critical thinking, self-regulation, and the use of meaningful learning strategies. This tripartite framework remains central in contemporary engagement research (Fredricks et al., 2021) and provides a comprehensive lens for examining how emerging factors, including digital tools, may influence students' learning experiences.

Beyond its multidimensional structure, student engagement has also been the subject of ongoing conceptual and methodological refinement. Fredricks, Filsecker, and Lawson (2016) emphasized that engagement must be understood within its broader contextual and developmental environment, arguing that definitional clarity and measurement precision remain critical for advancing engagement research. They highlight that engagement is not merely an observable behavior but a complex construct shaped by instructional context, social interactions, and individual adjustment processes. This perspective reinforces the importance of examining engagement as a dynamic and context-sensitive phenomenon, particularly in technology-mediated environments where digital tools may reshape how students participate, experience, and cognitively invest in learning.

In the context of technology-mediated learning, the measurement of engagement has received particular scholarly attention. Henrie, Halverson and Graham (2015) emphasize that engagement in digital environments extends beyond observable participation to include emotional involvement and cognitive investment. Their review highlights the importance of distinguishing between behavioral indicators, affective responses, and deeper learning processes when examining technology-supported learning. This multidimensional measurement perspective supports the analytical approach adopted in the present study, where behavioral, emotional, and cognitive engagement are examined separately to capture the nuanced influence of digital tool use. Recent shifts toward online and blended learning have introduced new challenges to sustaining engagement, including digital fatigue, uneven self-regulation skills, and disparities in access to technology (Zhao & Watterston, 2021; Surianshah, 2021; Rasheed et al., 2020). These evolving learning conditions highlight the importance of identifying evidence-based strategies that can support multidimensional engagement within technology-driven educational environments.

The Role of Digital Tools in Higher Education

Digital tools refer to technological platforms and applications that support teaching, learning, and communication within educational environments (Chiu, 2021). In higher education, these tools have evolved from supplementary resources to integral components of instructional

delivery, particularly in blended and online learning contexts (Bond et al., 2020). Their increasing integration reflects the demand for flexible, interactive, and student-centered learning environments. Research suggests that digital tools can enhance student engagement by enabling collaboration, real-time communication, personalized learning pathways, and interactive feedback mechanisms (Bond et al., 2020; Pagutayao & Paglinawan, 2024; Henrie et al., 2015). Platforms that support discussion, content sharing, and gamified activities have been shown to stimulate participation and motivation, while also promoting deeper engagement with learning materials (Martin et al., 2020). Such tools provide opportunities for both active involvement and self-directed learning, aligning with contemporary pedagogical approaches (Bedenlier et al., 2020).

However, the effectiveness of digital tools is not without limitations. Challenges such as digital fatigue, disparities in internet access, and differences in digital literacy may hinder meaningful engagement (Zhao & Watterston, 2021; Surianshah, 2021; Rasheed et al., 2020). These contextual factors suggest that technology alone does not guarantee improved engagement; rather, its impact depends on thoughtful integration within pedagogical design. Although existing studies generally report positive associations between technology use and engagement, much of the evidence remains descriptive or correlational (Uzorka & Odebiyi, 2025; Martín-Gutiérrez & Fernández, 2021). Limited research has examined the predictive influence of digital tool use on the distinct dimensions of student engagement. Addressing this gap is essential for understanding how technology-driven learning environments can systematically foster behavioral, emotional, and cognitive engagement.

Theoretical Framework Linking Digital Tools and Engagement

This study is grounded in Constructivist Learning Theory and Self-Determination Theory (SDT), which together provide a conceptual basis for understanding how digital tools may influence student engagement. Constructivist theory posits that learning occurs through active participation, interaction, and knowledge construction within meaningful contexts. Digital tools, by enabling collaboration, real-time communication, and access to diverse learning resources, create environments that support active involvement and deeper cognitive processing. From this perspective, technology-enhanced learning environments are expected to promote behavioral and cognitive engagement by encouraging participation and critical thinking. Self-Determination Theory further explains the emotional dimension of engagement by emphasizing the importance of autonomy, competence, and relatedness in fostering intrinsic motivation. Digital tools can support these psychological needs by offering flexible learning pathways, immediate feedback, and opportunities for social connection. When students perceive digital environments as supportive and empowering, they are more likely to experience enthusiasm, interest, and a sense of belonging. Together, these theoretical perspectives provide a foundation for examining the predictive influence of digital tool use on multidimensional student engagement.

Empirical research consistently suggests that digital tools can enhance student engagement in higher education. Interactive platforms and learning management systems have been shown to promote participation, collaboration, and self-regulated learning (Pagutayao & Paglinawan, 2024; Martin et al., 2020). Gamified and interactive applications further contribute to

motivation and enjoyment, thereby encouraging active involvement in academic tasks (Ambikapathy et al., 2024). More recent post-pandemic studies indicate that digital platforms also support students' sense of connection and sustained participation in online and blended learning environments (Chiu, 2021; Tang et al., 2021).

Despite these promising findings, much of the existing literature remains descriptive or correlational, often focusing on perceptions or patterns of technology use (Uzorka & Odebiyi, 2025; Martín-Gutiérrez & Fernández, 2021). Limited studies have examined the predictive influence of digital tool use on the distinct behavioral, emotional, and cognitive dimensions of engagement. This gap highlights the need for empirical investigations employing predictive statistical models to clarify how digital tool usage contributes to multidimensional engagement outcomes. Drawing on constructivist learning theory and Self-Determination Theory, this study proposes that digital tool use positively predicts student engagement across its three dimensions. Accordingly, the following hypotheses are formulated:

H1: Digital tool use positively predicts behavioral engagement.

H2: Digital tool use positively predicts emotional engagement.

H3: Digital tool use positively predicts cognitive engagement.

Figure 1 presents the proposed research framework, positioning digital tool use as the independent variable and student engagement as a multidimensional construct comprising behavioral, emotional, and cognitive dimensions. The model proposes that the extent of digital tool use directly influences students' participation in academic activities, their emotional connection to learning, and their cognitive investment in the learning process. This framework guides the empirical analysis by specifying the hypothesized predictive relationships tested in this study.

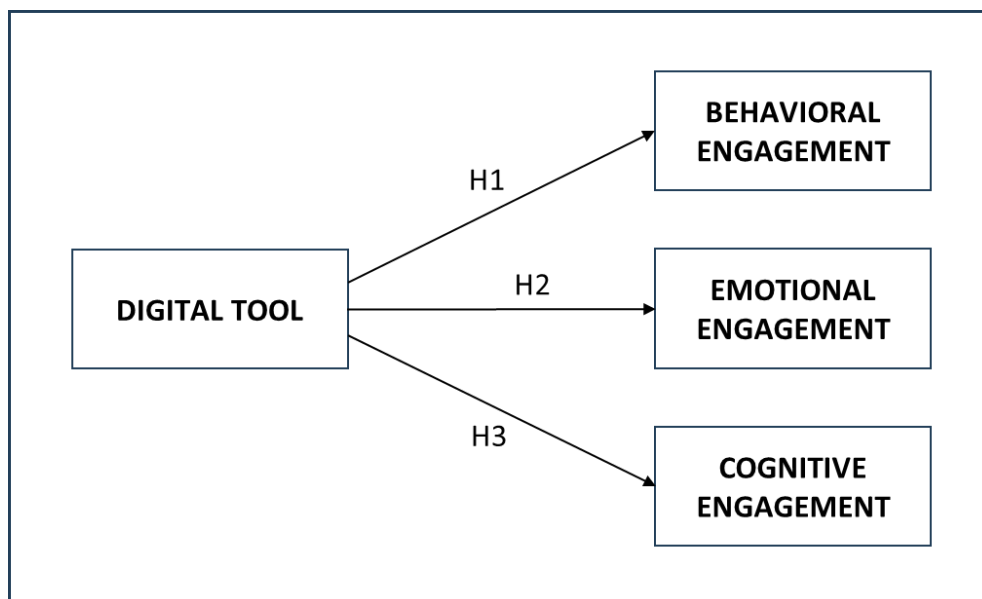


Figure 1: Proposed Research Framework

The framework is grounded in Constructivist Learning Theory and Self-Determination Theory. From a constructivist perspective, digital tools create interactive and collaborative

environments that encourage active participation and knowledge construction, thereby enhancing behavioral and cognitive engagement. Self-Determination Theory further explains the emotional dimension of engagement, suggesting that digital environments can support students' psychological needs for autonomy, competence, and relatedness, which in turn foster intrinsic motivation and positive learning experiences. By integrating these theoretical perspectives, the framework assumes that digital tool use functions as a mechanism through which technology-driven learning environments influence multiple dimensions of engagement simultaneously. The model guides the empirical analysis by specifying direct predictive relationships between digital tool use and each engagement dimension, which are tested using multiple regression techniques.

Methodology

This study employed a quantitative, cross-sectional survey design to examine the predictive relationship between digital tool use and student engagement in higher education institutions. The independent variable was digital tool use, while behavioral, emotional, and cognitive engagement were treated as dependent variables. A structured questionnaire was distributed online to students at a Malaysian public higher education institution. The sample consisted of 404 students from diverse academic programs. Participants were recruited using convenience sampling and represented various demographic backgrounds. Data were collected through voluntary participation with informed consent, and responses were anonymized prior to analysis.

The instrument was adapted from validated scales in the literature. Digital tool use was measured using 10 items (Cronbach's $\alpha = .928$). Student engagement was assessed across three dimensions: behavioral (10 items, $\alpha = .899$), emotional (10 items, $\alpha = .950$), and cognitive engagement (10 items, $\alpha = .929$), based on established engagement frameworks. All items were rated on a five-point Likert scale ranging from strongly disagree to strongly agree. Data were analyzed using SPSS. Descriptive statistics and Pearson correlation analysis were conducted to examine overall patterns and bivariate relationships. To test the hypotheses, multiple regression analysis was performed in three separate models, with each engagement dimension treated as an outcome variable. This approach allows for clearer interpretation of the predictive influence of digital tool use on each dimension of engagement. Regression assumptions were examined to ensure the validity of the results.

Results and Discussion

This section presents the findings derived from descriptive and inferential analyses of the collected data. Descriptive statistics summarize respondents' demographic characteristics and patterns of digital tool use, while inferential analysis using multiple regression examines the predictive influence of digital tool use on behavioral, emotional, and cognitive engagement. The results are interpreted in relation to existing literature to highlight their theoretical and practical implications for technology-driven learning in higher education.

Findings and Analysis of Demographic Data

The sample consisted of 404 students from a Malaysian public higher education institution. The majority were female (77.72%) and aged between 18-21 years old (54.46%). Most respondents were pursuing a bachelor's degree (70.54%), indicating that the sample was largely composed of undergraduate students. Digital accessibility among respondents was high, with 99.75% reporting ownership of a personal computer. Laptops were the most commonly used device (70.05%), followed by smartphones (17.82%) and tablets (11.63%). Internet usage was also frequent, with more than half of the respondents (56.93%) accessing the internet more than 15 times per day. Overall, the sample reflects a digitally connected student population, providing an appropriate context for examining the predictive influence of digital tool use on student engagement.

Correlation Analysis

The correlation analysis was carried out to explore the relationships between the key constructs in this study: Digital Tool Use, Behavioral Engagement, Emotional Engagement, and Cognitive Engagement. Pearson correlation coefficients were computed to assess the strength and direction of the associations among these variables. As presented in Table 1, all correlations were statistically significant at the 0.01 level (2-tailed), suggesting meaningful positive relationships between digital tool use and the three dimensions of student engagement, as well as strong interconnections among the engagement dimensions themselves.

Table 1: Correlational Analysis Results

		Mean_TU	Mean_BE	Mean_CE	Mean_EE
Mean_TU	Pearson	1	.680**	.742**	.783**
	Correlation				
	Sig. (2-tailed)		<.001	<.001	<.001
	N	404	404	404	404
Mean_BE	Pearson	.680**	1	.760**	.625**
	Correlation				
	Sig. (2-tailed)	<.001		<.001	<.001
	N	404	404	404	404
Mean_CE	Pearson	.742**	.760**	1	.690**
	Correlation				
	Sig. (2-tailed)	<.001	<.001		<.001
	N	404	404	404	404
Mean_EE	Pearson	.783**	.625**	.690**	1
	Correlation				
	Sig. (2-tailed)	<.001	<.001	<.001	
	N	404	404	404	404

** . Correlation is significant at the 0.01 level (2-tailed).

Pearson correlation analysis revealed significant positive relationships among all variables ($p < .001$). Digital tool use was strongly associated with emotional engagement ($r = .783$),

cognitive engagement ($r = .742$), and behavioral engagement ($r = .680$). The three engagement dimensions were also strongly interrelated, supporting the multidimensional nature of student engagement. The strongest correlation was observed between digital tool use and emotional engagement, suggesting that increased use of digital tools is closely linked to students' sense of motivation and connection in the learning process. These results provide preliminary support for the proposed hypotheses and justify further examination through regression analysis.

Multiple Regression Analysis

To examine the predictive influence of digital tool use on student engagement, three separate regression models were conducted, treating behavioral, emotional, and cognitive engagement as dependent variables.

Model 1: Digital Tool Use and Behavioral Engagement

The first regression model examined the extent to which digital tool use predicts behavioral engagement. Digital tool use significantly predicted behavioral engagement, $F(1, 402) = 345.04$, $p < .001$, explaining 46.2% of the variance ($R^2 = .462$, Adjusted $R^2 = .461$). The standardized coefficient ($\beta = .680$, $p < .001$) indicates a strong positive relationship. These findings suggest that increased use of digital tools enhances students' participation and effort in academic activities. Thus, Hypothesis 1 (H1), which posited that digital tool use positively predicts behavioral engagement, is supported.

Model 2: Digital Tool Use and Emotional Engagement

The second model tested whether digital tool use predicts emotional engagement. The regression model for emotional engagement was also significant, $F(1, 402) = 637.54$, $p < .001$, with $R^2 = .613$ (Adjusted $R^2 = .612$), indicating that digital tool use explains 61.3% of the variance. The standardized coefficient ($\beta = .783$, $p < .001$) demonstrates a strong positive effect. This suggests that digital tool use plays a substantial role in strengthening students' motivation, enthusiasm, and sense of connection. Therefore, Hypothesis 2 (H2) is supported, confirming that digital tool use is a significant predictor of emotional engagement among students.

Model 3: Digital Tool Use and Cognitive Engagement

The third model assessed the influence of digital tool use on cognitive engagement. Digital tool use significantly predicted cognitive engagement, $F(1, 402) = 491.90$, $p < .001$, explaining 55.0% of the variance ($R^2 = .550$, Adjusted $R^2 = .549$). The standardized coefficient ($\beta = .742$, $p < .001$) confirms a strong positive relationship. These results indicate that greater use of digital tools supports deeper learning processes such as critical thinking and self-regulation. Accordingly, Hypothesis 3 (H3) is supported, confirming that digital tool use is a significant predictor of cognitive engagement in higher education settings.

Table 2 presents the results of the three regression models examining the predictive effect of digital tool use on behavioral, emotional, and cognitive engagement. Across all models, digital

tool use was found to be a strong and statistically significant predictor of student engagement ($p < .001$). The explanatory power of the models varied, with emotional engagement showing the highest proportion of variance explained ($R^2 = .613$), followed by cognitive engagement ($R^2 = .550$), and behavioral engagement ($R^2 = .462$). These findings reinforce the critical role of digital tools in shaping different dimensions of engagement, with the strongest effect observed on students' emotional connection to learning.

Table 2: Summary of Regression Analysis Results

Dependent Variable	<i>B</i>	SE	β	<i>t</i>	<i>p</i>	R^2	Adj. R^2	<i>F</i>	Sig.
Behavioral Engagement	0.60 1	0.03 2	0.68	18.5 75	<.00 1	0.46 2	0.46 1	345. 039	<.00 1
Emotional Engagement	0.82 6	0.03 3	0.78 3	25.2 49	<.00 1	0.61 3	0.61 2	637. 536	<.00 1
Cognitive Engagement	0.73 3	0.03 3	0.74 2	22.1 79	<.00 1	0.55	0.54 9	491. 904	<.00 1

Based on the results of the regression analyses, the predictive equations for each dimension of student engagement are as follows:

Model 1 (Behavioral Engagement): $BE = 1.751 + 0.601(TU)$

Model 2 (Emotional Engagement): $EE = 0.635 + 0.826(TU)$

Model 3 (Cognitive Engagement): $CE = 1.075 + 0.733(TU)$

where BE = Behavioral Engagement, EE = Emotional Engagement, CE = Cognitive Engagement, and TU = Digital Tool Use.

The regression coefficients indicate that for each one-unit increase in digital tool use, behavioral engagement increases by 0.601 units, emotional engagement by 0.826 units, and cognitive engagement by 0.733 units. Across all three models, digital tool use emerged as a strong and statistically significant predictor of student engagement. The strongest predictive effect was observed for emotional engagement ($R^2 = .613$), followed by cognitive engagement ($R^2 = .550$) and behavioral engagement ($R^2 = .462$). These findings indicate that while digital tools enhance all dimensions of engagement, their most substantial impact lies in strengthening students' motivation, enthusiasm, and sense of connection in the learning process.

The strong effect on cognitive engagement further suggests that digital tools support higher-order learning processes, including critical thinking, problem-solving, and self-regulation. Although the predictive influence on behavioral engagement was comparatively lower, it remains substantial, indicating that technology also promotes active participation and consistent involvement in academic activities. Collectively, the results provide empirical support for Hypotheses H1–H3 and extend prior descriptive research by offering predictive evidence of the role of digital tool use in shaping multidimensional engagement. The findings reinforce the view that strategically integrated digital tools function as important enablers of meaningful engagement in higher education.

Discussions

This study examined the predictive effect of digital tool use on student engagement across its behavioral, emotional, and cognitive dimensions in higher education. The findings provide clear evidence that digital tool use significantly and positively predicts all three forms of engagement, with the strongest influence observed on emotional engagement, followed by cognitive and behavioral engagement. These results extend prior descriptive research by offering predictive evidence of how technology use shapes students' learning experiences. The strongest predictive relationship was found for emotional engagement, indicating that digital tools play a substantial role in enhancing students' motivation, enthusiasm, and sense of belonging. This aligns with prior research suggesting that technology-mediated platforms can foster connection and sustain motivation, particularly in digitally enriched learning environments. From a theoretical perspective, Self-Determination Theory explains this outcome, as digital tools may support students' needs for autonomy, competence, and relatedness, thereby strengthening intrinsic motivation.

Digital tool use also demonstrated a strong predictive effect on cognitive engagement, suggesting that technology supports deeper learning processes such as critical thinking, problem-solving, and self-regulation. This finding is consistent with constructivist learning theory, which emphasizes active knowledge construction through interactive and collaborative learning environments. The results further suggest that when students perceive digital tools as useful, they are more likely to integrate them into higher-order learning practices. Although the predictive effect on behavioral engagement was comparatively lower, it remained substantial, indicating that digital tools also encourage active participation and consistent involvement in academic tasks. Together, these findings reinforce the view that digital tools, when strategically integrated, function as powerful enablers of multidimensional student engagement in higher education.

These findings carry important theoretical implications. The results reinforce constructivist learning theory by demonstrating that digital tools facilitate active knowledge construction across behavioral and cognitive domains. The strong predictive effect on emotional engagement also provides empirical support for Self-Determination Theory, highlighting the role of digital environments in satisfying students' psychological needs and sustaining intrinsic motivation. By integrating these perspectives, the study advances understanding of how technology functions not merely as an instructional tool, but as a mechanism that activates multiple dimensions of engagement. From a practical standpoint, the findings underscore the importance of strategic digital integration in higher education. Institutions should move beyond basic technology adoption and focus on designing interactive, collaborative, and student-centered digital experiences that foster emotional connection and deeper learning. Investment in digital infrastructure and pedagogical training remains essential to maximize engagement outcomes in technology-driven learning environments.

Limitations and Future Research

This study is not without limitations. First, the data were collected from a single higher education institution, which may limit the generalizability of the findings. Second, the use of self-reported measures may introduce response bias. Third, the cross-sectional design restricts causal interpretation of the relationships observed. Future research may extend this study by incorporating multi-institutional samples, longitudinal designs, or additional moderating variables such as digital literacy or instructional practices to further examine the dynamics of technology-driven engagement.

Conclusion

This study examined the predictive influence of digital tool use on multidimensional student engagement in higher education institutions. By employing multiple regression analysis, the findings demonstrate that digital tool use significantly and positively predicts behavioral, emotional, and cognitive engagement. Among these dimensions, emotional engagement emerged as the strongest outcome, suggesting that digital environments play a particularly important role in shaping students' motivation, enthusiasm, and sense of connection in learning contexts. The results extend prior descriptive research by providing predictive evidence of the relationship between digital tool use and engagement outcomes. The findings reinforce the importance of integrating digital tools not merely as technological add-ons, but as strategically designed components of pedagogical practice. When thoughtfully implemented, digital platforms can enhance participation, foster intrinsic motivation, and support deeper cognitive investment in learning. From a practical perspective, higher education institutions should prioritize the purposeful integration of digital tools that encourage interaction, collaboration, and meaningful feedback. Investments in digital infrastructure must be complemented by pedagogical strategies that align technology use with engagement objectives. While the study contributes valuable empirical insight, future research may further explore contextual factors such as instructional design, digital literacy, and longitudinal engagement patterns to better understand how technology-driven learning environments can sustain engagement over time.

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FUNCTIONALITY OF MINI MELTING FOUNDRY FURNACE UTILIZING WATER AND OIL AS FUEL

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Abstract: *This study constructed an economically fueled foundry furnace and established a set-up with injectors using water and oil as fuel. The performance of the set up was investigated and quantified with known amount water and oil. Using oil with water and no air fan attained the highest burning flame while it has also the shortest period of duration. The ratio d_o/d_w established the sustainable operation between water and oil to be burned as fuel. The functionality of the flame burning inside the furnace will not function well if the ratio between the speed of the droplet of oil against the speed of the droplet of water (d_o/d_w) is equal or lesser to 2. It may function with sustainability if d_o/d_w varies from more than 2 to 20. However, with d_o/d_w at above 20 is already dangerous for the furnace to continue the burning operation since the height of the burning flame could reach the extreme level. A follow up study on the design of the top cover was recommended similarly with the actual melting of metal. Follow up study of expanded duration of burning oil with water is also recommended.*

Background/Justification of the Research

The advancement of any nation technologically has been influenced and elevated by the extent to which it can usefully harness and convert its mineral resources that include the productions of metal in foundries that for all human lives have also become a general practice (Bala, 2005). Four types of furnaces commonly used to melt the metal are using basic oxygen furnace which uses pure oxygen; electric arc furnace which is used without the aid of high-quality and expensive fuel; immersion furnace which is either done by low-temperature melting and high-temperature melting while the heat is generated by combustion or electrical resistance; and the blast furnace which has the combustion chamber as the place where the gas and fresh air delivered to the furnace for combustion take place (Firdaus & Zakaria, 2015). According to de Castro et al. 2020, new, improved technologies have recently been introduced in the mini blast furnace process, such as pulverized charcoal and gas injections (Rocha et al, 2013). The type of fuel used is important because some materials will interfere the materials placed inside the furnace and that for this reason most furnaces use liquid fuel, gaseous fuel or electricity as energy in- put (Dhiman & Bhatia, 2015).

Metal casting industry plays a vital role in today's modern economy. The Philippine metal casting industry is in its critical stage for several micro and small metal casting shops have closed down due primarily to its incapability to compete in the Philippine market as well as globally (Gonzales, 2018). This happen since industrialized countries have strong manufacturing industries fueled by a vibrant metal and engineering industries in which metal casting is a significant component (MIRDC, 2015). Another reason could be attributed that the focus of the energy sector is not on how to bring down the energy cost but instead, is how to meet the country's increasing demand for energy and devise a way for energy efficiency and conservation (Lister et al, 2017). This means that all sectors need to reduce their energy

consumption by implementing schemes to conserve energy whenever possible while foundries are energy-intensive (Arasu et al, 2009). By developing a mini melting foundry furnace could be used by small scale metal casting workers which is still unknown and is seldom practice in the country. This could become another source of livelihood. With an aim to produce an economically fueled foundry furnace, this program study is focused on the construction of a melting foundry furnace fueled with water and used oil. In oil burning, vaporization of the oil must be sufficient to yield a steady-state burning, that is, one in which the amount of vaporization is about the same as that consumed by the fire (Fay, 2006). The use of water as an ancillary combustion control technique has recently received renewed interest (Dryer, 1977). It was found that gasoline with water injection showed better performance than without (Strawn, 2018). But finally, self-contained water harvesting enables the option of wide-spreading on water injection as a future fuel consumption improvement technology (Bazala, 2021). Water injection can be used either for engine performance improvement or improved fuel consumption. Water injection can effectively increase the octane number of the fuel, which has the potential to improve engine performance and efficiency through higher compression ratios and reduced combustion temperatures (Borette, 2011). It is a thermal dilution technique, which helps to prevent abnormal combustion effects (Borette, 2013). Burning oil on water is not intuitive, and thus many people do not pursue to explore in scientific depth until recently (Fingas, 2011).

Objective of the study

The general objective of this study is to investigate the functionality of mini melting foundry by injecting water and used oil as fuel in mini melting foundry furnace. Specifically, this was able to:

- a) established a set-up of the melting foundry furnace with injector to use water and oil as fuel
- b) investigated the functionality of the set up
- c) quantified the functionality with known amount water oil as fuel

Methodology

The method used are as follows:

Materials and equipment used. Among the materials used are old cylindrical tank, 10 mm Φ reinforced structural bar, 1/4 “ Φ metal pipe, metal tube, welding rods, and steel epoxy, plastic bottles, plastic controllers, metal stand and plastic hose. The equipment used are welding machine, electric grinder and electric cutter.

Fabrication Procedure and Assembly. The cylindrical tank was cut to dimension and shaped to form the cylindrical structure of the furnace. The reinforced structural bar was cut and welded to form as stand and frame of the cylindrical furnace. The circular furnace is provided with opening and closing lid with small opening at top. The interior part of the furnace is provided with a circular platform for placing of a graphite crucible. The burner was provided with small holes and was attached through the metal tube serving as the exit of the airflow. The

airflow was provided by a small fan which is attached to the metal tube. The small fan has a control selector than can be used to direct the fan rotation to produce air from either from minimum to maximum velocity. It was assured that the gas burner is in place that the flame will be in direct contact with graphite crucible. The metal pipes serving separately as the passage of water and used oil were also attached to the furnace. One of the metal pipes is attached to the oil plastic container while the other is attached to the water plastic container through the plastic hose. The plastic containers were mounted vertically at equal height serving as the injector of the oil and water to the furnace. The injection process is using gravitational force so that the oil and water injectors are attached to the metal stand at higher location. Metal epoxy which is heat resistant was used to attain stability in the attachment of the metal tube and pipes.

Data gathering procedure. The data for the first objective was focused on the fabrication of the mini foundry furnace so that the specifications needed were established. It looked into the design of the structure, the designed set up and major feature of the furnace.

The data for the second objectives were collected by conducting several trials to establish the functionality of the set-up either it is fueled with oil, water and air. It looked into the maximum height of the burning flame and the duration of burning. Among those considered factors are the height that the burning flame that could be reached and the duration of burning. This was done by putting 2.5 ml of used oil inside the furnace. The functionality of the set up was investigated using the following situation: a) oil as fuel with no fan, b) oil as fuel with fan at minimum speed c) oil as fuel with fan at maximum speed, c) oil with water but no fan, d) oil with water and fan at minimum speed, and e) oil with water and fan at maximum speed. Water was supplied through droplets at unknown amount .

The data for the third objectives were also gathered by conducting several trials of burning using oil, water and air as the fuel. However, it is more focused on quantifying the amount of water being mixed with the burning oil as fuel. Several scenarios were used to describe the functionality. Among them is one (1) droplet of water per ten (10) seconds being mixed with one droplet of oil per five (5) seconds which means that the droplet of oil (d_o) is two times faster than the water droplets (d_w) being supplied to the furnace or $d_o = 2d_w$. The second scenario is when one (1) droplet of water per ten (10) seconds being mixed with oil at one (1) droplet/second which means that the droplets of oil is 10 times faster than the water being supplied to the furnace as fuel or $d_o = 10d_w$. The third scenario is when one (1) droplet of water per ten (10) seconds being mixed with 2.5 droplet of oil per seconds which means that the droplet of oil is twenty-five time faster than the water being supplied to the furnace as fuel or $d_o = 20d_w$.

Droplets of oil and water. Among the factors considered are the ratio of the velocity of the droplets of oil and water. One droplet of oil was estimated as 33.51 mm^3 which is similar to one droplet water. The droplets occur as the fluid passed through the control for water or oil inflow which happen since the diameter of the equipment are the same.

Air velocity. Air velocity was supplied through the air fan attached to the metal tube. The air fan can be adjusted to attain minimum and maximum velocity. Minimum velocity was estimated to be equal to 120mm/s while maximum velocity was 850mm/s.

Result and Discussion

Setup of the melting foundry furnace

The designed structure, designed set up and major feature of the furnace were significantly considered to overcome the construction of the foundry furnace.

The designed structure. The structure of the furnace was cylindrically designed for technical reason that it is effective in thermal distribution within the furnace chamber (Bhamare et al, 2017). To attain the maximum thermal performance the cylindrical furnace is connected with the following:

- inlet pipe for used oil. This was attached to the furnace to facilitate the passage of the injected fuel used oil.
- Inlet tube for air. The cylindrical furnace was supplied with air to allow combustion of the used oil with the oxygen and to make sure that the heat is directly used as thermal energy source.
- Inlet pipe for water. This material was purposely connected to the melting chamber to find the effect of adding water to the combusted air. It was cited that although no works in the literature report on the direct effect of water injection on the flameless combustion regime, it is possible to find studies on the effect of adding water to the combustion air, which helps to approach the phenomenon better (Lopez et al, 2022) The gravitational force was considered as the injectors for oil and water while the air was supplied using air fan.

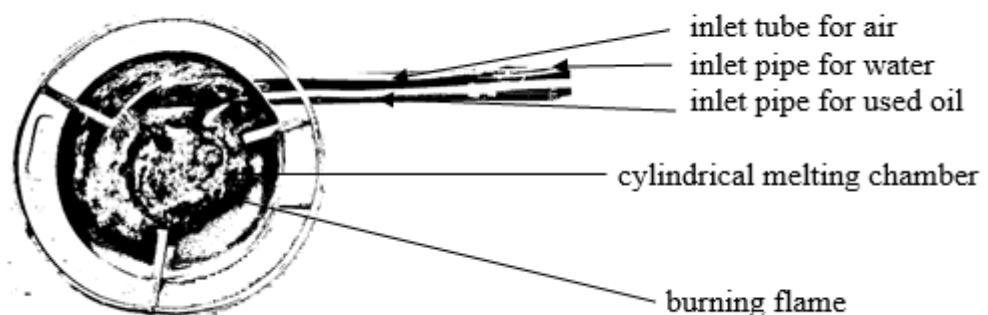


Figure 1. The designed Structure for Melting Operation

The designed set up. The design of the melting furnace is based on thermodynamic analysis of furnaces, materials availability, energy source and transfer. The following parameters guided during the design and fabrication of the set up.

- The materials used are selected due to their availability and ability to withstand the desire temperature and purpose of the system.
 - The energy sources are the combination of water used oil and air. Metal pipes and tube are provided to facilitate thermal energy transfer from the source to the furnace.
- The set up is composed mainly of the mini melting foundry furnace and injectors of oil and water.

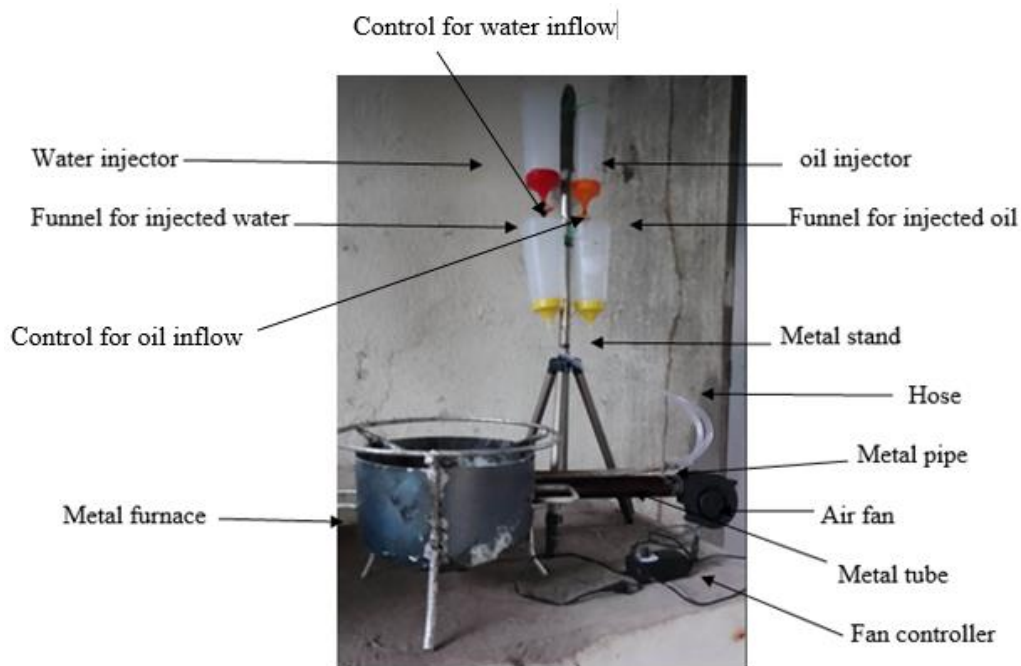


Figure 2. The designed set-up

Major Feature of the Furnace. The designed model was modified to have the following features;

- The body as a melting chamber. the body is formed from a cylindrical tank as a steel sheet functioning as a melting chamber. It is inside the chamber that the crucible will be placed to melt metal.
- The burner. The burner is attached to the body which was positioned to burn the supplied changed oil, air and water as an energy source of the melting chamber.
- The pipe and tube system. The pipe and the tube are attached to convey the supplied water, oil and air coming from the injection chamber.
- Fan. A small fan was attached to the metal tube to facilitate faster airflow inside the furnace.
- Oil and water injectors. These are the separate containers in which the oil and water are placed to start the conveyance through pipe system going to the burner. Oil and water are injected through gravitational force so that these parts are located higher than the furnace.
- Stand for oil and water injectors. This object is a stand made of metal pipe that holds the oil and water injectors.

- vii. Since this initial study is focused more on the utilization of water and used oil as fuel there are other features of the design that were not yet included in the conduct of this study. These portions are planned to be included on the follow up study. These are the following.
- viii. The crucible. the crucible made of graphite pot was commercially purchased to be placed in the melting chamber serving as the holder of the molten metal during the time of casting.
- ix. Top cover. The furnace cover increases energy efficiency which was provided to reduce conduction and radiation heat loss. It has a circular opening to introduce fresh oxygen into the furnace for proper combustion.

Functionality of the set up

Looked into this part are the height that the burning flame could reach and the duration of burning. It was done by putting 2.5 ml of used oil inside the furnace. The functionality was investigated using the following situation: a) oil as fuel with no fan, b) oil as fuel with fan at minimum speed c) oil as fuel with fan at maximum speed, c) oil with water but no fan, d) oil with water and fan at minimum speed, and e) oil with water and fan at maximum speed. Water supplied on each situation are droplets at unknown amount. The result is shown in Table 1.

Table 1. Functionality of the set up using oil, water and air as fuel

Parameters	Height (cm)	Duration (minutes)
Oil with no water & no fan	23	10.53
Oil with water & no fan	78	1.23
Oil with no water but with fan at minimum speed	19	10.38
Oil with no water but with fan at maximum speed	12	5.42
Oil with water and fan at minimum speed	54	2.27
Oil with water and fan at maximum speed	46	3.3

The table reveals that different burning performance of the furnace was demonstrated using different situation with oil, water and air as the fuel. The burning flame reaches the highest peak at 78 cm. when the furnace was supplied with oil and water but with no fan to supply the furnace with air. However, it has the shortest duration time for burning flame. The highest peak of burning flame was attained since it was not resisted by any outside forces such as air to flow in other direction. The height has a significant effect on flame and burning behaviors of the whole burning process that during the initial development stage, the total flame length and burning rate increase rapidly after the fuel was ignited (Zhao et al, 2022).

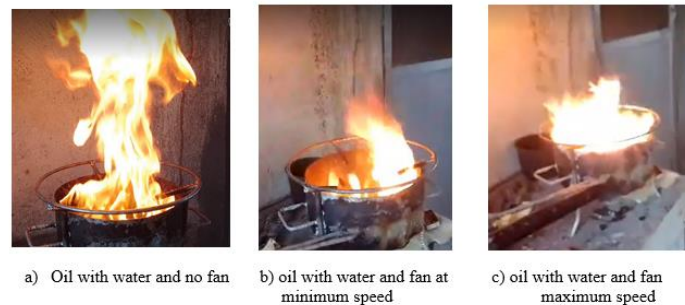


Figure 3. Continuous burning with mixture of oil and water

The height was at lowest level at 12 cm was when the furnace was fueled with oil but with no water and with fan at maximum speed. This occur since the direction of the burning flame was redirected by the airflow to circulate within the interior chamber of the furnace instead of moving freely upward. In this case the energy exerted by the air is dominantly affecting the fuel feed rate. Due to decrease of fuel feed rate, flame height decreases constantly and was correlated with mass loss rate per unit area (Xu and Lei, 2022). The heat transfer process between the water layer and the fuel layer has a significant effect on the burning behaviors. Under certain conditions, the burning of a thin fuel layer can develop into a special phenomenon known as boil over characterized by violent burning (Laboureur et al., 2013; Koseki et al., 2006), that its occurrence can change significantly the heat transfer process and increase the fuel burning rate.

It may be noted that in most cases the flame is high when the burning flame in the furnace are supplied with droplets of water, However, these are the time that the burning flame occur at the shortest duration. The duration for the burning flame in the furnace supplied with oil and water but with no fan is the shortest at 1.23 minutes followed by oil with water and fan at minimum speed at 2.27 minutes and oil with water and fan at maximum speed at 3.30 minutes. This occur since the quantity of the water was about to surpass the quantity of oil. With the increase of the water amount, the flame expansion was gradually weakened until it disappeared completely (Fan et al. 2020). Water mist extinguishes fires mainly by physical means such as cooling the flame, wetting or cooling the fuel, displacing the oxygen and fuel vapor available for combustion and radiant heat attenuation (Liu, 2004). To attain a desirable operation, maximizing the burning flame for melting foundry furnace is necessary. That is the amount of water droplet mixed to the burning oil is exactly quantified.

Functionality with quantified amount of water mixed with oil and air as fuel

Several scenarios were observed to describe the height of the burning flame when the quantified amount of water is mixed with the burning oil. The result is shown in Table 2.

Table 2. Functionality with quantified amount of water and oil as fuel

Parameters	Height of burning flame (cm)		
	No air fan was supplied	With air fan at minimum speed	With air at maximum speed
$d_o = 2d_w$	3	3	0
$d_o = 10d_w$	20	35	20
$d_o = 20d_w$	30	45	27

Droplets of oil is two (2) times faster than the droplets of water ($d_o = 2d_w$). The table show that when the droplets of oil is two times faster than the water droplets or with mathematical relationship of $d_o = 2d_w$ the burning flame is not functioning well attaining a height of 3.0 cm only even if supplied with air at minimum speed. The flame was dead a when supplied with air at maximum speed. On this case, the water droplets make the burning of oil weaker. As the water amount in the mixtures were increased, the reaction and peak temperatures shifted to lower temperatures (Kok et al, 2020). However, inefficiency of the burning process could be attributed to other factors such as: burning of water and oil as fuel without preliminary preparation causes disturbance of burning process down to extinction of the flame (Knorre, 1959) while it was suggested that for successful implementation it is necessary to homogenize the mixture of fuel and moisture in special device and effectively mix water-fuel emulsion with an air oxidant in a burner (Baubek et al, 2020). The experimental set up was not continued anymore at lower ratio for it will not function well anymore.

When droplets of oil is ten (10) times faster than the droplets of water ($d_o = 10d_w$). The height of the burning flame reaches 20 cm when not supplied with an air fan, 35 cm with air fan at minimum speed and 20 cm at maximum speed. Combustion is found to have a profound impact on the mixing characteristics (Jana et al, 2020). Based from the result, it seems that after the length or height of the flame reaches the maximum level, it will decrease as the velocity of the supplied air continue to increase. On this event, the combustion is positively affected by the aerodynamic characteristics of the fuel and air mixture (Baubek et al, 2020). The geometrical spacing between the flames can also plays a vital role in flame stabilization while the increased spacing between the flames causes a reduction in flame length by promoting the mixing of oxygen and air (Jana, 2020). The air jet produced led to a short flame and a significant increase in combustion achieved by internal recycling (Gheorghe, 2017).

When droplets of oil is twenty (20) times faster than the droplets of water ($d_o = 20d_w$). The height of the burning flame on this scenario is 20 cm when not supplied with an air fan, 45 cm when supplied with air fan at minimum speed, and 27 cm when supplied with air fan at maximum speed. The fluctuation of the burning flame fluctuates similarly in the case of $d_o = 10d_w$, however, the magnitude was increased. The experimental set up at higher level was not continued anymore for the reason that it is dangerous anymore.

Height of burning flame versus d_o/d_w . It is through the ratio between the velocity of the droplets of oil and water (d_o/d_w) that the functionality of the furnace may be established to sustain the stabilization of burning flame as water is continuously mixed with oil. Height of burning flame versus d_o/d_w is shown in Table 4.

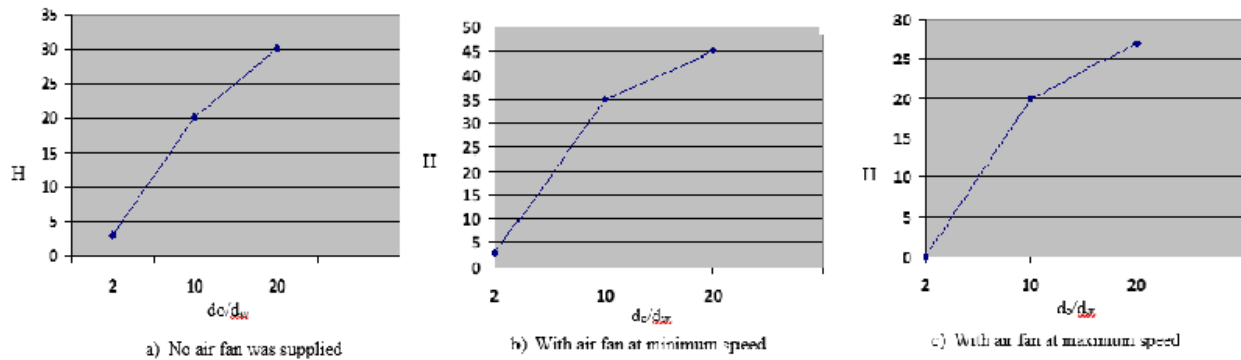


Figure 4. Height of burning flame versus d_o/d_w

The figure shows that if d_o/d_w is less than two (2) the burning flame will not perform well. The water content on this ratio is high that it affects the efficiency of burning. It was cited that increase of the water content of fuels has a significant effect on the effective heat of combustion decrease and a moderate effect on combustion efficiency decrease (Martinka & Rantuch, 2019). Therefore it can be deduced that if,

efficiently. $\frac{d_o}{d_w} < 2$; the burning process will not perform

As d_o/d_w ranges from 2 to 20 the height of the burning flame increases from 3cm to 30cm. On that case no air fan was supplied to the furnace while it increases from 3cm to 45 cm when the furnace was supplied with air fan at minimum speed and 0 to 20 cm at maximum speed. It can also deduce that if:

$2 < \frac{d_o}{d_w} < 20$: the ratio is typical for burning oil and water

It can be noted in the figure that the height of the burning flame increases as d_o/d_w increases. However, if no air fan was supplied the magnitude is greater than when air fan is supplied at minimum and maximum speed. The air supplied by the fan changed the direction of the flame for it is affected by the aerodynamic characteristics of the fuel and air mixture. The ratio d_o/d_w was not performed in the experiment for it may cause danger. When the ratio of oil against water is mixed the height of the burning flame will reach the extreme level. It was assumed that if,

$\frac{d_o}{d_w} > 20$; the ratio is dangerous for flame at extreme height

Water contains hydrogen which has a wide flammable range and a high adiabatic combustion temperature (Zhu et al, 2020). It has a larger flammability zone and a lower minimum ignition energy; thus, the probability of a fire or explosion is higher (Crowl & Jo, 2007). For burned oil, large heat flux could be generated by the plume directly above the fire, which could lead to fire spread to surrounding (Hamins et al, 2018). It is therefore necessary to put up a limitation in the ratio of mixing oil and water as furnace fuel.

Conclusion

This study was able to establish a setup of a furnace by which the combination of oil, water and air was used for sustainable burning. Using oil with water and no air fan was found to attain the highest burning flame while it has also the shortest period of duration. Looking at the ratio d_o/d_w can establish the sustainable operation between water and oil to be burned as fuel. The functionality of the flame burning inside the furnace will not function well if the ratio between the speed of the droplet of oil against the speed of the droplet of water (d_o/d_w) is equal or lesser to 2. It may function if with sustainability if d_o/d_w varies from more than 2 to 20. However, with d_o/d_w at above 20 is already dangerous for the furnace to continue the burning operation since the height of the burning flame could reach the extreme level. Follow up study of expanded duration of burning oil with water is recommended. A follow up study on the design of the top cover and the actual melting of metal is also recommended.

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PRECISION LIVESTOCK MONITORING USING IOT : HEART RATE AND TEMPERATURE SENSOR

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Abstract: *This study presents the development and field evaluation of a wearable livestock health monitoring prototype for real-time assessment of goat physiological conditions. The primary objective is to provide a low-cost and accessible digital solution that supports early detection of stress and health abnormalities, thereby enhancing farm-level decision-making and herd management practices. The proposed system integrates a heart rate sensor and a temperature sensor mounted on a breadboard, both interfaced with an ESP32 LoRaWAN microcontroller serving as the central processing and communication unit. The wearable device is secured to the animal using a belt, ensuring stable sensor positioning and reliable data acquisition during routine movement. Field experiments were conducted at Borneo Happy Farm, Bau, Sarawak, where the prototype was deployed on selected goats for continuous monitoring of heart rate and body temperature. The collected data were analysed and compared against established livestock healthiness index thresholds, with validation provided through veterinary assessments. The results indicate that healthy goats exhibited heart rate values ranging from 55 to 75 beats per minute and body temperatures between 38.0 and 39.0 °C, consistent with recognised physiological norms. Elevated readings exceeding 85 beats per minute or 39.5 °C were associated with mild stress indicators as reflected in the healthiness index, while stable values within normal ranges corresponded to good physiological status. Furthermore, the ESP32 LoRaWAN module demonstrated reliable and energy-efficient data transmission to a cloud-based dashboard, enabling real-time visualization and monitoring. Overall, the findings suggest that the proposed wearable prototype offers a practical and scalable approach for goat health monitoring, supporting early-warning detection and data-driven livestock management in rural agricultural settings.*

Keywords: *Wearable Livestock Monitoring, Goat Health Monitoring, Heart Rate, Temperature Sensing, ESP32 Lorawan*

Introduction

Livestock farming continues to play a significant role in ensuring food security, supporting rural livelihoods, and strengthening Agri-based economic activities in Sarawak. In recent years, the Sarawak government, through agencies such as the Ministry of Food Industry, Commodity and Regional Development (MFICORD), has emphasised the modernisation of the livestock sector by encouraging the adoption of smart farming technologies, improved animal health

management, and data-driven agricultural practices (Ministry of Food Industry, Commodity and Regional Development [MFICORD], 2023). These initiatives aim to enhance productivity while promoting sustainability and animal welfare, particularly within smallholder and community-based farming systems.

Goat farming has emerged as a promising livestock subsector in Sarawak due to its relatively low capital requirement, adaptability to local environmental conditions, and increasing market demand. Capacity-building and extension programmes, such as the goat farming course organised by Universiti Putra Malaysia (UPM) Bintulu, highlight the importance of proper farming practices, disease prevention, and effective health monitoring in improving farm performance (Universiti Putra Malaysia, 2018). Despite these efforts, many small-scale farmers still rely on manual observation and experience-based judgement to assess animal health, which can delay intervention and increase the risk of stress-related illnesses and production losses.

Similar challenges have been observed across the Asia-Pacific region, where small-scale livestock producers face constraints related to labour shortages, limited access to veterinary services, and insufficient monitoring tools. Regional studies emphasise that early detection of physiological abnormalities is critical for reducing mortality rates, improving animal welfare, and minimising economic losses, particularly in resource-limited rural settings (Food and Fertilizer Technology Center [FFTC], 2021). These findings underscore the need for practical, affordable, and scalable monitoring solutions that can be readily adopted by smallholder farmers.

Advances in Internet of Things (IoT) technologies offer a viable pathway to address these challenges. Wearable sensing systems enable continuous and non-invasive monitoring of key physiological parameters, such as heart rate and body temperature, which are widely recognised as early indicators of stress and health disorders. When integrated with low-power wide-area network technologies such as LoRaWAN, these systems provide long-range communication and low energy consumption, making them well-suited for rural deployment.

Motivated by regional policy directions, local capacity-building initiatives, and documented challenges in livestock health management, this study develops and evaluates a wearable livestock health monitoring prototype for goats in Sarawak. The proposed system aims to support early health detection, enhance farm-level decision-making, and contribute to the broader effort of modernising goat farming practices through accessible digital solutions.

Literature Review

Recent advancements in precision livestock farming demonstrate a growing reliance on wearable devices for continuous and non-invasive assessment of animal health. In contrast to manual observation, wearable technologies provide real-time monitoring of physiological parameters and promote the early identification of health anomalies, hence enhancing animal welfare and farm efficiency (Yu et al., 2024). Their research indicated that ongoing surveillance of body temperature and activity patterns facilitates the detection of minor health alterations prior to the manifestation of clinical symptoms. Non-invasive infrared temperature

sensing at the neck demonstrated a high correlation with rectal temperature, validating its appropriateness for prolonged monitoring without causing stress (Yu et al., 2024). Heart rate and body temperature have historically been recognized as fundamental physiological markers for evaluating animal health. Baig and Shastry (2022) introduced an IoT-based system for monitoring sheep and goats, demonstrating that fluctuations in heart rate, rectal temperature, respiration rate, and tail movement may effectively distinguish among healthy, calving, and ill states.

Employing a MQTT (Message Queuing Telemetry Transport) based publish-subscribe architecture, sensor data were sent to a cloud dashboard for real-time analysis, illustrating the efficacy of IoT systems in facilitating early detection of health and reproductive events in small ruminants. Studies examining huge sheep and goat production systems have further substantiated the potential of IoT-enabled monitoring systems to enhance livestock health management. Silva et al. (2022) emphasized that conventional agriculture lack by manpower shortages, inadequate animal oversight, and lengthy disease identification. Their analysis determined that precision livestock farming instruments specifically wearable sensors and remote monitoring technologies provide effective solutions for the early identification of stress and health issues in goats and sheep, particularly in broad and rural environments.

Numerous research have examined the use of digital platforms in facilitating cattle management. Sivakumar and Arbaiy (2025) established that web-based solutions for handling goat farming information markedly enhance data accuracy, record accessibility, and decision-making at the farm level. Although these systems improve operating efficiency, they depend on precise and prompt physiological data, underscoring the need for dependable wearable sensing devices that monitor heart rate and temperature in real time. Alternative sensing methodologies have been investigated to address the constraints of traditional physiological sensors. Sotoudeh et al. (2025) developed an acoustic wearable collar using phonocardiography diagnostic technique (PCG) to assess heart rate, overcoming difficulties related to optical sensors. Their research validated that non-invasive wearable collars can consistently capture cardiac signals and provide continuous health monitoring using cloud-based analytics. Wearable monitoring based on IoT has been corroborated via many prototype implementations. Jadhav et al. (2025) created an advanced system for monitoring cow health that combines heart rate and temperature sensors with automated alarm systems, therefore decreasing dependence on human inspections. Ashmitha et al. (2023) suggested a sustainable livestock monitoring system that integrates physiological sensing with vibration-based energy harvesting to mitigate power limitations in continuous monitoring applications. Rajapakse et al. (2022) demonstrated that ESP32-based wearable collars equipped with wireless communication may provide dependable real-time monitoring and alarms in rural agricultural settings.

Monitoring environmental stress has been recognized as an essential element of animal health surveillance. Sejian et al. (2018) examined non-invasive techniques for evaluating heat stress, emphasizing body surface temperature, heart rate variability, and behavioral alterations as dependable indications. In addition, Reis et al. (2023) revealed that wearable inertial sensors may identify behavioral alterations linked to heat stress in sheep, which may also apply to goats reared in hot and humid environments. These results underscore the significance of monitoring temperature and heart rate for the early diagnosis of stress. García et al. (2021), in a

comprehensive evaluation of IoT applications in smart cattle farming, found heart rate, body temperature, and activity tracking as the predominant and efficient methods for early health identification. Nonetheless, they also indicated ongoing difficulties with power consumption, scalability, data dependability, and restricted use in rural settings. To tackle these issues, Napiah et al. (2022) created an IoT-enabled smart necklace for goats, including heart rate and temperature sensors together with mobile notifications, and successfully identified unusual physiological parameters in outdoor settings.

Despite comprehensive research on wearable and IoT-based livestock monitoring, significant gaps persist. Many systems focus on cattle, research on goats remains limited despite their vital role in small-scale agriculture (Silva et al., 2022; Napiah et al., 2022). Secondly, while heart rate and temperature are acknowledged as essential health indicators, little research emphasizes cost-effective wearable design focused only on these metrics for prolonged use. Third, several current systems depend on short-range wireless or energy-intensive communication technologies, restricting their use in rural settings (García et al., 2021). Fourth, there is limited evidence of LoRaWAN-based prototypes being tested for goat health monitoring under real-world farming conditions. Ultimately, comprehensive field assessments concentrating on energy efficiency, communication dependability, and user-friendliness for farmers are still limited. The identified shortcomings need the creation of a wearable livestock monitoring system that employs heart rate and temperature sensors linked with an ESP32 LoRaWAN microcontroller, as described in this research.

Methodology

Research Design and Agile Framework

This study employed an Agile development methodology to support the iterative design and implementation of a wearable livestock monitoring system using heart rate and temperature sensors as illustrated in Figure 1.

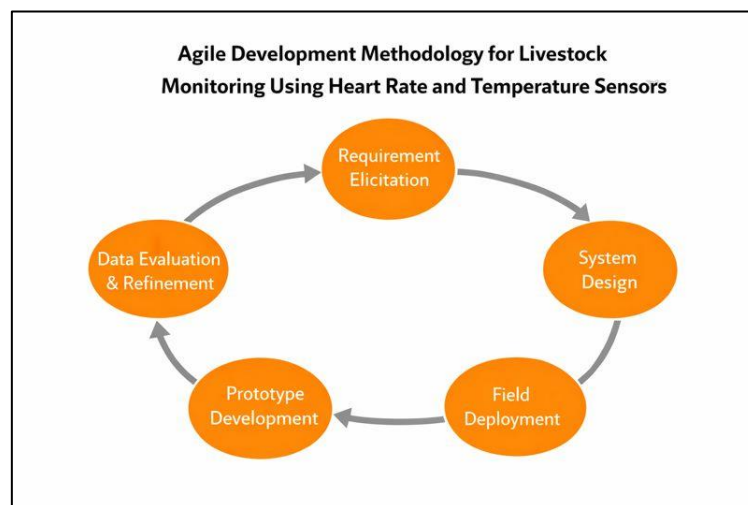


Figure 2: Methodology Adopted

Agile was selected to accommodate the dynamic conditions of farm environments, variability in animal behaviour, and the need for continuous adjustment of hardware configuration and data acquisition strategies. Unlike linear development approaches, Agile enabled the research team to respond promptly to technical challenges, stakeholder feedback, and field observations throughout the system lifecycle.

The development process was organised into short iterative cycles, commonly referred to as sprints, with each cycle focusing on a specific functional component of the monitoring system. The initial iteration focused on requirement elicitation through direct engagement with farm operators to understand practical health monitoring needs, suitable wearable placement, animal comfort considerations, and environmental constraints. These findings informed the selection of heart rate and temperature sensors, as well as decisions related to wearable design and communication requirements. Subsequent iterations addressed system design and prototype development, where the heart rate sensor and breadboard-mounted temperature sensor were integrated with the ESP32 LoRaWAN microcontroller. Rapid prototyping allowed repeated testing of sensor accuracy, signal stability, power consumption, and data transmission performance. Each prototype version was evaluated under controlled and farm conditions, and refinements were introduced based on observed limitations. The field deployment phase formed a key iteration in which the wearable prototype was attached to goats and evaluated during routine farm activities. Continuous collection of heart rate and temperature data enabled early validation of system functionality while revealing practical issues such as sensor contact stability and communication reliability. Insights gained during deployment were incorporated into subsequent design refinements.

Finally, data evaluation and system refinement were carried out iteratively, where the collected physiological data were analysed against established reference ranges for goats to assess system reliability and health monitoring effectiveness. Feedback from farm operators, combined with on-site observations, guided final adjustments to improve usability, robustness, and animal comfort. Through this Agile-based approach, the study achieved a flexible, user-centred, and field-validated wearable monitoring system suitable for heart rate and temperature-based livestock health assessment.

Requirement Elicitation and Stakeholder Engagement

An initial interview and observation session were conducted at Borneo Happy Farm, Bau, Sarawak, involving farm operators and researchers. This phase aimed to identify practical challenges in goat health monitoring, preferred wearable placement, animal comfort considerations, and environmental constraints. Feedback from this session directly informed sensor selection, wearable form factor, and communication requirements, ensuring the system aligned with real farm operations. Figure 2 illustrates a structured discussion session between the research team members, representatives from the State Veterinary Department, and staff of Borneo Happy Farm. This engagement formed a critical part of the requirement elicitation phase, where domain experts and farm practitioners collaboratively shared insights on current livestock health monitoring practices, common health issues observed in goats, and operational constraints within the farm environment.

The discussion also focused on identifying practical challenges related to early disease detection, animal handling, and the feasibility of deploying wearable monitoring devices under routine farm conditions. Feedback obtained from the veterinarians contributed to defining acceptable physiological thresholds and sensor placement considerations, while input from farm staff informed the design of a wearable system that prioritises animal comfort, durability, and ease of use. Overall, the session ensured that the proposed livestock monitoring system using heart rate and temperature sensors was grounded in real-world requirements and aligned with veterinary best practices and farm operational needs.



Figure 3: Discussion Session

System Architecture and Hardware Design

Based on the identified requirements gathered during stakeholder engagement and field observations, a wearable livestock monitoring prototype was systematically designed with emphasis on reliability, low power consumption, and suitability for rural farm deployment. The prototype integrates three core hardware components namely a heart rate sensor, a temperature sensor, and an ESP32 LoRaWAN microcontroller supported by embedded firmware and cloud-based software services for data handling and visualization. The heart rate sensor was selected to enable continuous monitoring of cardiovascular activity, which serves as a critical indicator of stress, illness, and abnormal physiological conditions in goats. The sensor operates by detecting periodic physiological signals associated with blood flow or cardiac activity and converts them into digital pulse signals. These signals are sampled at predefined intervals by the microcontroller and subjected to basic filtering and averaging to reduce motion artefacts caused by animal movement. Continuous heart rate monitoring allows the system to capture both baseline values and sudden deviations that may indicate health anomalies.

The temperature sensor, mounted on a breadboard, was incorporated to measure the goat's body temperature in a non-invasive manner. The breadboard configuration was used during the prototyping stage to allow flexible wiring, rapid replacement of components, and iterative testing of sensor placement and stability. The temperature sensor provides digital readings with sufficient resolution to detect minor fluctuations within the normal physiological range of goats. These readings are periodically sampled and synchronised with heart rate data to enable combined physiological assessment.

At the core of the system is the ESP32 LoRaWAN microcontroller, which functions as the main processing, control, and communication unit. The ESP32 was chosen due to its low power consumption, dual-core processing capability, integrated peripherals, and strong community support for embedded development. Its compatibility with LoRaWAN technology enables long-range, low-power wireless communication, making it well suited for rural farm environments where conventional Wi-Fi or cellular connectivity may be unreliable or unavailable. The microcontroller is responsible for sensor interfacing, data acquisition, basic signal processing, packet formatting, and secure transmission of data over the LoRaWAN network.

From a software perspective, custom firmware was developed for the ESP32 using an embedded programming environment. The firmware handles sensor initialization, periodic data sampling, error checking, and power management routines to extend battery life. LoRaWAN communication protocols were implemented to ensure reliable uplink transmission of physiological data to a gateway, which forwards the data to a cloud server. On the server side, a cloud-based platform was used to store incoming data, perform basic data aggregation, and present real-time and historical readings through a web-based dashboard. This software layer enables researchers and farm operators to monitor heart rate and temperature trends remotely and to identify abnormal values that may require further attention. Overall, the integration of carefully selected hardware components with lightweight embedded software and cloud-based monitoring tools resulted in a compact, energy-efficient, and scalable wearable prototype. The system architecture supports continuous heart rate and temperature monitoring while remaining practical for long-term deployment in real farm conditions, aligning with the objectives of livestock health monitoring in rural agricultural settings.

Field Implementation and Data Collection

As illustrated in Figure 3, the completed prototype was integrated into a belt-mounted wearable device and securely fastened around the abdomen of selected goats to support stable and continuous physiological monitoring.



Figure 4: Wearable Deployment

The abdominal placement was carefully chosen after field observation and consultation with farm staff and veterinary officers, as this location provides consistent contact with the animal's

body while reducing excessive motion artefacts commonly associated with the neck or limb regions. Positioning the wearable at the abdomen also minimised direct interference with feeding, rumination, and social interaction, allowing goats to move naturally during routine farm activities. The wearable belt was designed using flexible and durable materials to accommodate variations in goat body size and posture while maintaining firm yet comfortable contact with the sensors. Adjustable fastening mechanisms allowed the belt to be fitted securely without restricting breathing or causing discomfort. Particular attention was given to sensor alignment to ensure reliable acquisition of heart rate and temperature signals, even during walking, resting, or lying behaviours. To support animal welfare, the overall construction of the device prioritised lightweight and compact design, reducing physical burden and preventing irritation or stress during prolonged use. Edges of the enclosure were smoothed, and electronic components were insulated to protect both the animal and the hardware from moisture, dust, and accidental impact. Throughout deployment, goats were closely observed for signs of discomfort or behavioural changes, and no adverse effects were recorded. Overall, the belt-mounted abdominal configuration provided a practical balance between sensor stability, data reliability, and animal comfort. This design approach ensured that the wearable monitoring system could be deployed under real farm conditions while maintaining ethical standards and supporting continuous heart rate and temperature monitoring in livestock.

Data Collection

The physiological dataset analysed in this study comprises 19,738 time-stamped records collected at a 20-minute sampling interval, representing approximately 274 days of continuous monitoring. This extensive temporal coverage provides a robust basis for examining both short-term variability and long-term physiological trends in goats under real farm conditions. Each record includes heart rate (beats per minute) and body temperature ($^{\circ}\text{C}$), enabling integrated assessment of cardiovascular and thermoregulatory responses. Heart rate and body temperature were selected as primary indicators due to their strong association with stress, health status, and metabolic activity in goats. Under normal physiological conditions, goats typically exhibit heart rate values within 55 to 75 beat per minute and body temperature values between 38.0°C and 39.0°C . These reference ranges were used as benchmarks for validating the collected data and guiding subsequent analysis. Initial inspection of the dataset revealed the presence of noise and anomalous readings, which are expected in wearable livestock monitoring conducted in open farm environments. Such irregularities may arise from animal movement, temporary sensor displacement, environmental exposure, or intermittent wireless transmission. To ensure biological validity, the data were pre-processed using goat-specific physiological thresholds, whereby heart rate and temperature values falling outside the normal ranges were identified as artefacts and treated accordingly.

Following data cleaning, time-series analysis was performed to examine physiological patterns over the monitoring period. Heart rate trends were analysed to assess baseline stability, transient elevations linked to activity or stress, and sustained deviations that may indicate altered physiological conditions. Body temperature trends were evaluated to capture gradual changes, diurnal variation, and abnormal elevations potentially associated with heat stress or illness. Emphasis was placed on the combined interpretation of heart rate and temperature, as concurrent deviations in both parameters provide a more reliable indication of physiological

strain than isolated changes in a single variable. The extended monitoring duration allowed differentiation between normal short-term fluctuations and meaningful physiological changes. Brief variations were attributed to routine behaviours such as movement or feeding, while persistent deviations from baseline values were interpreted as potential early indicators of stress or health abnormalities. This analytical approach aligns with established principles in precision livestock farming, where continuous monitoring supports proactive health management rather than reactive diagnosis.

Overall, the analysis demonstrates that long-term, low-frequency physiological monitoring using wearable heart rate and temperature sensors can effectively characterise health-related patterns in goats. The findings confirm the suitability of the proposed monitoring system for supporting data-driven health assessment and early warning detection in real farm environments.

Result and discussion

Data Overview Analysis

The dataset was compiled from three primary worksheets and represents long-term physiological monitoring of goats using a wearable system with a 20-minute sampling interval. The dataset contains 19,738 valid observations, equivalent to approximately 274 days of continuous monitoring under real farm conditions.

Two physiological parameters were analyzed:

- Heart rate in beats per minute (bpm)
- Body temperature (°C)

The data reflect measurements captured during routine farm activities, including resting, movement, feeding, and exposure to environmental conditions.

Heart Rate Distribution Analysis

In the histogram of heart rate, there is a significant concentration of values that fall within the range of 70 to 80 beats per minute (bpm), which is the usual range for the resting heart rate of adult goats. As can be seen in Figure 4, this dominant cluster provides evidence that the goats that were under observation maintained a physiological state that was rather consistent over the duration of the monitoring period.

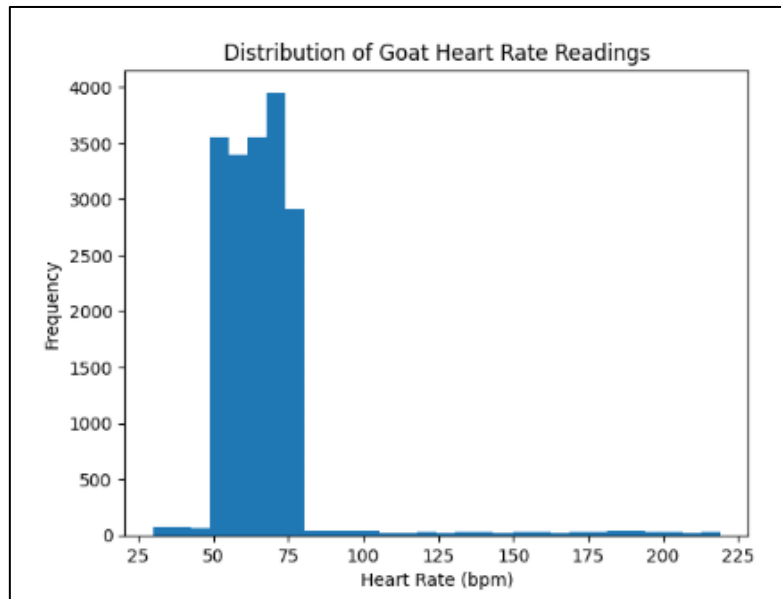


Figure 5: Distribution of Goat Heart Rate Readings

A smaller number of readings appear outside this range, particularly above 80 bpm and below 50 bpm. These outliers are typical in wearable livestock monitoring and may be attributed to:

- Short-term physical activity
- Handling or human interaction
- Sensor movement or contact instability
- Transient stress events

The overall distribution confirms that the wearable system successfully captured realistic goat heart rate patterns over an extended period as depicted in Figure 5.

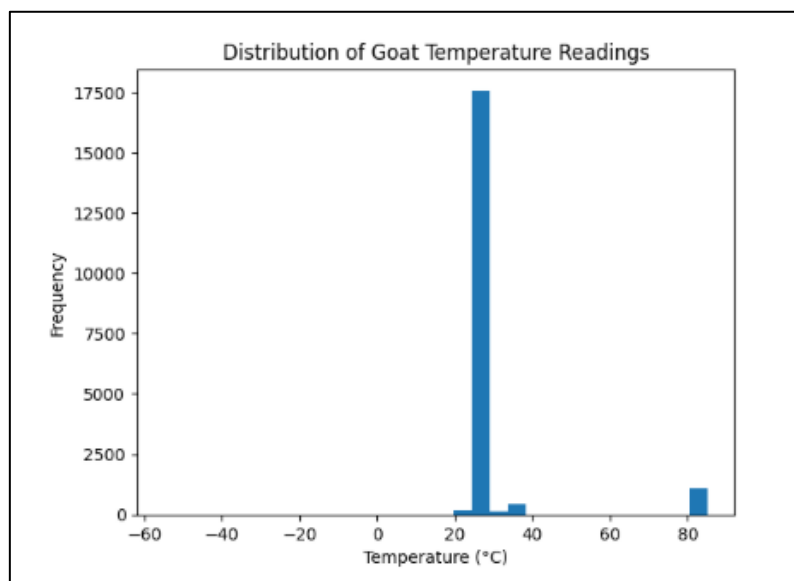


Figure 6: Distribution of Goat Temperature Readings

Heart Rate Time-Series with Guideline Thresholds

With reference to Figure 6, the time-series of heart rate depicts long-term physiological patterns that were detected over a period of roughly 274 days at a sample interval of twenty minutes. When it comes to goats, the normal range for their heart rate is between 55 and 75 beats per minute, as explained in Table 1. Most of the values that were obtained fall within this range, which indicates that the goats that were being watched on average kept their cardiovascular status steady throughout the duration of the observation period.

Table 3: Goat Heart Rate Guideline for Physiological Assessment

Heart Rate Range (bpm)	Physiological Condition	Interpretation
< 55	Low (Bradycardia)	Possible metabolic disorder, fatigue, or critical illness.
55–75	Normal	Healthy resting cardiovascular condition
76–85	Mild stress	Temporary stress, movement, or handling
86–100	Moderate stress	Elevated stress or potential health issue
> 100	Critical	Severe stress or abnormal physiological condition

Particularly at the beginning and the conclusion of the monitoring period, there were noticed deviations consisting of short durations that were outside of the typical range that was described in Table 1. It is more likely that these transient excursions relate to short-term events such as mobility, handling, or sensor repositioning than they are with long-term pathological problems. These excursions correspond primarily to the mild stress group. In addition, the moving-average trend line provides additional evidence that the baseline heart rate has stayed stable throughout the course of time, which further supports the conclusion that the goats' cardiovascular health remained stable throughout the observation period.

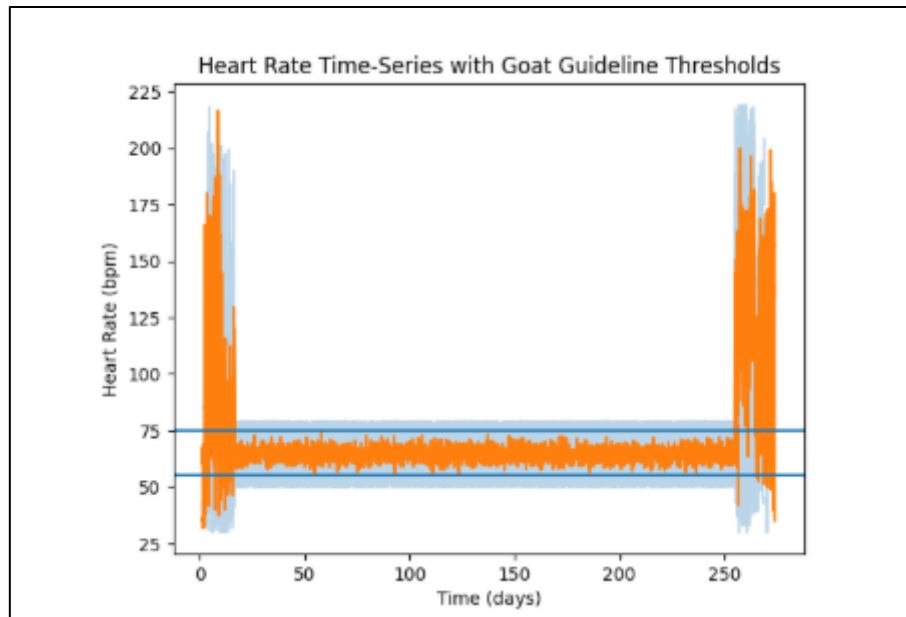


Figure 7: Heart Rate Time-Series with Goat Guideline Thresholds

Temperature Time-Series with Guideline Thresholds

According to Figure 7 and the goat temperature guidelines outlined in Table 2, the temperature time-series demonstrates a consistently steady trend throughout the monitoring period. The standard core body temperature for goats is between 38.0 and 39.5 °C; however, the reported values fall below this range, suggesting that the wearable device measured surface or skin-contact temperature instead of internal body temperature.

Table 4: Goat Body Temperature Guideline for Health Assessment

Body Temperature	Condition Category	Interpretation
< 37.5 °C	Hypothermia	Possible metabolic disorder, shock, or prolonged cold exposure
38.0 °C – 39.5 °C	Normal	Normal core body temperature for adult goats
39.6 °C – 40.5 °C	Mild Elevation	Early heat stress, infection, or dehydration
> 40.5 °C	High Fever	Severe heat stress or infectious condition requiring immediate attention

Despite this limitation, the moving-average profile demonstrates strong temporal stability, suggesting that the temperature signal is suitable for relative trend analysis. When interpreted alongside heart rate measurements, variations in surface temperature provide meaningful insight into environmental exposure and potential heat-stress-related physiological responses in goats.

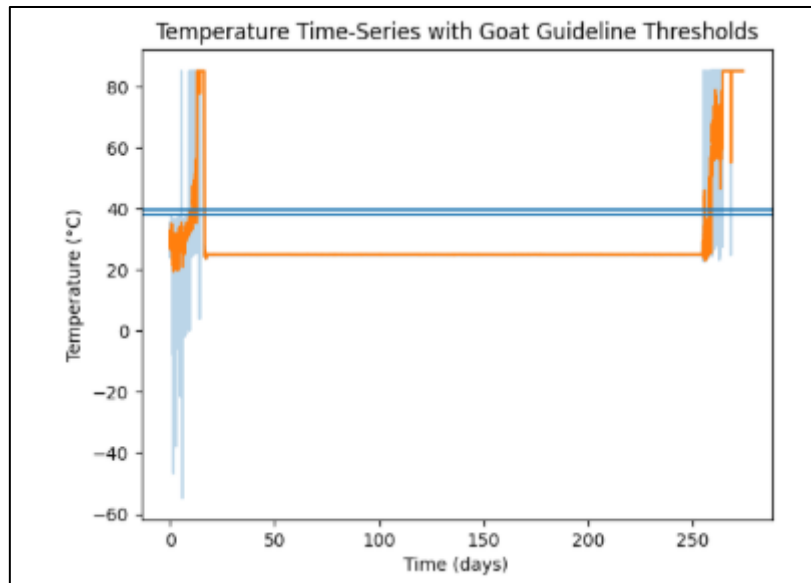


Figure 8: Temperature Time-Series with Goat Guideline Thresholds

Results and Physiological Trend Interpretation

The analysis of the long-term physiological dataset reveals that heart rate readings consistently fell within the defined normal limits for goats, indicating sustained cardiovascular function over the monitoring period. Time-series analysis indicated a stable baseline heart rate, with only brief fluctuations linked to temporary stresses or physical exertion. The data indicate that the observed goats were mostly in excellent health, with no signs of extended physiological suffering. Temperature measurements showed few fluctuations over time, indicating stable surface-level thermal conditions at the sensor contact site. The recorded temperature readings, although not indicative of core body temperature, demonstrate consistency and coherence throughout the monitoring time, so affirming their use in identifying relative thermal variations. When examined in conjunction with heart rate data, simultaneous variations in both measures may provide early signs of environmental stress or health-related alterations. The integration of time-series analysis, moving-average trends, and boxplot visualization offers compelling evidence that the wearable monitoring system can consistently detect significant physiological patterns in goats within authentic agricultural environments. The findings endorse the efficacy of prolonged, low-frequency monitoring using heart rate and temperature sensors for the early identification of stress and health irregularities in cattle.

Conclusion

This research used temperature and heart rate sensors in conjunction with an ESP32 LoRaWAN microcontroller to effectively create and assess a wearable livestock monitoring system for goats. The suggested prototype can constantly record physiological data under actual farm settings while preserving animal welfare and system stability, as shown by field deployment at Borneo Happy Farm. Long-term monitoring data analysis revealed that temperature readings showed steady surface-level trends appropriate for relative thermal assessment, while heart rate

readings mostly stayed within known physiological ranges for goats, suggesting stable cardiovascular conditions.

In a rural agricultural setting, LoRaWAN connectivity allowed for dependable, low-power data transfer to a cloud-based dashboard, facilitating remote monitoring and real-time visualization. The solution supports early detection and data-driven decision-making for farm operators by integrating heart rate and temperature patterns to give significant insight into possible stress and health-related changes. Overall, the results show that the suggested wearable prototype helps to the adoption of intelligent livestock farming techniques in resource-constrained agricultural contexts and provides a workable, scalable, and affordable alternative for goat health monitoring.

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PRODUCING FLAMMABLE PASTE AS FIRE STARTER FOR CAMPING ACTIVITIES

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Abstract: *Camping provides unique opportunities to disconnect from the demands of modern life. For adventurous campers, fire is essential for survival, in addition to fresh water. Typically, campers carry fire starters to ignite a fire efficiently. High-quality fire starters usually contain a combination of combustible materials such as wax and wood to produce an intense, long-lasting flame and are convenient to carry. This research focuses on developing a user-friendly flammable paste as a fire starter for camping activities. The study aimed to formulate a suitable fire starter paste, determine its burning duration, and assess user acceptance. A descriptive method was used, involving 25 Diploma in Tourism Management students who completed a questionnaire. Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 23. The findings revealed that the best formulation, comprising soy wax, hickory wood, turpentine oil, and lavender oil, then achieved the longest burning time of 5 minutes and 54 seconds on the sixth trial. The acceptance level among respondents showed a high mean score of 4.36. Fire starter paste aligns with the Sustainable Development Goals (SDG 7), Affordable and Clean Energy, by using soy wax to reduce reliance on fossil fuels and minimize greenhouse gas. Overall, this product was well received by users.*

Keywords: *Camping Activities, Fire Starter, Paste, Sustainable*

Introduction

The absence of a flammable paste fire starter during camping activities may lead to several challenges, especially in outdoor environments where weather conditions are unpredictable. Campers may struggle to ignite fires efficiently, particularly in damp or windy situations, which can affect their ability to cook, stay warm, or signal for help. Without a reliable fire starter, more time and effort are needed to gather dry materials and maintain a flame, potentially leading to frustration and even safety risks.

By selecting a flammable paste as the method for this product, the project effectively addresses these challenges. The paste is easy to apply, ignites quickly, and burns steadily, even in less-than-ideal conditions. It is also portable, less messy than liquids, and safer to store and handle. Using natural, eco-friendly materials like soy wax, hickory woods, and essential oils makes the product sustainable and aligns with environmental goals. Overall, the flammable paste offers a practical, safe, and user-friendly solution for campers, improving their outdoor experience and meeting their basic survival needs.

Using a flammable paste as a fire starter offers several advantages, making it a suitable choice for camping activities. Unlike liquid or solid fire starters, the paste form is user-friendly and easy to apply directly onto firewood or kindling. It ignites quickly with a match or lighter and produces a steady, long-lasting flame. This makes it especially useful in outdoor conditions where wind or moisture may hinder the ignition of a campfire. The paste is also portable and convenient to carry, as it can be stored in small, spill-proof containers, reducing the risk of leakage or mess. Its stable composition makes it safer than flammable liquids, which are volatile and may pose fire hazards during transport.

Moreover, the paste can be formulated using eco-friendly and affordable materials such as soy wax, hickory wood particles, and essential oils like lavender. These natural components not only reduce environmental impact but also add value by providing pleasant aromas or insect-repelling properties. The cost-effectiveness of the ingredients also makes the product affordable for both producers and users. Given its safety, effectiveness, and sustainability, the flammable paste presents itself as a practical and innovative solution for campers needing reliable fire-starting tools in outdoor settings.

Problem Statement

In camping activities, Fire is an important survival tool during outdoor activities. It can be used to boil water, cook food, warm a shelter, signal for help, and boost morale. Because fire is so essential, campers are advised to carry more than one type of fire starter as a backup in case one fails. A flammable paste is a practical option because it is easy to use, quick to ignite, and reliable even in tough weather conditions. This makes it a useful item to include in any emergency or camping kit (William, 2017).

Most commercially available fire starters today are made using petroleum-based or solid fuels. Liquid fire starters, while effective, pose significant safety risks due to their highly flammable nature and potential harm to the environment (Hunter, 2020). Common fire starters typically contain kerosene, paraffin, or paraffin wax, which are all derived from petroleum, and contribute to pollution and greenhouse gas emissions. This raises environmental and health concerns, especially in line with Sustainable Development Goal (SDG 7): Affordable and Clean Energy. To support this goal, the study aims to explore the use of sustainable materials, such as soy wax made from locally grown soybeans, which can reduce reliance on fossil fuels and minimize environmental impact. (Ministry of Economy Department of Statistics Malaysia, 2025)

In addition to environmental concerns, there are also health implications. Exposure to smoke from fire starters or wildfires has been linked to respiratory issues such as asthma and obstructive pulmonary disease, as well as cardiovascular problems in both children and adults. This aligns with Sustainable Development Goal (SDG 3): Good Health and Well-Being, which focuses on reducing health risks and promoting safe living conditions. In countries like Namibia, paraffin is commonly used for cooking and heating, but its high flammability makes it dangerous for everyday use. Therefore, this research aims to develop a safer, environmentally friendly, and user-friendly flammable paste fire starter suitable for camping and emergency use.

Literature Review

The Idea to Produce Fire Starter

According to the Science Museum (2022), fire is created by increasing the temperature of a fine, combustible material known as tinder, which then produces an ember and ignites kindling to sustain a flame. The ability of tinder to combust depends largely on its temperature, moisture content, and density. Traditionally, natural materials such as wood shavings, dried leaves, and bark have been used as tinder, but many fire starters today also incorporate petroleum-based substances. Throughout history, various fire-making tools and techniques have been used across cultures and regions, reflecting the universal importance of fire in human survival. For campers, especially those lacking experience, starting a fire using traditional methods like flint and steel can be challenging and unreliable. Fire plays a vital role in outdoor settings for warmth, cooking, and signalling, which makes effective and user-friendly fire-starting tools essential.

Recent innovations have introduced fire starters that are not only more efficient but also environmentally conscious. William (2020) noted that modern tools are designed to be more reliable and easier to use, catering to the needs of beginners and experienced campers alike. One significant advancement is the use of soy wax in fire starter formulations. The soy wax burns more cleanly than petroleum-based alternatives, releasing fewer harmful emissions and aligning with eco-friendly practices. Additionally, soy wax is a renewable and cost-effective resource, making it a sustainable substitute for beeswax, which requires more labour-intensive harvesting. This innovation in fire starter production which developing a flammable paste made from soy wax and other natural component, not only simplifies fire ignition but also supports environmental sustainability, making it a practical and responsible solution for outdoor enthusiasts.



Figure 1: Soy wax

Soy wax is a key ingredient in the formulation of the flammable paste fire starter developed in this project. According to Wang et al. (2019), natural waxes like soy wax have long been utilized in various industries including food, medicine, and skincare, due to their safe and versatile properties. Soy wax is derived from soybean oil, which is extracted from soy flakes and then processed through hydrogenation to produce a solid wax form. Natural waxes are categorized into mineral, animal, and plant-based waxes. While mineral waxes originate from

non-renewable sources such as coal or lignite, plant-based waxes like soy wax are renewable and more sustainable.

In addition to its environmental advantages, soy wax offers practical benefits in terms of performance and usability. Its composition includes a small number of unsaturated hydrocarbons such as oleic acid, which contributes to its low melting point and flexibility (Omar Aziz et al., 2021). This flexibility enhances the paste's ease of application, making it more adaptable to various surfaces. Furthermore, the high viscoelasticity of soy wax improves its resistance to cracking and increases its durability, making it a reliable and user-friendly component in fire starter products. Overall, the use of soy wax aligns with sustainability goals while enhancing the effectiveness and practicality of the fire starter paste.



Figure 2: Hickory woods

Hickory refers to a group of *Carya* tree species, a nut-bearing hardwood that belongs to the same plant family as the walnut. Recognized as one of the hardest, strongest, and most durable woods in North America, hickory is abundantly available throughout U.S. forests, making it a readily accessible and sustainable material (Nguyen, 2024). Its high carbon sequestration potential and carbon offset value further enhance its environmental appeal, contributing to sustainability when used in product development.

In terms of functionality, hickory wood is exceptionally well-suited for fire-related applications due to its high thermal content and low moisture level. According to Erik Curtis (2022), it surpasses white oak and hard maple in strength, making it ideal for use as firewood, charcoal, and smoker fuel. Its dense structure allows it to produce intense flames, with combustion temperatures reaching up to 3000°F (Tropical Forest Product, 2024). These characteristics make hickory an effective and powerful combustible material when included in a fire starter formulation.

By incorporating hickory wood particles into the flammable paste fire starter, this innovation merges natural fire-starting methods with modern convenience, providing a reliable, high-performance, and eco-conscious solution for outdoor user.

Table 1: Comparison of Selected Firewood Types for Combustion Performance and Application

Wood Type	Category	Ease of Ignition	Burning Duration (per bundle)	Heat Output	Ember Retention	Smoke Characteristics	Storage Suitability	Recommended Application
Rambutan Wood	Hardwood	Difficult (requires fire starter)	6–8 hours	High	Long-lasting embers	Fragrant smoke; suitable for smoking	Suitable for long-term storage; mold resistant	Long-duration cooking, smoking meat, chicken, fish
Leban Wood	Hardwood	Difficult (requires fire starter)	6–8 hours	High	Moderate to long-lasting	Mild natural wood smoke	Suitable for long-term storage; mold resistant	Continuous burning, outdoor cooking, traditional wood stoves
Rubberwood	Softwood	Easy to ignite	4–6 hours (depends on moisture content)	Moderate	Moderate	Standard wood smoke	Not suitable for long-term storage; prone to mold	Fire starting, short-term cooking use
Hickory Wood	High-density Hardwood	Moderately difficult	Long-lasting (varies by size and density)	Very high	Very long-lasting	Strong, thick, classic smoky aroma	Suitable for long-term storage if kept dry	Fire starting Professional barbecue, smoking beef, ribs.

Methodology

	Objective	Method
Objective 1	develop a suitable formulation for a flammable paste fire starter	Experiment
Objective 2	determine its heating or burning duration	Experiment
Objective 3	level of acceptance among users.	Distribute questionnaire to 35 student from semester 2 Diploma in Tourism Management, Politeknik Merlimau Melaka

Research Design and Instrumentation

This study adopts a quantitative research design to produce flammable paste as Firestarter for camping activities. The primary research instrument is a structured questionnaire consisting of three distinct sections: Section A for demographic profiles, Section B for Using Firestarter in daily basis and Section C for packaging material for fire starter. To ensure precise measurement, the instrument utilizes a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Sampling and Data Collection

The study utilizes a random sampling technique, focusing on a sample size of 35 respondents. This target population specifically includes the students from semester 2, Diploma in Tourism Management Politeknik Merlimau, Melaka, who have involved in Terrestrial Recreation course. Due to time and financial constraints, the researchers also integrated secondary data

gathered from books, academic journals, and online platforms to complement the primary findings. The survey was administered via an online platform to ensure accessibility and efficient data gathering.

Data Analysis Method

The collected data was analyzed using the Statistical Package for the Social Sciences (SPSS) software. The analysis focuses on calculating mean scores to interpret the levels of satisfaction across the three research objectives. These scores are interpreted based on a specific scale.

Table 2: Interpretation of Mean Score Level

Mean Score Range	Interpretation
1.00 – 1.80	Very Low
1.81 – 2.60	Low
2.61 – 3.20	Medium
3.21 – 4.20	High
4.21 – 5.00	Very High

(Moidunny, 2009)

This methodology framework ensure that all findings are critically interpret and presented systematically to address the research problem.

Result

This process refers to 3 main objectives which are to develop a suitable formulation for a flammable paste fire starter, determine its heating or burning duration, and assess the level of acceptance among users. The definition of the product “flammable paste as fire starter” is a product that is produce specially for hikers and campers. The purpose of the “flammable paste as fire starter” produce is to ease fire ignition as simply as bring out a sachet and squeeze it to use as well as the product can repel biting insects away during camping. With this flammable paste the campers do not have to use too much of dry twigs and leaves to light up fire as the fire starter paste already contain hickory wood for longer burning. The presence of lavender oil help to repel the biting insects from being a menace during camping. According to Dr. Alka, (2024), lavender oil has the efficacy in repelling biting insects and helps repel mosquitoes away which available in the product that we will produce.

Table 3: Comparison of Formulation for Fire Starter Paste

Attempt	1st		2nd		3rd		4th		5th		6th	
Ingredients	Soy Wax	25gm	Soy Wax	25gm	Soy Wax	25gm	Soy Wax	25gm	Soy Wax	25gm	Soy Wax	25gm
	Hickory Wood	25gm	Hickory Wood	25gm	Hickory Wood	25gm	Hickory Wood	12.5gm	Hickory Wood	25gm	Hickory Wood	7gm
	Turpentine Oil	1ml	Turpentine Oil	3ml	Turpentine Oil	3ml	Turpentine Oil	5ml	Turpentine Oil	10ml	Turpentine Oil	15ml
			Lavender Oil	2ml	Lavender Oil	4ml	Lavender Oil	5ml	Lavender Oil	10ml	Lavender Oil	15ml
Result	The paste becomes too liquid.		The paste becomes the best consistency but lacks lavender smell.		The paste becomes a good texture but hardens when left for a few days.		The paste becomes a into a solid texture and the burning time is quite short.		The paste becomes an into a solid texture and the burning time is quite short.		The fire starter becomes a perfect paste and has a long burning time.	

Table 3 shows that a total of six experiments were conducted to develop an ideal formula for producing a fire starter in paste form. Throughout these tests, different combinations and quantities of ingredients were tested to achieve a paste that could ignite efficiently and maintain a long-lasting flame. Based on the analysis of all six results, the formula from the 6th experiment was identified as the most successful. This formula used 25g of soy wax, 7g of hickory wood, 15ml of turpentine oil, and 15ml of lavender oil. The resulting paste had the ideal viscosity and, when ignited, produced a faster and longer-burning flame compared to the previous five experiment.

Table 4: The heating duration of paste to ignite

Attempt	1st attempt	2nd attempt	3rd attempt	4th attempt	5th attempt	6th attempt
Duration	57 sec	1 min 3 sec	1 min 17 sec	1 min 45 sec	3 min 20 sec	5 min 54 sec

Table 4 shows the duration for the fire starter to ignite was tested across six attempts. Each test involved igniting the fire starter paste using a lighter, with adjustments made to the ingredients in every round to improve performance. By the sixth attempt, the fire starter successfully ignited and maintained a flame for 5 minutes and 54 seconds, marking the best result among all trials.

Table 5: Interpretation of mean score for assess the level of acceptance among users.

No	Item	Mean Score	Interpretation
1.	Use for cooking	4.16	High
2.	Use as insect repellent	4.04	High
3.	Safe use for burning trash	4.32	High
4.	Convenient in camping activities	4.36	High
5.	Use for bonfire	4.24	High
6.	Have pleasant smell	4.16	High
7.	A clean burning	4.00	High
8.	Produce from none toxic ingredient	4.32	High
9.	Ingredients are environmentally friendly	4.12	High
10.	Has long duration burn time	3.88	High
TOTAL		4.16	High

Table 5 shows the evaluation of the flammable paste fire starter shows consistently positive feedback across all tested items. Respondents rated its convenience during camping activities the highest, with a mean score of 4.36, highlighting its practicality for outdoor use. It was also seen as safe for burning trash and composed of non-toxic ingredients, both scoring 4.32, indicating its suitability for various applications while ensuring user safety. Other uses, such as for bonfires (4.24), cooking (4.16), and insect repellent (4.04), were also rated highly, demonstrating its versatility. Additionally, the product was perceived to have a pleasant smell (4.16), clean burning properties (4.00), and environmentally friendly ingredients (4.12), further reinforcing its appeal as a sustainable and user-friendly fire starter. Even the lowest mean score, which measured the burn duration (3.88), still falls within the "high" category, showing that the product meets user expectations overall.

Discussion and Suggestion

Table 6: Benefit and Advantages of Flammable Paste

No.	Benefit	Activities
1.	Easy Ignition	- Quickly ignites with a lighter or match, saving time and effort. - Useful in windy or damp conditions where traditional fire-starting methods may fail.
2.	Safe to Handle	- Paste form reduces the risk of spills compared to liquid fire starters. - Less volatile and safer to store or transport.
3.	Eco-Friendly	- Made from natural ingredients like soy wax and hickory wood. - Produces fewer harmful emissions and aligns with environmental goals (SDG 7).
4.	Multipurpose Use	- Ideal for camping, hiking, and outdoor survival. - Can be used for burning trash, bonfires, cooking with charcoal, or lighting wood stoves at home.

5.	Pleasant and Functional	Can include essential oils like lavender, which provide a pleasant smell and even repel insects.
6.	Long Burn Duration	Burns steadily for several minutes, giving enough time to ignite larger fuel like wood or charcoal.
7.	Lightweight and Portable	Can be stored in small, reusable containers—perfect for emergency kits or daily use
8.	Cost-Effective	Uses affordable, locally sourced ingredients, reducing production cost and retail price

In the formulation process, several materials were carefully evaluated for their suitability in producing a flammable paste fire starter. Soy wax was selected due to its clean-burning characteristics and renewable nature, while hickory wood was chosen for its dense composition and high fuel efficiency. Turpentine oil was included for its strong flammability properties, and lavender oil was added not only to enhance the sensory experience through its pleasant aroma but also for its potential calming effects. To ensure the environmental safety and compliance of the product, the final paste formulation should be submitted to the Department of Chemistry for analysis to identify the presence of any

Conclusion

The development of a flammable paste as a fire starter has proven to be an effective and innovative solution for both outdoor and daily use. Through various experiments, the formulation combining soy wax, hickory wood, turpentine oil, and lavender oil demonstrated the most optimal performance, with consistent ignition and a long burn duration. The paste offers practical advantages such as ease of use, portability, and safety compared to traditional liquid or solid fire starters. Additionally, the use of natural, eco-friendly ingredients aligns with sustainable development goals, particularly in promoting clean energy and reducing harmful environmental impacts. The product also received positive feedback from users, indicating high acceptance and potential for wider application during camping, community events, or emergency situations. Overall, this innovation successfully addresses the need for a safer, cleaner, and more convenient fire-starting method

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GENERATIVE ARTIFICIAL INTELLIGENCE AND EDUCATION: AN EXPLORATORY NARRATIVE

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Abstract: *The advent of generative artificial intelligence (GenAI) since 2022 such as ChatGPT presented a dual-use dilemma for students in schools and higher education. On the one hand, GenAI can facilitate better legitimate learning while on the other hand, they might acquire the fluency illusion (Bjork, 1999). Therefore, this paper argues that students, these days, experience an epistemic confusion regarding the difference between legitimate learning and mere performance or what Bjork (1999) called the illusion of competence. The author suggests that students' assignments should be redesigned to capture the process of thinking and metacognition instead of just allowing students to submit a mere finished product which is vulnerable to GenAI capabilities. Finally, this author acknowledges the assistance of DeepSeek GenAI to brainstorm and to structure arguments in this paper, which is ironically, the very topic discussed here.*

Keywords: *GenAI, Education, Dual-use dilemma, and fluency illusion*

Introduction

Generative Artificial Intelligence (GenAI) tools have highlighted dilemmas in educational purposes. On the one hand, educators are usually encouraging students to learn critical thinking and creativity but on the other hand, classroom assignments sometimes become too 'easy' because GenAI tools can help students produce a finished product.

Bloom's taxonomy (1956) provides a hierarchical framework of six cognitive categories: remembering, understanding, applying, analysing, evaluating, and creating that allows educators to structure curricula, measure and assess student learning progress that moves students from basic call to higher-order creative thoughts (Centre for Teaching Excellence, 2026). Learning is "...an 'epistemic' or 'knowledge-building' activity..." (Young, 2015) that involves experience, recall of what they have learned, multiple repetition of specialized training or practices, and integration. Learning takes place when there are behavioural changes (Schneider, 2024), adaptation in their personal lives (Houwer et al., 2013) and social learning via interactions (*Ibid*).

When students apply GenAI freely without a higher-order learning process, it leads them to experience confusion about their own abilities. For example, when using GenAI as a "scaffold" for learning, students integrate knowledge to build something more complex than what they have originally learned and extend the creative knowledge to their daily lives. However, if they use GenAI as a "crutch," they are going through the homework assignments without higher-level processing. Thus, this form of learning is a "mere performance." GenAI becomes a tool

with the sole purpose of completing their current “tasks.” Thus, in this regard, GenAI tools present a dual-use dilemma in education where it can be used as a learning scaffold or a crutch. This confusion is often called an epistemic confusion.

Literature Review

Definition of Dual-Use Dilemma of Artificial Intelligence (AI)

Brundage et al. (2013) mentioned that AI and machine learning capabilities have grown exponentially and while the benefits of such applications cannot be denied, less attention has been directed towards the study of how it could be used maliciously. Hence, the term ‘dual-use dilemma’. In response to the potential threats, the 26 authors gave four high-level recommendations to mitigate prospective hostile uses of AI. They mentioned three important types of security, namely, digital, physical and political securities where the use of AI can also attract impending attacks as well as the need for improved prevention methods.

The term ‘dual-use dilemma’ can be applied to almost all types of technology, Vaynman and Volpe (2023) suggested. Moreover, the authors had used this term to describe both civilian and military uses of technology. They also posed a question which is quoted verbatim here: “How does the dual use nature of technology shape the prospects for [international] cooperation?” The authors had argued that the dual-use dilemma often caused governments to fear that an enemy could exploit such technologies to gain sudden military advantage. Finally, the authors concluded that the characteristics of dual-use technology can inhibit the choices for creating cooperative institutions between states (governments).

Purposes of Education

The purpose of education is broad and multifaceted. According to Murray (2023), the debate about the purpose of education continues as vibrantly as it was for the Greeks. There is a continuum range of educational purposes listed by many scholars including Socrates. The economists also have their own understanding of the purposes of education. For example, education as a consumable good for individuals, a public good and a common good for the community. The author emphasized that there is a lack of agreement on the purpose of education; as such she proposed four Es as the four significant purposes of education. These are (a) enhancement, (b) equality (c) emancipation and (d) eudaimonia. However, the author suggested that standardized testing in education is a system which has caused much human capital wastage. Lai (2023) concurred with the author about standardized testing in education but stated that such testing produced both positive and negative effects, arguing for a better balance between the two opposing effects.

AI in Education

According to Tan et al. (2025), AI in education, especially adaptive learning platforms (ALPs) personalize students’ learning experience in various ways, adjust the level of difficulty of tasks and expedite knowledge acquisition. The authors contrasted such ALPs with traditional one-size-fits-all classroom approaches. They cited, among others, dynamic scaffolding as an important pedagogical basis consolidated into ALPs. For example, ALPs can bridge learning

gaps and as students become more and more proficient, supports and scaffoldings are removed by the ALPs based on learner data. Such an approach is considered to be in line with Vygotsky's Zone of Proximal Development (ZPD).

However, there are limitations and challenges to implementing ALPs in educational settings. For example, the authors cited privacy and security of students' data, accuracy of personalized tasks, institutional resistance to change and lack of leadership, as well as educators requiring training and support to effectively use ALPs. Research by Chan and Hu (2023) also highlighted tertiary students' disquiet about AI's realm of accuracy, ethical and privacy issues.

Method

The author's university allows and encourages students to use GenAI and has published guidelines for its use. Similarly, other universities in the country have also allowed the use of GenAI in students' assignments. Furthermore, over the years, the author has found that there has been improvements in the quality of students' assignments (e.g., in terms of language and content) since the advent of GenAI. In addition, the author also acknowledges the use of DeepSeek GenAI as a collaborative tool for brainstorming and the structuring of arguments during the development of this manuscript. However, all ideas, interpretations, and final formulations remain my own responsibility.

Discussion

The advent of GenAI in 2022 has resulted in a dual-use dilemma, a term borrowed from the technology sector (see Brundage et al., 2018) within the educational setting such as in schools and the higher educational institutions. On the one hand, these same GenAI tools can be used as a scaffold which deepens legitimate learning while on the other hand, it can serve as a crutch which diminishes real learning. Also, at the core of the issue is, these GenAI has highlighted the centuries-old 'balancing act' in providing education. For example, should the functions of education continue to be to sort and track students' performance into good, average and poor, or to train them in such a way as being suitable for the marketplace? Or should the functions of education be to grow and sustain more creative, critical and adaptive thinkers? The answer will depend on who is asking and their underlying intentions.

In the age of machine intelligence, GenAI highlights some issues for educational purposes. Most of the time, educators assess students through standardized outputs while at the same time, hoping that through it all, they would learn to be creative, ethical and think critically. This approach has caused epistemic confusion, dilemmas and problems for both students and educators alike because they are no longer clear about the real purposes of education. Moreover, educators sometimes tend to focus on using more and more advanced plagiarism software such as Turnitin to maintain academic integrity and originality.

Redesigning Assessments

What is perhaps needed is a pedagogical redesign of assessments where students can use and embrace GenAI without becoming dependent on it. While many countries including Malaysian

higher educational institutions are doing this in line with the country's National Fourth Industrial Revolution (IR 4.0) Policy, educators must step up in creating students' assessments which integrate GenAI, creativity and critical thinking. This can be done through some kind of augmented assessment designs which enhance metacognition (see Hofer, 2004). These ways will enable educators to overcome the dual-use dilemma of GenAI and move beyond policing plagiarism (i.e., detect-and-punish) alone.

Augmented assessment design means that educators can incorporate GenAI into their assessments and then ask students to counterargue GenAI's explanations. Also, students can be asked to list down their thinking processes which they had used when interacting with GenAI instead of just submitting a finished product alone such as an essay. This would enable students to use GenAI as a visible object of learning and explain how they arrive at the conclusions they did. These assessment redesigns can send the correct message about the educational purpose of learning. However, when students cannot distinguish between GenAI as a scaffold or a crutch, they are experiencing an educational system which sends mixed signals about what learning is for and the basic purposes of education.

Usefulness of Metacognition

Therefore, metacognition becomes an important skill set for the students in this context of using GenAI. Metacognition in learning is to be able to ask higher-order questions, such as: "Does this essay or outline reflect my arguments? Do I agree with its logic? Do I have proof or evidence for these points? Do I understand what it is saying? Could I argue for this? Which part of this thinking is mine? Which part of this thinking is GenAI's? Why did I accept or reject the GenAI's suggestions? What did I learn about my own thinking from my interactions with GenAI? What will I do differently next time?"

Students who lack metacognition skills struggle to distinguish between legitimate GenAI-supported learning (i.e., use it as an educational scaffold) and skill-substituting dependency (i.e., an educational crutch which is undesirable). They experience the fluency illusion or the illusion of competence (Bjork, 1999). This means that they have only recognized clear writing but not really learning enough. For example, they are not able to explain the message on their own without referring to a text or without referring to the GenAI platform.

By redesigning assessments to value processes over a mere product, and by requiring students to use their cognitive/reasoning skills to articulate ideas, educators can disempower the illusions of learning from mere performance. Moreover, educators can encourage the growth of humanistic purposes of education (Bandura, 1977) by creating environments where students practise using metacognitive judgements, enhance their counter-arguments, ethical reasoning and communication skills.

Ethics in Education

According to Chan and Hu (2023), students are uncertain about ethical boundaries when using GenAI despite guidelines given. For example, students use such GenAI tools when they struggle with assignments (*Ibid*) without citing the source of this knowledge. Without

acknowledging its source, students risk being accused of plagiarism and transgressing ethical behaviour.

Ethics in education, like in all other fields, is important because it is the cornerstone of integrity and good reputation. Students doing their assignments must be keenly aware of ethics and ethical boundaries. They should not become tempted to plagiarize out of desperation because outside academia, the temptations to transgress ethics are even higher and so, students' growth and development must be grounded in this pertinent principle.

Conclusion

Students these days experience confusion about what it means to learn and the purpose of education. While the purpose of education is still being debated, most educators tend to agree that we should produce creative and critical thinkers who can apply the knowledge they learned into their daily lives. The disruption of GenAI has highlighted an ever important need to redesign students' assignments and assessments so that they use more of their metacognition skills and not merely use GenAI as a crutch. Students can then enhance their learning and use GenAI as a tutor for enhanced learning.

Finally, as stated by Eisikovits and Burley (2026), and I quote: "The greatest risk of AI in higher education isn't cheating – it's the erosion of learning itself."

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CUSTOMER RETENTION TOWARDS FAST-FOOD RESTAURANT IN KLANG VALLEY

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Abstract: *This study examines the factors influencing customer retention toward fast-food restaurants in Klang Valley, Malaysia. With the rapid growth of the fast-food industry and increasing competition among local and international brands, retaining customers has become a critical challenge. The research focuses on three independent variables – brand image, service quality, and price perception – and examines their impact on the dependent variable, customer retention. The study is grounded in Customer Perceived Value Theory and Relationship Marketing Theory, which explain how perceived value, trust, and commitment influence long-term loyalty. A quantitative research approach was adopted using a structured questionnaire distributed through Google Forms. A total of 167 valid responses were collected from customers aged 18 years and above who had experience dining at fast-food restaurants in Klang Valley. The data were analysed using descriptive statistics, correlation analysis, and regression analysis. The findings reveal that price perception and service quality have a significant positive effect on customer retention. Price perception was identified as the strongest predictor, indicating that customers are more likely to remain loyal when they perceive prices as fair and reasonable. Service quality also significantly contributes to retention, particularly in terms of staff friendliness and efficiency. However, brand image, although rated positively in the descriptive analysis, was not found to be statistically significant in influencing customer retention. The regression model shows that 72.4% of the variance in customer retention can be explained by the three variables. The study concludes that fast-food operators in Klang Valley should prioritize fair pricing strategies and high service standards rather than relying solely on brand reputation. These findings provide practical insights for marketers and contribute to a better understanding of customer retention in the Malaysian fast-food industry.*

Keywords: *Customer Retention, Fast-Food Industry, Price Perception, Service Quality, Malaysia*

Introduction

Background Of Study

The fast – food industry in Malaysia, particularly in the Klang Valley, has rapid increase in recent year due to rising income level, urbanization and changing consumer lifestyle. This area has many local and international fast-food brand that compete by offering similar food, prices, and promotion (Habib et al., 2011). This makes it difficult for fast food restaurants to keep their customer loyal. According to (Parasuraman et al., 1988), customer satisfaction and service

quality have been important topics of study. In today's competitive market, other factors like brand image, service quality and price perception play an important role in keeping customers (Samah et al., 2015).

This study focuses on fast-food restaurants in Klang Valley. It examines how brand image, service quality, and price perception affect customer loyalty and helps businesses understand how to retain customers.

Problem Statement

In Malaysia, fast food chains are growing quickly and trying hard to attract and keep customers (Habib et al., 2011). Although many brands offer similar food, prices and promotions, not all of them succeed in keeping customer loyal. When customers often switch between brands, it shows that brand loyalty is still a problem (Nastasoiu & Vandenbosch, 2019). Previous studies have mostly focused on customer satisfaction and service quality (Hernon et al., 1999). However, they don't clearly explain how brand loyalty can help companies keep their customers for the long term. Therefore, it is important to study how these factors influence customer loyalty and retention in fast food restaurants, especially in Klang valley. By understanding what really matter to customer, fast food business can improve their strategies to attract and keep loyal customers.

Research Objective

1. To determine the relationship between brand image and customer retention is fast food restaurants in Klang Valley.
2. To identify the impact of service quality on customer loyalty in fast food restaurants in Klang Valley
3. To investigate the effect of price perception on customer retention in fast food restaurants Valley
4. To determine which factor (brand image, service quality, or price perception has the strongest influence on customer retention.

Significance Of the Study

This study is important to help fast food business to understand what makes customer so stay with their brand. As Hallberg, 1995 pointed out, understanding different types of customers helps businesses focus more effectively on those who are likely to stay. This research identifies factors that influence customers to return, focusing on brand image, service quality, and price perception. The findings can assist marketers and managers in allocating resources efficiently, particularly in improving service quality, brand positioning, and pricing strategies (Noorsyah et al., 2024). Furthermore, relationship quality and loyalty programs have also been proven to play a significant role in building long-term customer loyalty (Kwiatek et al., 2020). This research can benefit future researchers and students studying consumer behaviour or marketing in the fast-food industry. It contributes to customer loyalty literature by applying Customer Perceived Value and Relationship Marketing theories in the Malaysian context.

Scope of the study

This study focuses on fast-food consumer in Klang Valley, Malaysia. Klang Valley is chosen because it is a well-developed and highly populated area that has a wide variety of local and international fast-food brands. Such as McDonald's, KFC, Burger King, Texas Chicken, A&W, and others (Abdullah et al., 2015).

The purpose of this study is to examine how brand image, service quality, and price perception influence customer retention. Customer retention refers to how likely a consumer will return and continue purchasing the same brand over time (Hofman-Kohlmeyer, 2020). These 2 independent variables were selected because they are commonly discussed in marketing and consumer research, and they are believed to play an important role in shaping customer decisions.

This research will use quantitative approaches, where data will be collected through structured questionnaires. The target respondents are customers aged 18 years old and above who have experience visiting or purchasing from fast food restaurants in Klang Valley. Respondents will be asked to rate their opinion on statements related to brand image, service, pricing and their intention to keep supporting the same brand.

The study focuses only on the fast-food industry in Klang Valley and does not include other food service businesses such as cafés or fine dining. Therefore, the results may not represent consumers in other parts of Malaysia. However, the findings can still provide useful insights for fast-food operators and marketers in Klang Valley.

Literature Review

Theories

Customer Perceived Value Theory (CPV Theory) (Zeithaml 1988)

Customer Perceived Value (CPV) states that customers evaluate a product or service by comparing perceived benefits with perceived costs, which influences satisfaction, loyalty, and retention. The theory suggests that value is subjective and varies based on individual needs and preferences. Understanding CPV helps companies provide better value, improve competitiveness, and achieve long-term profitability.

Relationship Marketing Theory

A suitable theory for understanding customer retention is Relationship Marketing Theory by (Morgan & Hunt, 1994). This theory focuses on building long-term relationships between companies and customers through trust and commitment. Trust refers to a customer's belief in the brand's reliability and integrity, while commitment reflects their emotional attachment to the brand. When companies continuously deliver value and satisfaction, trust and commitment increase, leading to customer loyalty and repeat purchase. Therefore, customer retention is not only a behavioural outcome but also a strategic result of strong value-based relationships with customers (Morgan & Hunt, 1994).

Dependent Variable

Customer retention refers to a company's ability to keep existing customers and encourage repeat purchases. In the fast-food industry, it means customers continue returning to the same restaurant instead of switching to competitors. It reflects customer satisfaction and loyalty and is more cost-effective than attracting new customers. Retained customers are more likely to make repeat purchase, spread positive word-of mouth, and stay loyal even when competitor offers the same product and likely prices. (Kotler and Keller,2016)

Customer retention is also seen as customer satisfaction and perceived value, as supported by Customer Perceived value Theory by (Zeithaml,1988) and Relationship Marketing Theory (Morgan & Hunt, 1994). When customers have positive perceptions of brand image, service quality, and price perception, they are more likely to continue supporting the same fast-food brand. Customer retention is important in competitive markets, as understanding what keeps customers returning helps businesses improve strategies and build long-term relationships.

Independent Variable ***Brand Image***

Brand image refers how customer view and feels about a brand. Customer overall impression based on experience, advertising, brand reputation of a brand. A strong and positive brand image can help customer to remember the brand easily and trust the brand more than others. A positive brand image builds emotional attachment and makes customer more likely to return to the brand and purchase. (Hanaysha J.R.M,2016).

Service Quality

(Jones and Shandiz 2015) explained that the SERVQUAL model is effective in evaluating customer expectations of service quality experienced. (Aliff et al., 2018) stated that service quality is an important factor in customer restaurant selection and is considered an important strategy in restaurant positioning.

In fast-food restaurants, it includes cleanliness, staff friendliness, order accuracy, speed of service, and how well problem is handled. Service quality uses five key dimensions: tangibles, reliability, responsiveness, assurance, and empathy. High service quality creates customer satisfaction, leads to higher retention. (Parasuraman et al., 1988).

Price Perception

Price perception refers how customer judge fairness of value of the price they pay. According to (Mohd Farid Shamsudin et al. 2020) Price is one of the important elements in customer decision-making. Customers are more likely to remain loyal to a brand when they feel the price they pay provides the value they expect. Stated by (Kaura et al. ,2015) that service providers need to carefully tag the prices as high prices may have perceived to be quality. Service providers must ensure that the price is representing the quality of the products and services.

Research Framework

The research framework shows how variables in the study are connected. In this study, it illustrates the relationship between three independent variables—Brand Image, Service Quality, and Price Perception—and the dependent variable, Customer Retention. The framework helps explain how these factors may influence customer retention in the fast-food industry in Klang Valley.

Independent Variable:

- Brand Image, Service Quality, Price Perception

Dependent Variable:

- Customer Retention
-

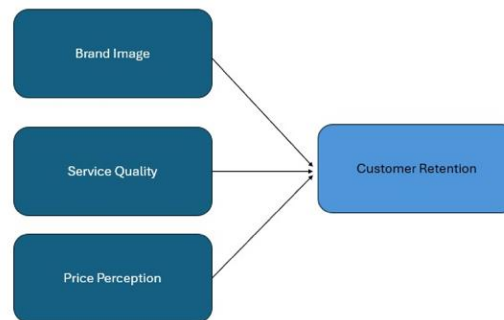


Figure 1: Framework Of Independent Variable & Dependent Variable

Research Hypotheses

H1: There is a significant positive relationship between brand image and customer retention in fast-food restaurants in Klang Valley.

H2: There is a significant positive relationship between service quality and customer retention in fast-food restaurants in Klang Valley.

H3: There is a significant positive relationship between price perception and customer retention in fast-food restaurants in Klang Valley.

Methodology

This chapter explains the methodology used in this research. It covers the research design, sample selection, data collection, data analysis method, and research instrument. The research investigates customer retention toward fast-food restaurants in Klang Valley. This study applied a quantitative approach using a structured questionnaire distributed via google forms. The methodology explains the questionnaire design, respondent's selection, and data collection and analysis. This chapter discusses the total number of respondents, the sampling technique used, and how customer – related factors were measured using Likert scale items.

Data Collection Technique

A research design is a framework that explains how a study is conducted, including the procedures for collecting and analysing data to answer the research questions. This study uses a quantitative research design to examine factors influencing customer retention in fast-food restaurants in Klang Valley using a structured questionnaire. The approach helps identify relationships between variables such as food quality, service quality, restaurant location, and customer loyalty. According to (Malhotra, 2010), a good research design ensures the project is conducted effectively and efficiently. The research design was tailored to suit the fast-food industry context in Klang Valley.

Sampling Process

This study focused on individuals who have prior experience dining at fast-food restaurants in Klang Valley, such as McDonald's, KFC, A&W, and Texas Chicken. The target population included Malaysian consumers who are regular or occasional fast-food customers in Klang Valley. Respondents were invited to participate in the study by completing a self-administered online questionnaire to ensure the data collected came from actual customers with relevant experience.

Sampling Technique

This study applied a non-probability convenience sampling technique. The respondents were selected based on availability and willingness. The survey was distributed via Google Forms and shared on WhatsApp, Instagram, and Telegram. This method was chosen due to time constraints and the absence of a complete list of all fast-food customer in Klang Valley, which made probability sampling impractical. According to (Bernard, 2002), convenience sampling is commonly used when researchers need to gather data quickly and efficiently from accessible participants. While this technique does not guarantee equal population representation, it allows data collection from actual fast-food consumers in the Klang Valley.

Sampling Timeline

The data collection process for this study was conducted over a period of one month, beginning on Wednesday, 18 June 2025. During this period, the online questionnaire was distributed via WhatsApp, Instagram and Telegram. The survey was created using Google Forms, that recorded each response. The target was feedback at least 150 respondents with experience dining at fast – food restaurants in Klang Valley. The one-month timeline was sufficient to gather.

Questionnaire Design

The questionnaire was developed using Google Forms and had two sections. Section A included demographic questions such as gender, age, race, occupation, and monthly income. Section B contained 20 close-ended statements designed to measure four key variables: service

quality, food quality, restaurant location, and customer retention. Respondents rated their agreement on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).

Data Analysis

Demographic & Frequency

Table 1. Demographic Variable

Items	Profile	Total Number (N)	Percentages (%)
Gender	• Male	98	58.7%
	• Female	69	41.3%
Frequency Eating Fast Food A Week	• 0	10	6.0%
	• 1	63	37.7%
	• 2	73	43.7%
	• 3	14	8.4%
	• 4 or More	7	4.2%
Which Fast Food Chain Prefer the Most	• McDonald's	138	82.6%
	• KFC	15	9.0%
	• Subway	8	4.8%
	• Texas Chicken	3	1.0%
	• Burger King	1	0.6%
	• None, I don't have	1	0.6%
	Habit Eating Fast Food • Lajiaobanmian	1	0.6%

Gender & Age

The are 98 male respondents (58.7%) and 69 female respondents (41.3%) Most respondents are aged 18–24 with 125 people (74.9%). This is followed by below 18 with 22 respondents (13.2%). The 25–34 age group has 8 respondents (4.8%), while 45 & above has 7 respondents (4.2%). The least respondents are 35–44 with 5 people (3.0%).

Occupation & Monthly Income/ Pocket Money

Most respondents are students (82.7%), followed by employed individuals (11.3%). A small number are self-employed (3.0%), and only 0.6% are entrepreneurs.

For income or pocket money, the largest group earns below RM500 (38.3%). This is followed by RM500–RM1,499 (34.7%). Smaller groups include RM1,500–RM2,999 (10.8%), RM3,000–RM4,999 (7.8%), and RM5,000 and above (8.4%).

This shows that most respondents have relatively low monthly income, which is common among students.

Frequency of Eating Fast Food & Preferred Fast-Food Brand

Most respondents eat fast food twice per week (43.7%), followed by once per week (37.7%). Smaller groups eat it three times (8.4%) or four times or more (4.2%), while 6.0% do not eat fast food during the week.

For preferred brands, McDonald's is the most popular (82.6%), followed by KFC (9.0%), Subway (4.8%), and Texas Chicken (1.6%). A very small number chose La Jiao Ban Mian and Burger King (0.6% each). Overall, McDonald's clearly dominates respondents' preferences.

Correlation Analysis

Table 2 Correlation Analysis Data Table

	Brand Image	Service Quality	Price Perception	Customer Retention
Brand Image	1	0.734	0.844	0.740
Service Quality	0.734	1	0.764	0.737
Price Perception	0.844	0.764	1	0.837
Customer Retention	0.740	0.737	0.837	1

Correlation analysis was conducted to examine the relationship between Brand Image, Service Quality, Price Perception, and Customer Retention. The results show that all variables are positively correlated with customer retention.

The strongest correlation was found between Price Perception and Customer Retention ($r = 0.837$), indicating that customers who perceive prices as fair (Aaker, D.A.1996) are more likely to return to the restaurant. In addition, brand image shows a strong relationship with Price Perception ($r = 0.844$). Service Quality is also positively correlated with Price Perception ($r = 0.764$) and Customer Retention ($r = 0.737$). Overall, these variables play an important role in influencing customer retention.

Regression Analysis

Table 3. Regression Analysis Data Table (R)

Model	R	R-Square	Adjusted R Square
1	0.851	0.724	0.719

$$Y = 1.23 + 0.035BI + 0.21SQ + 0.52P$$

The regression equation shows the relationship between the dependent variable (Y) and three independent variables: Brand Image (BI), Service Quality (SQ), and Price Perception (P). The constant (1.23) is the baseline value of Y when all variables are zero. The coefficients show

that BI increases Y by 0.035, SQ by 0.21, and P by 0.52 when each increase by one unit, assuming other variables remain constant.

This shows that price perception has the strongest effect on Y, followed by service quality while brand image has the smallest effect. Overall, the model suggest that these three factors positively influence the value of Y.

Regression analysis was conducted to examine how Brand Image, Service Quality, and Price Perception influence Customer Retention. The R value of 0.851 indicates a strong relationship between the variables.

The R-Square value is 0.724, which means that 72.4% of the variation in customer retention can be explained by brand image, service quality, and price perception. The remaining 27.6% may be influenced by other factors not included in this study. The Adjusted R-Square value of 0.719 also confirms that the model provides a strong explanation of customer retention in fast-food restaurants

P – Value

Table 4. Regression Analysis Data Table (P -Value)

Variable	P-Value
Brand Image	0.558917
Service Quality	0.000811
Price perception	5.26E-12

According to standard significance testing, a p-value less than 0.05 indicates a statistically significant effect on the dependent variable (Field, 2013).

The results show that Service Quality and Price Perception are significant predictors of Customer Retention, as their p-values are below 0.05. Price Perception is the most significant factor, indicating that when customers feel the price is fair and worth the value, they are more likely to remain loyal.

Price Perception has the lowest p-value (5.26E-12), showing a very strong relationship with customer retention. In contrast, Brand Image has a p-value of 0.5579, which is above 0.05, indicating that it does not significantly affect customer retention in this study.

Discussion, Conclusion and Recommendation

Discussion of Findings

This study looked at how brand image, service quality and price perception affect customer retention in fast-food restaurants in Klang Valley. The result gave several useful findings:

Brand Image

Most customer have a positive view of their preferred fast-food brands and like their appearance and product variety. However, the regression analysis show that brand image does not significantly influence customer retention ($p= 0.5589$). This shows that customers recognize and like the brand. (Aaker,1996)

Service Quality

Service Quality had a significant impact on customer retention ($p=0.0008$). Most respondents agreed that the staff were friendly, the service was fast, and they received good treatment. This matches the SERVQUAL model by (Parasuraman et al, 1998), this says service quality is very important in making customers happy and keeping them coming back.

Price Perception

Many respondents agreed that the prices were fair, reasonable, and matched the value of the food. This was strongly supported by the statistical result ($p = 5.26E-12$). (Zeithaml 1988) noted that when customer feel they are getting good value for the price, they are more likely to stay loyal. The regression model showed that 72.41% of the change in customer retention can be explained by the three factor – brand image, service quality, price perception (Field,2013)

Conclusion

This research examines factors influencing customer retention in fast-food restaurants in Klang Valley. The results show that price perception has the strongest influence, as customers stay loyal when they feel the food is worth the price. This supports the theory by (Zeithaml,1988) that says customer satisfaction and loyalty are driven by the value customers believe they get what they pay.

Service quality was also found to have significant impact on customer retention. Respondents valued friendly staff, fast service and overall helpfulness. The SERVQUAL model (Parasuraman et al, 1988) explains that good service experience increases customer satisfaction and that leads to repeat visits and long-term loyalty.

Although respondents rated brand image highly that it was not a significant factor in customer retention. This means that even though customer like brands such as McDonald's or KFC, branding alone cannot keep customer loyal without fair prices and good service. (Garcia,2024) mentions that brand image plays a supporting role, but actual performance and value are what truly influence loyalty.

This research shows that price fairness and good service are the main factors influencing customer loyalty in fast-food restaurants in Klang Valley. Fast-food businesses cannot rely only on a famous brand name. They must provide good value, treat customers well, and

maintain a clean and safe environment to build strong relationships and encourage customers to return.

Recommendation

To improve future research and data collection, the following suggestion are recommended based on the experience and findings from this study.

Get Responses from A More Diverse Group

In this study, most respondents were students aged 18–24, so the results may not fully represent all fast-food customers in Klang Valley. Future research should include a more balanced group, such as working adults, parents, senior citizens, and people from different income levels. Surveys can be shared in places like offices, shopping malls, and community events to reach more diverse participants and provide a clearer understanding of customer opinions.

Survey Timeline

The data for this research was collected over one month through online questionnaires shared on WhatsApp, Instagram, and Telegram. Although this helped gather over 150 responses quickly, most respondents were students or active social media users, which limited the diversity of the sample. In future research, a longer data collection period could help reach a wider range of respondents and produce more accurate results.

Different methods to distribute the survey

The survey was mainly distributed through social media such as WhatsApp and Instagram, which may exclude non-social media users. Future studies could use printed surveys, email, or face-to-face interviews to reach more respondents and reduce bias.

Suggested New variable for future research

To build on this study and better understand customer retention, future researchers are encouraged to explore additional independent variables (IVs) and dependent variables (DVs). One important factor is food quality, including taste, freshness, and portion size. Customers who perceive higher food quality are more likely to revisit the same brand. (Hanaysha, 2016).

Another key variable that can be used is restaurant cleanliness and hygiene, that can greatly affect customer trust and comfort, especially in pandemic times last time (Salleh et, 2023). Moreover, as more customers order food through digital platforms, a user-friendly mobile app can improve convenience and encourage customers to continue using the same fast-food brand. (Noorsyah et, al,2024).

For Dependent Variable, researchers may go beyond with, for example, repeat purchase intentions can be measured to understand if customer plans to return in the future (Chen, 2008). In similar, customer satisfaction level is a useful dependent variable that reflects overall customer impression of the service experience (Parasuraman et, al,1988)

These variables may provide a better understanding of what drives fast-food customer behaviour and helps marketers improve strategies to retain customers.

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BLACK BEAN FLOUR-BASED POPIAH SKIN: SUSTAINABLE PRODUCT DEVELOPMENT WITH CONSUMER ACCEPTANCE AND NUTRITION EVALUATION

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Abstract: *This research presents an innovative product derived from black bean (*Phaseolus Vulgaris* L) as a popiah skin crafted to augment the diversity of popiah skin offerings in the market. Even though its numerous benefits, black bean flour are underutilized in culinary practices. A nutrient-dense substitute for conventional wheat flour, black bean flour contains more protein and dietary fiber besides essential minerals and antioxidants. Because it has a reduced glycemic index and is naturally gluten-free, consumers who are health-conscious or gluten-intolerant can benefit from it. Black bean flour is an ideal ingredient for the production of healthier, value-added food items since it enhances the nutritional value of food products while offering practical advantages like better texture and moisture retention. Custom method encompassing cleaning, drying, grinding, sieving and cooking were employed for this innovation. The primary research objectives encompassed the development of popiah skin using black bean flour, assessing the sensory acceptance of the black bean flour popiah skin among consumers, determine the nutritional composition of the developed black bean flour popiah skin and compare the nutritional properties of black bean flour popiah skin with conventional wheat-based popiah skin. A survey involving 30 participants from the community was conducted via Google Form to gauge the acceptance of the product. SPSS was utilized for data analysis. The findings indicate high acceptability scores: colour and taste (3.94) and smell (3.59), while taste received a favourable rating (4.00). The result of nutritional analysis also show that this product has a lower GI than normal popiah skin because of higher protein and fiber, slightly lower carbohydrate, and moderate fat. This study affirms the positive reception of the black bean popiah skin product, offering potential for enhancement in subsequent investigations, and highlighting the manifold potential benefits of black beans for human consumption.*

Keywords: *Phaseolus vulgaris L, Black Bean, Popiah Skin, Black Bean Flour*

Introduction

Black bean (*Phaseolus vulgaris*) is a legume that is widely recognized for its nutritional value and potential health benefits. According to Melini et al. (2024), black beans are typically kidney-shaped, dark in colour with a small white spot, and possess a mildly sweet flavour. In addition to being rich in protein and dietary fiber, black beans also contain various essential nutrients that contribute to human health (Ware, 2024). Due to these nutritional advantages, black beans have attracted increasing attention in the development of functional and plant-based food products. In recent years, the demand for functional foods and plant-based

alternatives has increased significantly, encouraging the exploration of legumes as alternative food ingredients. One potential approach is the processing of beans into flour, which can be utilized as a functional ingredient in food preparation and product formulation. Converting beans into flour not only enhances their versatility in food production but also provides an alternative method to increase bean consumption. However, Yahya et al. (2022) reported that black bean flour is still less commercially recognized and has limited application in food products, indicating the need for further product development and innovation. Popiah, also known as fresh spring roll, is a traditional dish commonly consumed in Malaysia and other Southeast Asian countries. It typically consists of various fillings such as vegetables, meat, and sauces wrapped in a thin and soft crepe-like skin made primarily from wheat flour and water. Popiah skin is characterized by its paper-thin structure, soft texture, and flexibility, allowing it to hold fillings without tearing. Soegiono (2023) described popiah skin as a thin and soft crepe similar to a pancake, commonly produced using wheat flour as the main ingredient. Despite its popularity, the traditional reliance on wheat flour in popiah skin production may raise certain health concerns. Kang et al (2014) stated that wheat-based products are known to potentially cause allergic reactions or gluten intolerance in some individuals. Jiang et al. (2025) reported that wheat and wheat-based products may trigger allergic responses among sensitive consumers. Therefore, exploring alternative flour sources such as black bean flour may provide a promising approach to develop a nutritionally enhanced and potentially healthier popiah skin product.

Literature Review

Black bean (*Phaseolus vulgaris* L.) is a legume widely consumed in many parts of the world and recognized for its high nutritional value. It is an excellent source of plant-based protein, dietary fiber, complex carbohydrates, vitamins, and essential minerals such as iron and magnesium. It also rich source of protein, carbohydrate, dietary fiber and minerals (Meenu et. al., 2023). According to Ware (2024) black beans contain various nutrients important for health. It can maintain bone health, lowering high blood pressure, preventing heart disease, preventing cancer, maintaining digestive health, and losing weight. Additionally, black bean flour is rich in antioxidants, gluten-free, and extremely healthy. Black bean is one of the essential parts in human diet due to their nutrition value. The production of black bean protein concentrates or isolates is of growing interest to food industry because of their functional properties and ability to improve the nutritional quality of food products. There is growing interest in the food industry in using black bean protein concentrates or isolates, as they not only offer functional benefits but also help improve the nutritional quality of various food products (Nguyen, 2023). Popiah skin is a thin crepe-like wrapper made mainly from wheat flour, water, and salt, commonly used to wrap vegetables and other fillings in fresh spring rolls (Marvellina, 2023). Experience with a certain technique is necessary to make popiah skin. Using a quick, sweeping motion of the hands, spread the dough evenly over a hot pan. This guarantees that the skin cooks evenly, giving it the perfect smooth texture and transparency. Every skin is made uniquely, showcasing the talent and enthusiasm of the designer. Nowadays people more conscious about what them eat. There is an alternative way to produce the popiah skin. It supported by Ann Chin (2026) that, alternative popiah skins such as gluten-free and vegetable-infused varieties have been developed to meet the needs of health-conscious consumers.

Methodology

Standard procedure for black bean popiah skin involves several steps. The first step is to cleaning and drying the black bean. Black beans were cleaned to remove impurities and washed thoroughly. The beans were dried at 60–70°C for 24 hours until completely dry (Yahya et al., 2022). The next step is grinding and sieving. The dried beans were ground using a grinder into fine powder. The powder was then sieved (60–80 mesh) to obtain uniform particle size. Then the formulation of popiah skin per pack 100g were developed. The black bean powder was weighed according to the specified formulation and mixed evenly with salt. Water was then gradually added while whisking continuously to produce a smooth, lump-free batter. A small amount of oil was incorporated to enhance flexibility and reduce sticking during cooking. The batter was subsequently allowed to rest at room temperature for 30 minutes to ensure proper hydration and optimal gluten development prior to use. Once the dough is ready, cooking steps begin with a non-stick pan was preheated at a medium temperature of approximately 120–150°C before a ladle of batter was poured onto the surface and spread thinly in a circular motion. The popiah skin was cooked for 1–2 minutes until the surface became dry and the edges lifted slightly, after which it was carefully removed from the pan and allowed to cool at room temperature. Figure 1 show the process flow product Black Bean Popiah Skin development respectively.

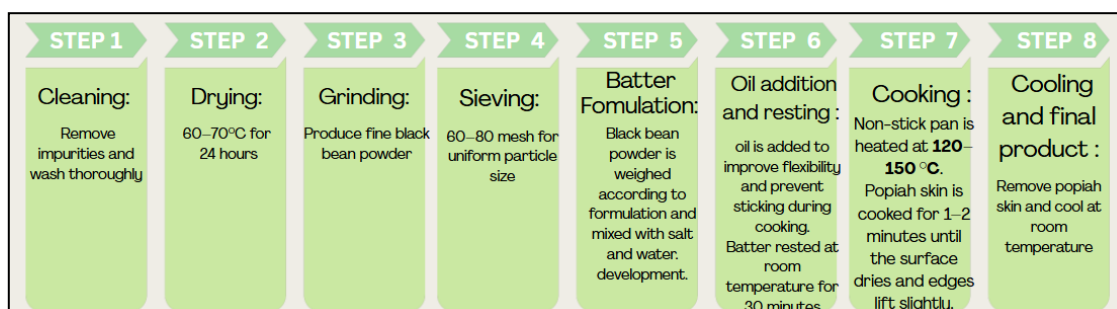


Figure 1: Process Flow Product Black Bean Popiah Skin Development

Sensory evolution or organoleptic analysis was used in this study. The researcher employs a hedonic test using five face hedonic scores. Thirty respondents took the hedonic test to find the acceptance level of Black Bean Popiah Skin. The sensory evaluation was conducted using a hedonic scale to measure consumer acceptance of the product in terms of colour, aroma, texture, taste, and overall acceptability, following the method developed by Peryam and Pilgrim (1957). This scale has achieved wide popularity since it was first invented in the 1940s at the Food Research division of the Quartermaster Food and Container Institute in Chicago, Illinois. Hedonic scale rating can be affected by changes in environmental conditions, but the relative order of sample preference was usually not affected. The 5-scale hedonic test was comprised of 5 = Like very much, 4 = Less a little, 3 = Not sure, 2 = Dislike a little and 1 = Dislike very much as stated at Figure 2 (Munro, 2017).

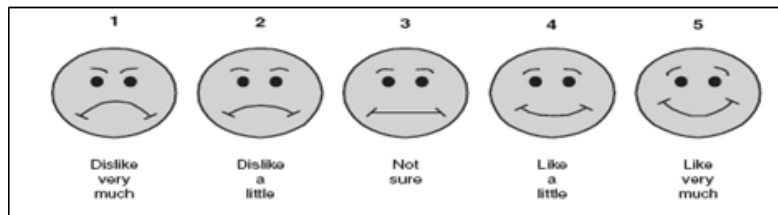


Figure 2: Five Levels Facially Hedonic Scale

Source: (Munro, 2017)

The data obtained have analysed by using the Statistical Package for the Social Sciences (SPSS) version 23 to get mean and percentage result. Table 2 shown the interpretations mean score scale that used to analyze based on (Nur Farhana Zulkernain, 2018).

Table 2: Mean Range Interpretation Table

Mean Score Range	Interpretation	Level
1.00-2.33	Low	Weak
2.34-3.67	Moderate	Moderate
3.68-5.00	High	Good

Source: (Nur Farahana Zulkernain, 2018)

Black Bean Popiah Skin was submitted to Melaka Biotechnology Corporation for determine the nutritional composition. The Melaka Biotechnology Corporation used Gas Chromatography-Mass Spectrophotometry (GCMS) for the analysis to identify the amounts of carbohydrate, protein fat, sugar and energy.

Finding and Discussion

The demography analysis in this research was age and gender of the respondent. Based on the Table 3, 30% or 9 respondents from 21 – 23 years old, the highest 60% from 18 - 20 years old followed by the smaller percentage was from 24 - 26 years old with 10% or only 3 respondents. 53.3% respondents from male and the 46.7% are female.

Table 3: The Total of Respondents

		Frequency (N)	Valid Percent (%)
Age	18-20	18	60
	21-23	9	30
	24-26	3	10
	26 above	0	0
Total		30	100
Gender	Male	16	53.3
	Female	14	46.7
Total		30	100

Sensory evaluation of Black Bean Popiah Skin from respondents is a vital instrument in measuring the patterns of product as well as to assessing the level of respondent's acceptance over the product. It is a scientific discipline used to evoke measure, analyze, and interpret those responses to products that are perceived by the senses of sight, smell, touch, taste, and hearing (Stone and Sidel, 1993).

Table 4: Mean Score of Black Bean Popiah Skin

Characteristic	Mean	Interpretation
Smell	3.57	Moderate
Texture	3.94	High
Colour	3.94	High
Taste	4.00	High
Overall Acceptance	3.86	High

Data analysis in Table 4 indicated the mean score of level acceptance respondents towards Black bean Popiah Skin is moderate and high level. The highest score mean is from taste that is 4.00. It gives the high interpretation of the product. The respondents like the soothing texture of Black Bean Popiah Skin. Smell got the moderate interpretation which are 3.57. It interprets that the respondent accepted the smell of Black Bean Popiah Skin and like the colour. Therefore, the overall acceptance of respondents is at high level and good. It means that the Black Bean Popiah Skin is accepted among the community.

The result of nutritional composition for Black Bean Popiah Skin has been shown at Table 5 were submitted to Melaka Biotechnology Corporation for laboratory analysis. The analysis was conducted to obtain the official nutrition facts of the product, including energy value (kcal), carbohydrate content, crude protein, total fat, moisture content, and sugar level. Standard laboratory procedures and accredited analytical methods were used to ensure the accuracy and reliability of the results.

Table 5: Nutrition Composition of Black Bean Popiah Skin and Commercial Wheat Popiah Skin

Test Parameter	Unit	Result	
		Black Bean Popiah Skin	Commercial Wheat Popiah Skin
Energy	kcal/100g	281	220
Total Carbohydrate	g/100g	41.3	45
Protein	g/100g	9.08	7
Total Fat	g/100g	8.8	1
Total Sugar	g/100g	5.6	2
Sodium	g/100g	83.2	200

Source: (Melaka Institute of Biotechnology, 2024)

According to analysis, each 100g sample of Black Bean Popiah Skin has 41.3g carbohydrate, 8.8g of total fat, 9.08g of protein and 83.2g sodium. Additionally, each 100g Black Bean Popiah Skin produces 281 kcal of energy. Based on the analysis comparing to the Commercial Popiah Skin, Black Bean Popiah Skin provides a comparable energy value (281 kcal) to commercial

wheat-based popiah skin. However, the carbohydrate content (41.3 g) was lower than that of conventional products, which typically range between 50–60 g per 100 g. This reduction may contribute to improved glycemic response, particularly when combined with higher protein and fiber content. Notably, the protein content (9.08 g) of the developed product was higher than that of commercial popiah skin (6–8 g), demonstrating the nutritional advantage of incorporating black bean flour. Increased protein content enhances the functional and nutritional value of the product, making it more suitable for health-conscious consumers. Although the total fat content (8.8 g) was slightly higher than some commercial variants, the sodium level (83.2 mg) was lower than many market products, which often contain between 100–300 mg. Lower sodium content may provide additional health benefits, particularly for individuals monitoring salt intake (Guan et al., 2022). Overall, the black bean flour popiah skin exhibited improved protein content, reduced carbohydrate level, and moderate sodium content compared to conventional wheat-based popiah skin, indicating its potential as a nutritionally enhanced alternative product. It is known that foods higher in protein and dietary fiber can slow gastric emptying and carbohydrate digestion. As a result, glucose enters the bloodstream more gradually, leading to a lower postprandial glycemic response (Kang et al., 2014; Nilsson et al., 2007). Legume based products, including those made from black beans, have been reported to exhibit lower glycemic index (GI) values due to their resistant starch and fiber content. Therefore, the incorporation of black bean flour likely contributed to the reduced GI observed in the developed product, making it potentially more suitable for individuals managing blood glucose levels. It also supports by Soegiono (2023), that black bean flour has a potential functional food element to be employed in food items. Based on the findings of this study, several suggestions for further research and product development can be made in light of the study's conclusions. In order to increase consumer acceptance, more research should explore various approaches to improve the formulation of black bean popiah skin, especially in terms of improving the aroma and general sensory qualities. Besides that, future research should involve a larger and more diverse group of respondents in sensory evaluation to obtain more representative and reliable consumer feedback. Researchers may also study on shelf life, storage stability, and commercial market potential are recommended to support the future development of black bean popiah skin as a functional food product.

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DIGITAL LEADERSHIP COMPETENCY AND TECHNOLOGY ADOPTION SUCCESS, A CONCEPTUAL FRAMEWORK FOR TECHNOLOGY MANAGEMENT

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Abstract: *Organisations continue to invest heavily in digital transformation; however, many initiatives fail to achieve expected outcomes due to an overemphasis on technological infrastructure rather than human and leadership dimensions. Grounded in Upper Echelons Theory and the Technology-Organization-Environment framework, this conceptual paper aims to shift the analytical lens from capital IT investment to leadership capability by proposing a comprehensive framework linking Digital Leadership Competency (DLC) to technology adoption success. As a conceptual study, it synthesises extant literature to construct a multidimensional model and develop theoretical propositions, outlining a variance-based structural equation modelling (PLS-SEM) methodology for future empirical validation. The proposed framework operationalises DLC across four core dimensions: strategic digital vision, technological literacy, change management capability, and data-driven decision orientation. It hypothesises that DLC directly enhances initial technology adoption effectiveness and indirectly drives sustainable organisational performance through two mediating pathways: employee engagement and process alignment. Furthermore, the model positions digital culture as a critical boundary condition that positively moderates and amplifies the impact of digital leadership on adoption outcomes. The paper concludes that technological acquisition provides no inherent competitive advantage without strategic socio-technical orchestration. To reverse high failure rates in digital initiatives, organisations must move beyond isolated technical training and prioritise holistic leadership development, cultivating executives who can simultaneously manage digital architectures, mitigate employee technostress, and embed adaptive digital cultures to achieve enduring resilience and competitive advantage.*

Keywords: *Digital Leadership Competency, Technology Adoption Success, Upper Echelons Theory, Technology Organization Environment, Digital Governance*

Introduction

Background and Context

In the contemporary global economy, organisations across all sectors continue to invest heavily in advanced digital systems, ranging from enterprise platforms and cloud computing to artificial intelligence (AI) applications (Hamza & Karadas, 2025). This relentless drive toward digitalisation represents a fundamental paradigm shift from traditional information technology (IT) management to comprehensive digital transformation (DT). DT is defined not merely as a technological upgrade such as digitisation or digitalisation, but as a profound cultural, strategic, and organisational reconfiguration aimed at fundamentally reshaping business operations and stakeholder engagement (Alhameed & Emeagwali, 2026; Obeidat, 2026).

However, a persistent paradox plagues this era of digital ubiquity: despite massive financial allocations toward technological infrastructure, many technology initiatives fail to achieve their expected performance outcomes (Obeidat, 2026). The root cause of this high failure rate rarely lies in the limitations of the technology itself. Instead, human factors, organisational inertia, resistance to modernisation, and the socio-technical complexities of implementation pose the primary challenges to successful transformation (Singun, 2025). Organisations often falter because they treat DT as a localised IT project rather than a deep, systemic reconfiguration of institutional logics and governance processes. Consequently, academic and practitioner focus must urgently evolve from prioritising purely technical infrastructure to examining the human and leadership dimensions of technology management (Obeidat, 2026).

Problem Statement

Prevailing technology management literature has traditionally relied on robust individual-level models to explain technology adoption. While these models successfully explain end-user technological readiness and localised acceptance, they inadequately address the macro-level, strategic drivers required for enterprise-wide adoption success.

The critical gap in the current literature is the underdevelopment of leadership competency as a strategic determinant of DT (Jalil et al., 2026). Leadership is widely acknowledged as a pivotal enabler of innovation, yet it is frequently treated merely as a background variable or an abstract concept rather than a core, operationalised driver (Obeidat, 2026). Bibliometric analyses reveal that while "digital leadership" has rapidly become a central construct in academic discourse, there remains a lack of comprehensive empirical frameworks that distinctly operationalise these competencies to support sustainable competitive advantage (Jalil et al., 2026). Consequently, there is a pronounced scarcity of theoretical models exploring how digital leadership specifically drives technology adoption success and superior organisational performance through employee-centred mechanisms (Chian et al., 2025).

Research Objectives and Scope

To address these theoretical gaps, this concept paper proposes a comprehensive framework linking Digital Leadership Competency (DLC) to technology adoption success. First, this paper

conceptualises DLC not as a generalised management trait, but as a specific, multidimensional construct.

Second, the paper proposes a theoretical framework integrating these competencies with established organisational theories. To explain the macro-level impact of leadership, the framework integrates Upper Echelons Theory, which posits that organisational outcomes are reflections of the values and cognitive bases of powerful actors in the organisation (Jalil et al., 2026), with the Technology-Organisation-Environment (TOE) framework (Obeidat, 2026). Within this synthesis, DLC functions as the apex organisational mechanism that interprets technological innovations and drives employee engagement, ultimately dictating post-adoption performance.

Literature Review and Theoretical Foundation

The Paradigm Shift in Technology Management

The literature on technology management has undergone a profound thematic evolution, transitioning from a narrow focus on IT infrastructure to the holistic paradigm of digital transformation (Jalil et al., 2026). Contemporary scholarship emphasises that DT demands a deep reconfiguration of institutional logics, operational models, and governance processes. Success is evaluated by an organisation's ability to achieve sustainable competitive advantage, continuous innovation, and resilience (Alhameed & Emeagwali, 2026). Significant barriers to DT are rooted in human and cultural rigidities, such as resistance to change and deeply ingrained aversions to new operational methods, rather than the technologies themselves (Singun, 2025).

Defining Digital Leadership Competency: A Multidimensional Evolution

Initial academic discourse focused heavily on e-leadership, defining it primarily as a social influence process mediated by advanced information and communication technology (ICT) to manage remote teams (Jalil et al., 2026). However, the literature has shifted towards Digital Leadership as a more comprehensive construct (Jalil et al., 2026). To illustrate this theoretical evolution, Table 1 synthesises the progression of leadership definitions in the digital context.

Effective digital leaders craft a coherent digital vision, align digital initiatives with broader business objectives, and orchestrate the socio-technical shifts necessary to navigate digital disruptions (Chian et al., 2025).

Table 1: Evolution of Digital Leadership Definitions

Author(s) & Year	Construct	Key Definitional Focus
Avolio et al. (2000)	<i>E-leadership</i>	A social influence process mediated by advanced information technology to change attitudes, thinking, and performance.
Sandell (2013)	<i>Digital Leadership</i>	Capabilities and capacities to provide a creative environment by optimising digital technologies.
Sawy et al. (2016)	<i>Digital Leadership</i>	The process of achieving success in strategic digitalisation for a firm and within its business ecosystem.
Zeike et al. (2019)	<i>Digital Leadership</i>	A leader's ability to establish a clear and compelling vision for the digitalisation process and the skills needed to implement it.
Wirtz (2021)	<i>Digital Leadership</i>	Requires a strong proficiency in new technologies, digital literacy, receptiveness to innovation, and a digital culture.

Source: Adapted From Jalil et al., 2026)

Theoretical Underpinnings: Upper Echelons Theory and the TOE Framework

To understand how leadership characteristics translate into technological outcomes, this framework integrates Upper Echelons Theory and the Technology-Organisation-Environment (TOE) framework. Upper Echelons Theory connects organisational outcomes with leadership cognition, establishing that top management's strategic choices inherently shape a firm's capacity for complex transformation (Jalil et al., 2026). The TOE model postulates that the adoption of technological innovation is conditioned by three interdependent domains: technological, organisational, and environmental (Obeidat, 2026). The concept of digital leadership is ascribed to the organisational domain. Digital leadership acts as the conduit through which executives translate technological affordances into actionable strategic guidance (Obeidat, 2026). Thus, digital leadership functions as a critical resource, providing the structural support and vision necessary to buffer against technological challenges, thereby converting passive compliance into proactive work engagement.

Conceptualizing Digital Leadership: A Four-Dimensional Approach

This study operationalises Digital Leadership Competency (DLC) as a multidimensional construct designed to orchestrate socio-technical transformations. DLC is disaggregated into four core dimensions.

Strategic Digital Vision

The foundational dimension of DLC is the capacity to articulate a clear, forward-looking roadmap for digital integration (Jalil et al., 2026). Digital transformation frequently falters when organisations lack a coherent vision, leading to disjointed initiatives and data fragmentation (Singun, 2025). Digital leaders with strong visionary competencies transcend short-term technological trends, aligning digital initiatives with long-term organisational goals and sustainable performance (Huang et al., 2026).

Technological Literacy

Technological literacy represents a leader's advanced cognitive grasp of emerging technologies and their strategic implications (Liao & Ismail, 2025). Leaders must possess sufficient expertise to evaluate architectures, assess cybersecurity risks, and role-model digital tool usage. When leaders demonstrate high ICT competence, it lowers the psychological threshold for adoption and cultivates digital self-efficacy among employees (Li et al., 2026).

Change Management Capability

Digital transformation is inherently disruptive. Therefore, the third dimension of DLC is change management capability, defined as the leader's proficiency in orchestrating the human elements of transformation (Shie et al., 2025). A critical component of this is cultivating an environment of psychological safety. By fostering a digital ethos that embraces setbacks and promotes trial-and-error, leaders empower employees to engage in constructive innovation (Shie et al., 2025). Additionally, proactive change management by leaders directly mitigates the psychological strain caused by the constant need to adapt to complex new technologies (Li et al., 2026).

Data-Driven Decision Orientation

The final dimension represents a fundamental shift from intuition-based leadership to a data-driven decision orientation (Hamza & Karadas, 2025). Digital leaders leverage advanced business intelligence and AI integration to inform agile and precise strategic choices (Chian et al., 2025). This empirical approach models a culture of accountability and ensures that transformation outcomes are meticulously monitored.

The Conceptual Framework and Theoretical Propositions

Building upon Upper Echelons Theory and the TOE framework, this section formally details the proposed conceptual framework linking DLC to technology adoption success. The theoretical model, summarising the direct and mediating paths, is visualised in Figure 1.

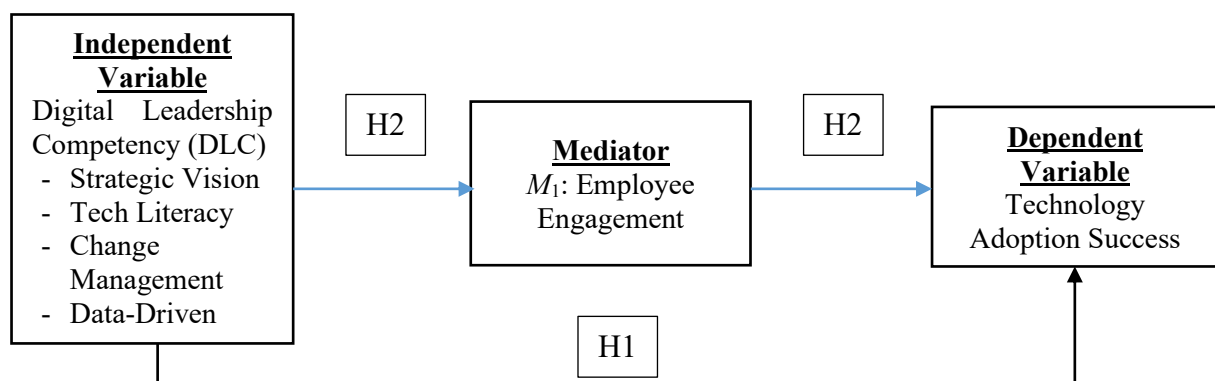


Figure 1: Conceptual Framework of Digital Leadership and Technology Adoption

Source: Synthesised And Adapted From Structural Models in Li et al., 2026; Alhameed & Emeagwali, 2026

Direct Influence on Adoption Effectiveness

Digital leadership acts as the central mechanism that mobilises internal resources to achieve sustainable technological integration (Alhameed & Emeagwali, 2026). Visionary digital leaders mitigate bureaucratic inertia by articulating forward-looking narratives and embedding them within institutional routines (Chian et al., 2025). Therefore, we propose:

- H1: Digital Leadership Competency (DLC) exhibits a direct, positive relationship with initial technology adoption effectiveness and post-adoption performance.

The Mediating Pathways (Indirect Effects)

Executive characteristics impact macro-organisational outcomes through intermediate behavioural mechanisms (Alhameed & Emeagwali, 2026). This study identifies a primary mediating pathway: Employee Engagement (M1).

- H2 - Employee Engagement: Employee engagement positively mediates the relationship between Digital Leadership Competency and technology adoption success. During digital transformation, employees frequently encounter stress resulting from system complexity and information overload. By acting as "resource enablers" who provide support, empathy, and training, digital leaders mitigate this resource depletion and enhance employees' digital self-efficacy, thereby converting passive compliance into active work engagement (Li et al., 2026).

Formalising the Mediation: To provide a rigorous foundation for future empirical testing, the mediating pathway can be expressed through structural equations. Let Y represent Technology Adoption Success, X represent Digital Leadership Competency, and M1 represent the mediator (Employee Engagement). The indirect effects are modelled as:

$$Y = \beta_0 + \beta_1 X + \beta_2 M1 + \epsilon$$

Proposed Methodology for Future Empirical Testing

To empirically validate this structural model including the mediating mechanism, future studies should employ Partial Least Squares Structural Equation Modelling (PLS-SEM) (Alhameed & Emeagwali, 2026). PLS-SEM is highly suited for complex, prediction-oriented models and handles non-normally distributed data robustly.

To mitigate Common Method Bias (CMB) inherent in cross-sectional self-reported data, researchers should implement multi-wave, time-lagged research designs and utilise statistical remedies such as Harman's single-factor test and Variance Inflation Factor (VIF) assessments (Li et al., 2026).

Table 2: Proposed Construct Operationalisation and Measurement Strategies

Construct	Measurement Focus / Dimensions	Example Items (Measured on 5-point Likert Scale)
Digital Leadership Competency (DLC)	Strategic vision, IT support, infrastructure investment, support for experimentation	- "Our leaders inspire employees with clear digital transformation plans."- "Our leaders provide a clear digital transformation vision that guides employees' actions."
Mediator: Employee Engagement	Vigor, dedication, absorption, digital self-efficacy	- "Employees are highly engaged and show strong digital self-efficacy when using new tools."- "I feel energised and highly dedicated when engaging with the new digital systems."
Technology Adoption Success (DV)	Digital integration, post-adoption performance, continuous utilisation	- "We allocate significant resources to digitise the business successfully."- "The degree of process automation is high in my company, yielding sustainable performance."

Source: Adapted from Huang et al., 2026; Li et al., 2026; Chian et al., 2025

Discussion and Practical Implications

Theoretical Contributions

This framework refines the application of organisational theory in digital contexts by explicitly modelling the intervening mechanism that translates leadership intent into sustainable organisational performance. By conceptualising digital leadership as a multidimensional dynamic capability, the paper shifts the analytical lens from technological investment to strategic socio-technical orchestration (Alhameed & Emeagwali, 2026). Furthermore, by integrating the TOE framework and Upper Echelons Theory, the framework addresses the critical, often-overlooked role of employee-level behavioural outcomes, theorising how leaders function as essential resources that convert technology-induced anxiety into proactive employee engagement (Li et al., 2026; Obeidat, 2026).

Practical Guidance for Organizations

- **Targeted Leadership Development Initiatives:** Organisations must move beyond isolated technical training to develop leaders as architects of a digital ecosystem (Liao & Ismail, 2025). Programmes must enhance leaders' strategic digital vision and their change management capabilities.
- **Fostering Employee Engagement via Support:** As organisations rapidly integrate AI and data analytics tools, leaders must intentionally cultivate psychological safety to mitigate technology-induced stress (Li et al., 2026). By establishing transparent communication channels and role-modelling digital tool usage, leaders can lower the psychological threshold for adoption.

Conclusion

The persistent failure of capital-intensive digital transformation initiatives is rarely a consequence of technological inadequacy; rather, it stems from a profound deficit in strategic leadership (Obeidat, 2026). This concept paper provides a comprehensive framework that shifts the focus from pure technological investment to Digital Leadership Competency (DLC). By delineating a specific socio-technical mechanism, the mediating role of employee engagement, this model demonstrates how leadership characteristics influence organisational readiness and adoption effectiveness. Ultimately, technology adoption success is fundamentally a human endeavour. By centering digital leadership as a strategic determinant, organisations can ensure that their technological investments translate into enduring post-adoption performance and sustainable competitive advantage (Alhameed & Emeagwali, 2026).

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INTEGRATING CHATGPT AND AI VOICE TOOLS IN DEVELOPING AN ENGLISH-BASED MICRO-CREDENTIAL COURSE ON ADOBE INDESIGN INTERACTIVE PANEL FOR TVET EDUCATORS: CHALLENGES AND INSTRUCTIONAL REFLECTIONS.

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Abstract: *The rapid advancement of Artificial Intelligence (AI) is reshaping instructional design practices in Technical and Vocational Education and Training (TVET). This study examines the integration of ChatGPT and AI voice tools in developing an English-based micro-credential course on the Interactive Panel features of Adobe InDesign. The course was designed to support TVET educators and students in mastering interactive elements such as buttons, animations, forms, and hyperlinks for digital publishing. As a higher education instructor working with TVET students who focus primarily on practical and hands-on learning, all AI-generated scripts were systematically reviewed, refined, and contextualised to ensure alignment with learning outcomes, technical accuracy, and instructional clarity. A qualitative case study approach was employed to explore the development process, challenges encountered, and instructional reflections. Data were collected through structured reflective documentation and learner feedback. Findings indicate that AI tools enhanced efficiency in content creation, improved linguistic quality, and increased the professionalism of video tutorials through AI-generated narration. However, continuous human intervention was necessary to refine technical explanations and maintain contextual relevance. The study highlights the potential of AI-assisted tools to empower TVET educators in producing scalable, high-quality digital learning resources aligned with emerging megatrends in vocational education. Usability testing was conducted with Semester 2 students for Session 2, 2025/2026. A total of 45 students successfully completed the testing and provided positive feedback. In conclusion, the micro-credential course on the Interactive Panel features of Adobe InDesign has proven to be a practical and inclusive learning tool, particularly beneficial for Ibrahim Sultan Polytechnic.*

Keywords: *Artificial Intelligence, Micro-credential, TVET, Adobe InDesign, Interactive Learning*

Introduction

The integration of Artificial Intelligence (AI) in education has accelerated rapidly, reshaping instructional design, content development, and learning delivery across disciplines. In Technical and Vocational Education and Training (TVET), this transformation is particularly significant, as educators must continuously adapt to industry-relevant technologies while maintaining practical and competency-based learning approaches. AI-driven tools offer new opportunities to enhance efficiency and scalability in instructional design, especially in developing digital learning resources.

Micro-credentials have emerged as a flexible and targeted approach to skill development, enabling learners to acquire specific competencies aligned with industry demands (Oliver, 2019). In the context of digital publishing, Adobe InDesign remains a critical tool, particularly its Interactive Panel features, which allow users to create engaging digital content through animations, buttons, forms, and hyperlinks. However, teaching these features effectively requires structured instructional design, which can be time-intensive for educators.

Recent advancements in generative AI, particularly ChatGPT, have demonstrated strong potential in supporting instructional content development, including syllabus design, assessment creation, and script writing (Kasneci et al., 2023; Lo, 2023). Additionally, AI voice tools provide an alternative to traditional voice recording by generating professional narration, thus improving production efficiency and consistency (Huang et al., 2021).

This study explores the integration of ChatGPT and AI voice tools in developing an English-based micro-credential course focusing on Adobe InDesign Interactive Panel features. Specifically, the study investigates the development workflow, challenges encountered, and instructional reflections from a TVET educator's perspective. The study also evaluates the usability of the developed course through student feedback.

Literature Review

Artificial Intelligence in Education

Artificial Intelligence has become a transformative force in education, enabling personalized learning, automated content generation, and enhanced instructional support (Holmes et al., 2019). AI-powered tools such as ChatGPT have demonstrated potential in assisting educators with lesson planning, content creation, and assessment design (Kasneci et al., 2023).

Recent studies highlight that AI can reduce educators' workload while improving instructional efficiency (Zawacki-Richter et al., 2019). However, the role of human oversight remains critical to ensure accuracy, contextual relevance, and pedagogical alignment.

ChatGPT in Instructional Design

ChatGPT, a generative AI model, has been increasingly utilized in educational contexts for generating teaching materials, quizzes, and explanations (Lo, 2023). Its ability to produce structured and coherent content makes it particularly useful in developing course outlines and instructional scripts.

Nevertheless, several researchers emphasize that AI-generated content requires validation due to potential inaccuracies and lack of contextual specificity (Tlili et al., 2023). In TVET settings, where technical precision is essential, human intervention becomes even more crucial.

AI Voice Technology in Education

AI voice tools have gained popularity for producing high-quality narration in e-learning environments. These tools enable educators to generate consistent and professional audio without the need for recording equipment or multiple retakes (Huang et al., 2021).

The use of AI-generated voices can enhance learner engagement and accessibility, particularly in multilingual or English-based courses. Additionally, AI voice tools reduce production time and eliminate issues such as background noise and pronunciation errors.

Micro-Credentials in TVET

Micro-credentials are short, focused learning programs designed to develop specific skills or competencies (Oliver, 2019). In TVET, micro-credentials support flexible learning pathways and align closely with industry demands.

Research indicates that micro-credentials enhance employability and provide opportunities for continuous professional development (Wheelahan & Moodie, 2021). They are particularly effective in delivering digital skills training, such as software-based competencies.

Digital Publishing and Adobe InDesign in Education

Adobe InDesign is a key tool in digital publishing education, widely used for creating interactive documents and multimedia content. Teaching interactive features requires a combination of technical instruction and practical application.

Previous studies suggest that structured tutorials and hands-on activities are essential for mastering software-based skills (Martin & Ertzberger, 2013). Integrating interactive learning elements can further enhance student engagement and understanding.

Challenges of AI Integration in Teaching

Despite its advantages, AI integration presents challenges such as accuracy concerns, dependency risks, and ethical considerations (Selwyn, 2019). Educators must critically evaluate AI outputs and ensure alignment with learning objectives.

In TVET contexts, where practical skills are emphasized, AI tools should complement, not replace the hands-on instruction. Effective integration requires a balance between automation and human expertise.

Methodology

Theoretical Framework

This study is grounded in a combination of the ADDIE instructional design model, Human-AI collaboration theory, and Cognitive Load Theory to provide a comprehensive framework for understanding AI-assisted instructional development.



The ADDIE model (Analysis, Design, Development, Implementation, Evaluation) serves as the foundational structure guiding the development of the micro-credential course. The use of ChatGPT aligns primarily with the Design and Development phases, where structured content, scripts, and assessments are generated. Meanwhile, AI voice tools contribute to the Development and Implementation phases by enhancing content delivery.

Human-AI collaboration theory emphasizes that AI systems function most effectively when combined with human expertise rather than operating independently (Holmes et al., 2019). In this study, ChatGPT acts as a co-creator, while the educator ensures contextual accuracy, pedagogical alignment, and technical correctness.

Additionally, Cognitive Load Theory (Sweller, 1988) is relevant in evaluating how AI-generated structured content and clear narration reduce extraneous cognitive load. The use of organized scripts and consistent voice narration supports learners in processing complex technical information more efficiently. By integrating these frameworks, the study positions AI not merely as a tool, but as part of a hybrid instructional design ecosystem that enhances both efficiency and learning quality.

Development Process

The development of the micro-credential course followed several key phases:

Phase 1: Syllabus Development Using ChatGPT

ChatGPT was used to generate a structured syllabus for the Interactive Panel topic in Adobe InDesign. The generated content included step-by-step learning topics and a clear course progression, which served as a foundational guide for the development of the micro-credential course.

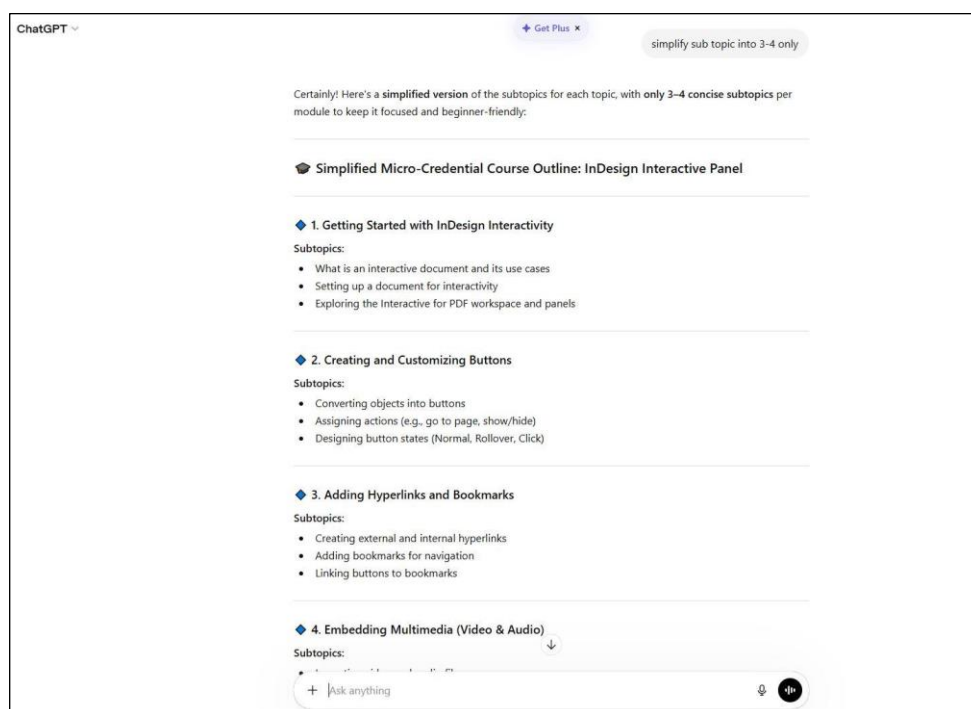


Figure 1: ChatGPT-generated syllabus structure and step-by-step course outline for the Adobe InDesign Interactive Panel micro-credential.
Source: Screenshot from ChatGPT interface (OpenAI, 2025)

As illustrated in Figure 1, the AI-generated syllabus provided an organized framework outlining the sequence of instructional topics, enabling a systematic approach to teaching interactive features such as buttons, animations, forms, and hyperlinks. This initial structure significantly supported the instructional design process by offering a comprehensive starting point, which was later reviewed and refined to ensure alignment with current software updates, learning outcomes, and the specific needs of TVET learners.

Phase 2: Content Validation and Refinement

The initial syllabus was reviewed and refined through collaborative discussions with a partner. During this process, several adjustments were made to ensure alignment with the latest software updates, the intended learning outcomes, and the specific requirements of the TVET teaching context. This collaborative validation helped enhance the accuracy, relevance, and instructional effectiveness of the course content.

Phase 3: Quiz Development

ChatGPT was used to generate quiz questions at various difficulty levels. The researcher then selected and refined the questions based on their relevance and appropriateness to the learning objectives.

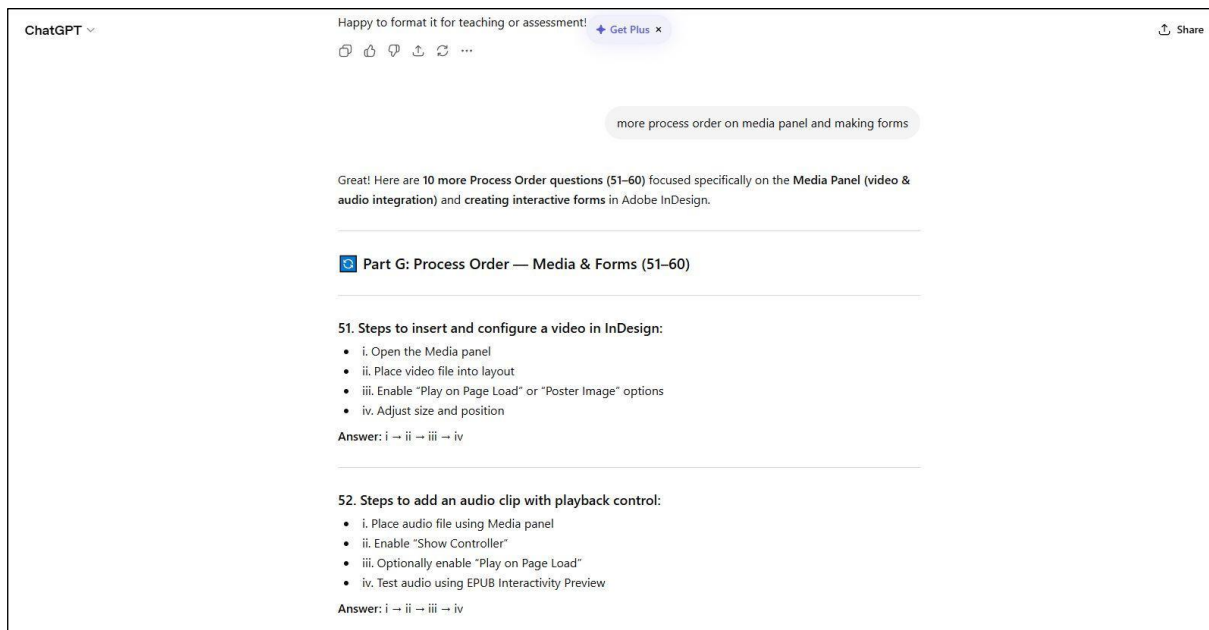


Figure 2: AI-generated quiz questions developed using ChatGPT in alignment with the intended learning outcomes.

Source: Screenshot from ChatGPT interface (OpenAI, 2025)

As shown in Figure 2, the AI-generated quiz questions were developed in alignment with the intended learning outcomes, ensuring a structured assessment approach. The figure specifically illustrates the process order for Quiz 2, which was designed with a higher level of difficulty compared to Quiz 1, demonstrating a progression in cognitive challenge and learner competency. The researcher then added sample images to accompany the questions and edited the answers, as AI tends to provide linear, overly simplified steps for step-by-step questions.

Phase 4: Tutorial Video Production

Tutorial videos were recorded manually based on the refined syllabus. The researcher followed structured steps generated by ChatGPT to ensure clarity and consistency throughout the instructional delivery. As illustrated in Figure 3, the tutorial video recording process demonstrates the step-by-step use of the Interactive Panel in Adobe InDesign. The figure presents an example from Topic 3, focusing on adding hyperlinks and bookmarks, highlighting how the instructional content was translated into practical demonstration.

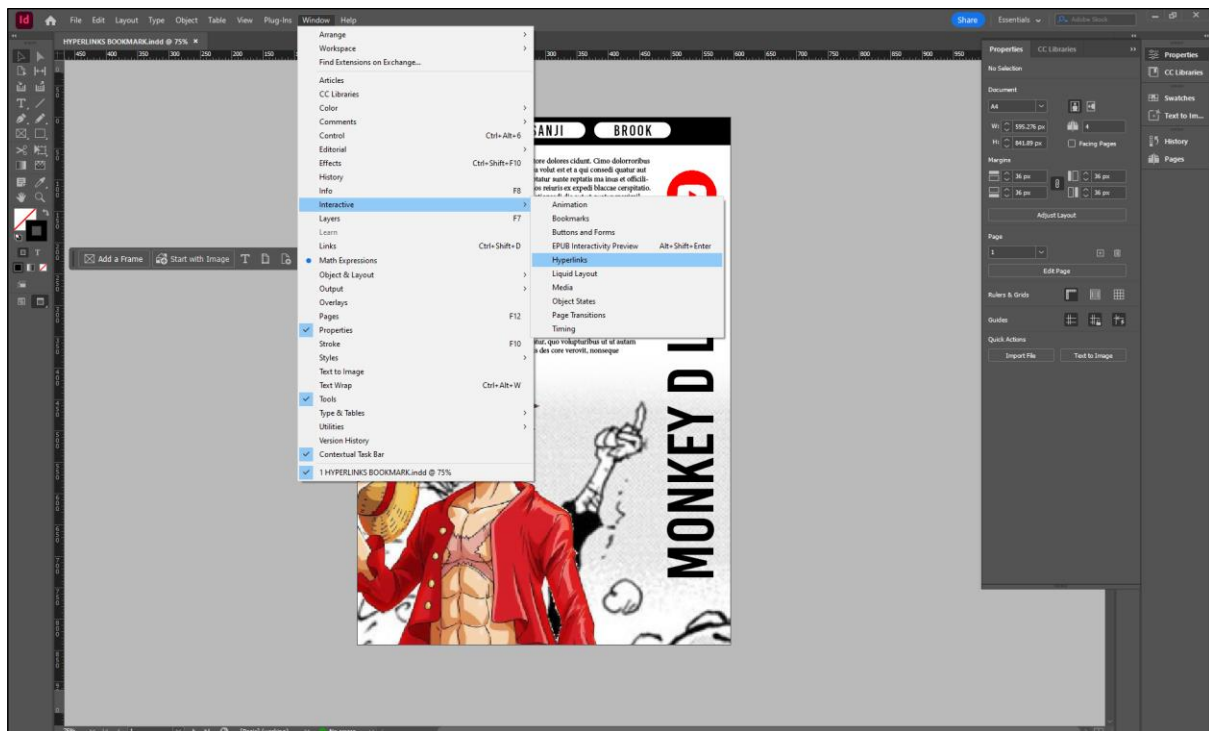


Figure 3: Tutorial video recording process illustrating step-by-step use of the Interactive Panel in Adobe InDesign.

Source: Screenshot from *Adobe InDesign* (2025)

Phase 5: Script Writing Using ChatGPT

ChatGPT also assisted in generating organized and professional tutorial scripts, which were subsequently edited to improve clarity and accuracy. As shown in Figure 4, the structured voice-over script includes a clear timeline, segmented sections such as introduction and main content, and aligned narration flow to support coherent instructional delivery. This structured scripting approach contributed to a more systematic and professional presentation of the tutorial content.

Figure 5 illustrates the refinement process of the AI-generated voice-over script to ensure alignment with the recorded tutorial video. Although the initial script was generated using ChatGPT, several modifications were necessary during post-production. These adjustments were made to accommodate additional explanations introduced during the recording process, as well as to improve clarity and instructional flow.

Furthermore, examples used in the script were revised to better reflect contexts that are more relatable to students, enhancing their understanding and engagement. This iterative editing process highlights the importance of human intervention in adapting AI-generated content to suit real teaching scenarios, ensuring that the final instructional material remains accurate, relevant, and pedagogically effective.

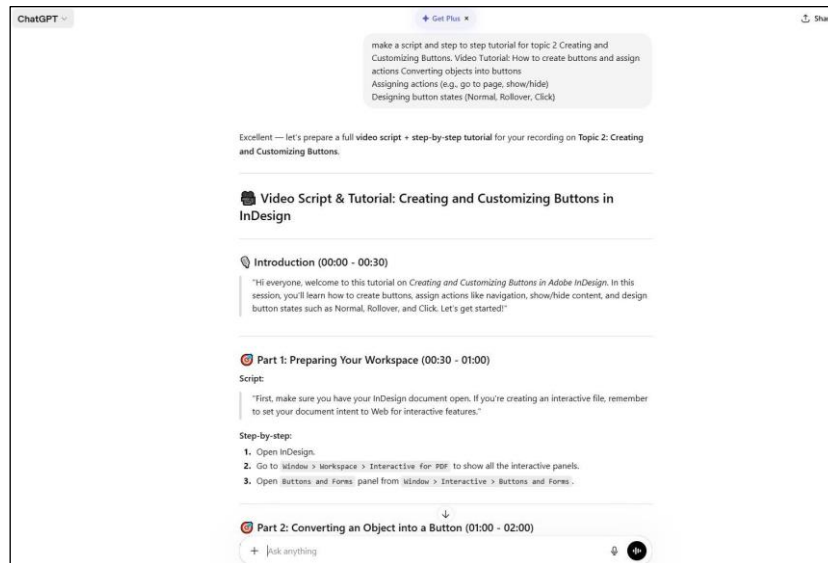


Figure 4: Structured voice-over script generated using ChatGPT to support clear and coherent instructional delivery.

Source: Screenshot from ChatGPT interface (OpenAI, 2025)

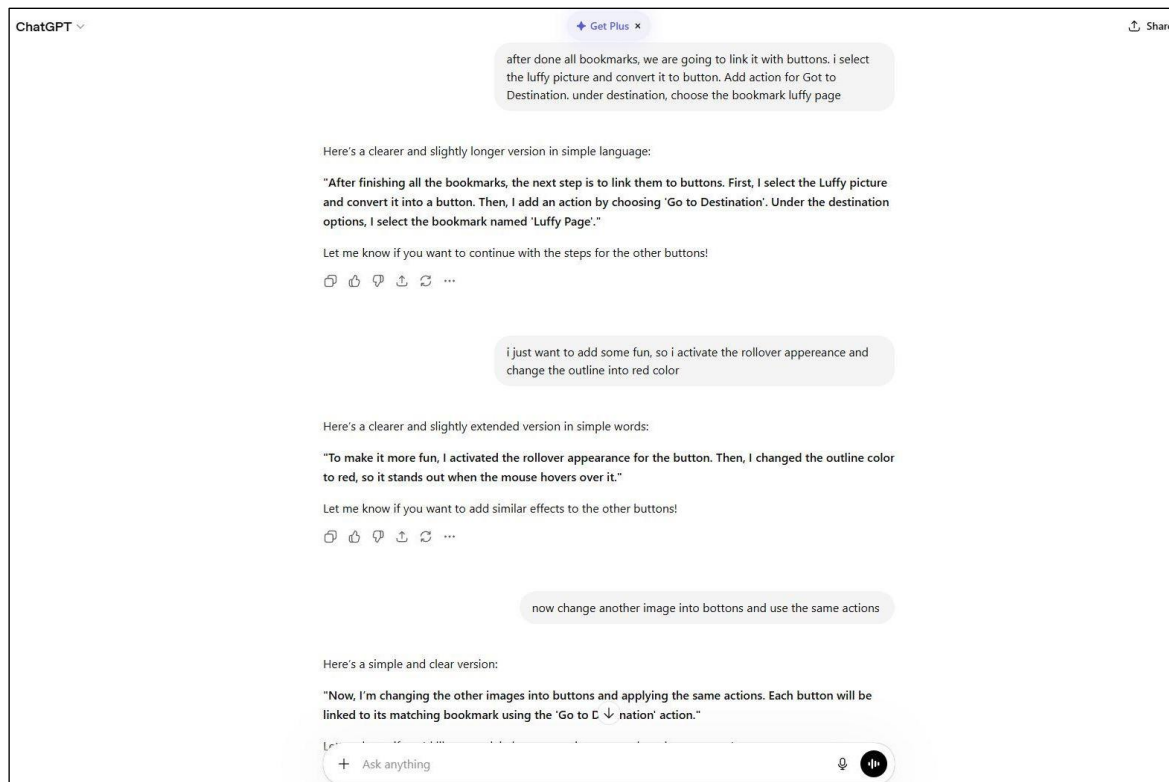


Figure 5: Refinement of the AI-generated voice-over script to align with the recorded tutorial video and instructional context.

Source: Screenshot from ChatGPT interface (OpenAI, 2025)

Phase 6: AI Voice Integration

AI voice tools were used to generate narration for the tutorial videos, providing a more efficient alternative to manual voice recording. Both male and female voices were selected to introduce variation and enhance learner engagement. As illustrated in Figure 6, AI voice generation was conducted using Canva, where the generated audio was subsequently integrated and edited into specific segments of the tutorial videos. This approach ensured better synchronization between narration and visual content, resulting in a more polished and professional instructional output.

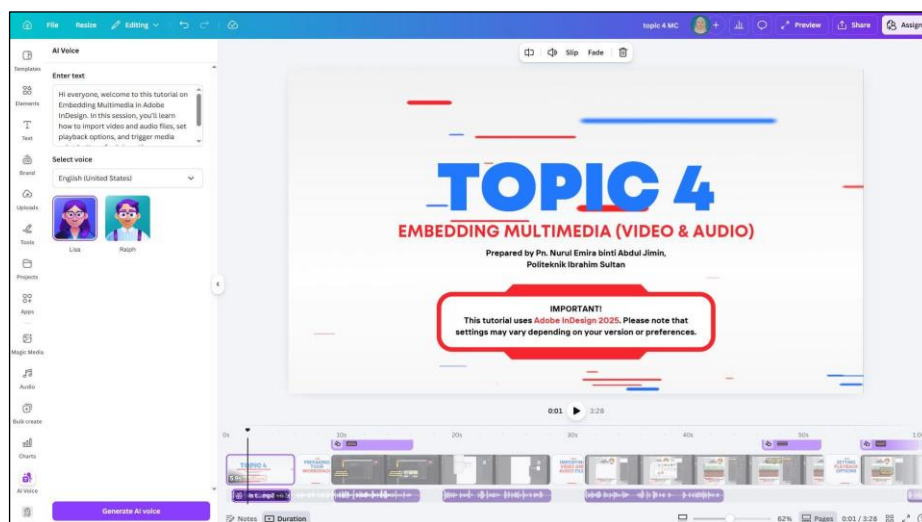


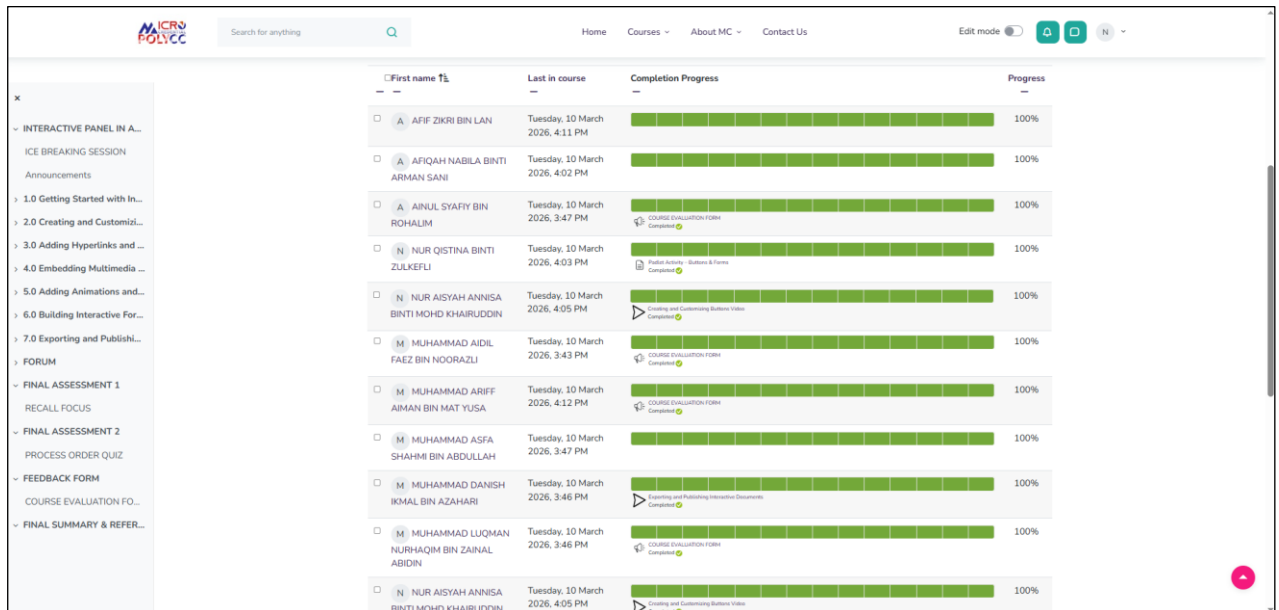
Figure 6: AI-generated voice narration created using Canva and integrated into the tutorial video to enhance instructional delivery and synchronization.

Source: Screenshot from Canva (2025)

Data Collection

Data for this study were gathered using three primary methods. First, reflective documentation was maintained throughout the development process to capture iterative improvements and design decisions. Second, structured feedback was collected from 45 students from Semester 2 (Session 2: 2025/2026) to evaluate user experience and system effectiveness. Third, direct observations were conducted during usability testing sessions to identify user interaction patterns and potential issues.

Figure 7 presents the administrative interface displaying the list of users enrolled in the micro-credential course. The figure shows that a total of 45 users participated in the initial usability testing phase, providing a sufficient sample to evaluate the effectiveness and usability of the developed course. This enrolment data also allows administrators to monitor participation and track user engagement throughout the course. Following the successful completion of the initial testing, the course has been made publicly accessible, enabling a wider audience to enrol and benefit from the learning materials. This transition from controlled testing to open access reflects the scalability and practical applicability of the AI-assisted micro-credential course in a broader educational context.



First name	Last in course	Completion Progress	Progress
A AFIF ZIKRI BIN LAN	Tuesday, 10 March 2026, 4:11 PM		100%
A AFIAH NABILA BINTI ARMAN SANI	Tuesday, 10 March 2026, 4:02 PM		100%
A AINUL SYAFIY BIN ROHALIM	Tuesday, 10 March 2026, 3:47 PM	COURSE EVALUATION FORM Completion	100%
N NUR QISTINA BINTI ZULKEFLI	Tuesday, 10 March 2026, 4:03 PM	Project Activity - Submit & Name Completion	100%
N NUR AISYAH ANNISA BINTI MOHD KHAIRUDDIN	Tuesday, 10 March 2026, 4:05 PM	Creating and Customizing Business Value Completion	100%
M MUHAMMAD AIDIL FAEZ BIN NOORAZLI	Tuesday, 10 March 2026, 3:43 PM	COURSE EVALUATION FORM Completion	100%
M MUHAMMAD ARIFF AIDAN BIN MAT YUSA	Tuesday, 10 March 2026, 4:12 PM	COURSE EVALUATION FORM Completion	100%
M MUHAMMAD ASFA SHAHMI BIN ABDULLAH	Tuesday, 10 March 2026, 3:47 PM		100%
M MUHAMMAD DANISH IKMAL BIN AZAHARI	Tuesday, 10 March 2026, 3:46 PM	Exporting and Publishing Interactive Documents Completion	100%
M MUHAMMAD LUQMAN NURHAQIM BIN ZAINAL ABIDIN	Tuesday, 10 March 2026, 3:46 PM	COURSE EVALUATION FORM Completion	100%
N NUR AISYAH ANNISA BINTI MOHD KHAIRUDDIN	Tuesday, 10 March 2026, 4:05 PM	Creating and Customizing Business Value Completion	100%

Figure 7: Administrative interface displaying the list of users enrolled in the micro-credential Interactive Panel in Adobe Indesign course.

Source: Screenshot from <https://mcpolycc.cidos.edu.my> (2026)

Data Analysis

The collected data were analyzed using thematic analysis. This approach enabled the identification and categorization of recurring patterns across the dataset. The analysis focused on four key themes: (i) the efficiency of AI tools, (ii) the quality of instructional delivery, (iii) challenges encountered during use, and (iv) overall user feedback.

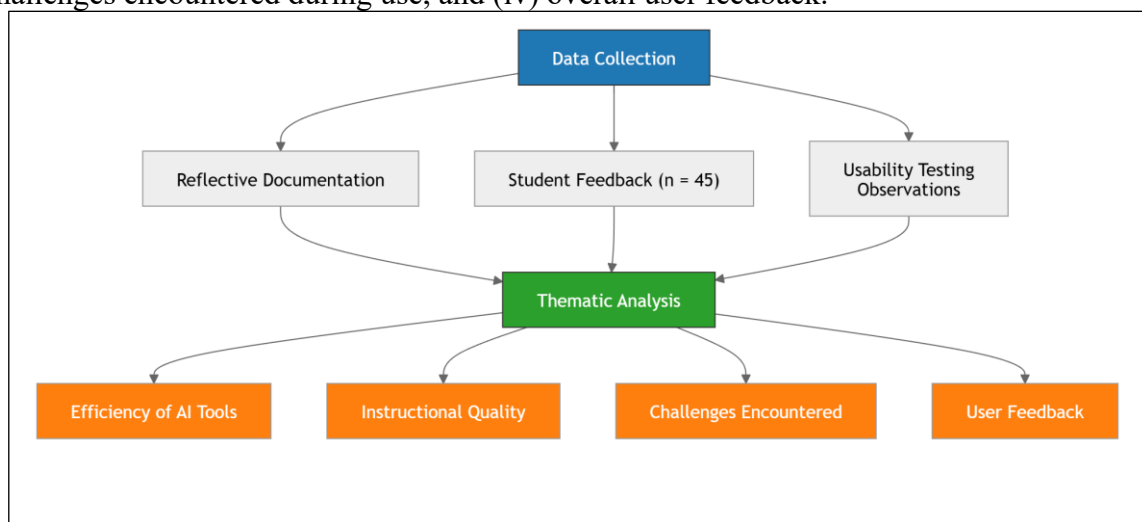


Figure 8: Research Methodology Diagram (Input-Process-Output Model).

Source: Developed by the author (2026)

Findings and Discussion

AI as a Cognitive and Instructional Amplifier

The findings demonstrate that ChatGPT functioned as a cognitive amplifier in the instructional design process, significantly reducing the time required to generate structured content. This aligns with Kasneci et al. (2023), who argue that generative AI enhances productivity by automating repetitive cognitive tasks.

However, beyond efficiency, the structured outputs produced by ChatGPT contributed to improved instructional sequencing. This suggests that AI not only accelerates development but also supports instructional coherence, particularly in technical subjects such as Adobe InDesign. From an ADDIE perspective, this highlights AI's strong potential in the Design phase, where content structuring is critical.

Human-AI Collaboration: Beyond Automation

A key finding of this study is that AI did not replace the educator but instead functioned as a collaborative partner. While ChatGPT generated initial content, human intervention was necessary to refine, validate, and contextualize the material.

This supports the argument by Holmes et al. (2019) that AI should be viewed as an augmentation tool rather than a replacement for human expertise. In this study, the educator played a crucial role in correcting outdated or inaccurate technical instructions, aligning content with current software updates and adapting materials to the TVET learning context. This hybrid approach reflects a Human-in-the-Loop model, which is increasingly recognized as essential in AI-assisted education.

Managing Accuracy and Contextual Relevance

Despite its strengths, ChatGPT exhibited limitations in technical accuracy and contextual awareness. Some generated tutorials did not align with the latest Adobe InDesign features, reinforcing concerns highlighted by Tlili et al. (2023).

This finding is particularly significant in TVET contexts, where instructional accuracy directly impacts skill acquisition. The need for continuous validation indicates that AI-generated content cannot be adopted uncritically.

From a theoretical perspective, this highlights a limitation in current AI systems: they lack real-time contextual sensitivity. Therefore, the effectiveness of AI in education depends heavily on the educator's ability to critically evaluate and adapt outputs.

AI Voice Tools and Cognitive Load Reduction

The integration of AI voice tools contributed to improved instructional delivery by providing consistent and clear narration. This aligns with Cognitive Load Theory, as well-structured audio explanations help reduce extraneous cognitive load (Sweller, 1988).

Unlike manual voice recording, AI-generated narration eliminates inconsistencies in tone, pacing, and pronunciation. This creates a more stable learning experience, particularly for English-based instruction among non-native speakers.

Furthermore, the use of both male and female voices introduced variation, which may enhance learner engagement. This supports findings by Huang et al. (2021) that AI voice technologies can improve both accessibility and learner experience.

Implications for Micro-Credential Design in TVET

The study highlights the potential of AI tools in supporting scalable micro-credential development. By reducing development time and improving content quality, AI enables educators to produce modular learning resources more efficiently. This is particularly relevant in TVET, where rapid technological changes require continuous curriculum updates. The integration of AI tools aligns with the evolving nature of micro-credentials, which emphasize flexibility, responsiveness, and industry relevance (Wheelahan & Moodie, 2021). Moreover, the structured and modular nature of AI-assisted content supports competency-based learning, which is central to TVET pedagogy.

Learner Experience and Usability

The positive feedback from all 45 students indicates that the AI-assisted micro-credential course was effective in supporting learning. Students highlighted its clear instructional flow, easy-to-follow tutorials and it improved understanding of interactive features. From a Cognitive Load perspective, this suggests that the structured design and clear narration reduced unnecessary cognitive burden, allowing learners to focus on skill acquisition. However, it is important to note that the evaluation was limited to usability and perception. Future studies should incorporate performance-based assessments to measure actual learning outcomes.

Contribution to Knowledge

This study contributes to the existing literature in several meaningful ways. First, it provides empirical evidence of AI integration in TVET instructional design, offering practical insights into its implementation. Second, it demonstrates a structured and practical workflow that combines multiple AI tools within a single course development process. Third, the study highlights the importance of Human-AI collaboration, particularly in technical education where accuracy and contextual relevance are critical. Additionally, it extends the application of AI beyond simple content generation to encompass the full development of a micro-credential course. Unlike previous studies that primarily examine AI as a standalone tool, this research positions AI as part of a broader instructional ecosystem that integrates both technological capabilities and human expertise.

Instructional Reflections

The integration of AI tools highlighted several important insights. Firstly, AI is highly effective as a support tool rather than a replacement for educators. Secondly, human expertise remains

essential for validating and contextualizing AI-generated content to ensure accuracy and relevance. Additionally, AI tools can significantly enhance productivity and improve the overall quality of instructional materials. Finally, the combined use of multiple AI tools contributes to a more efficient and streamlined workflow in instructional design.

Implications and Future Research

The findings suggest that AI-assisted instructional design has strong potential in TVET education. Institutions should consider integrating AI tools into curriculum development processes while ensuring proper training for educators.

Future research should explore the quantitative impact of AI-assisted instructional design on student performance, particularly in measuring learning outcomes and skill acquisition. In addition, longitudinal studies are needed to examine the long-term effectiveness and retention benefits of AI-assisted learning environments. Expanding the implementation of such approaches across different disciplines would also provide insights into their adaptability and scalability beyond TVET contexts. Furthermore, greater attention should be given to ethical considerations, including data privacy, academic integrity, and the development of clear governance frameworks to guide the responsible use of AI in education.

Conclusion

The integration of ChatGPT and AI voice tools offers a practical and efficient approach to developing micro-credential courses in TVET. While AI enhances productivity and instructional quality, human intervention remains crucial to ensure accuracy and relevance.

This study demonstrates that AI-assisted instructional design can support scalable and high-quality learning resource development. Future research may focus on measuring learning outcomes and expanding implementation across different disciplines.

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A STUDY ON THE EFFECTIVENESS OF THE e-VISIT BOOKING SYSTEM ON VISITOR SATISFACTION AT IMAN RABBIT FARM

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Abstract: *Digital transformation has become an increasingly vital driver of service improvement in the tourism industry, particularly for small and medium-sized tourism enterprises that often face operational and resource constraints. This study investigates the effectiveness of the e-Visit Booking system and examines its relationship with visitor satisfaction at IMAN Rabbit Farm, a prominent tourism attraction in Malaysia. Employing a quantitative research design, data were collected through a structured survey administered to 300 visitors who had utilized the digital booking platform. Reliability analysis indicated high internal consistency for both constructs, confirming the measurement instruments were robust and dependable. Descriptive findings revealed that visitors generally perceived the e-Visit Booking system as highly effective, with a mean score of 4.02, and reported a high level of overall satisfaction, with a mean score of 4.55. However, Pearson correlation analysis indicated a slightly weak positive relationship between system effectiveness and visitor satisfaction, suggesting that while digital systems contribute positively to visitor experiences, other factors such as service quality, staff interactions, and on-site amenities also play a critical role. The results highlight the need for tourism operators to adopt a holistic approach, combining investments in digital platforms with enhancements in the overall visitor experience. By doing so, organizations can foster greater visitor engagement, satisfaction, and long-term loyalty, supporting sustainable growth in the competitive tourism sector.*

Keywords: *E-booking System, Visitor Satisfaction, Tourism Management*

Introduction

The tourism industry has undergone significant transformation over the past two decades due to the rapid advancement of digital technology. Information and communication technologies (ICT) have become integral tools for tourism operators in managing services, improving operational efficiency, and enhancing visitor experiences. Digital innovations such as online reservation systems, mobile applications, and electronic payment platforms have reshaped the way tourism services are delivered and consumed. Tourism organizations increasingly rely on digital technologies to remain competitive in a highly dynamic environment. Online booking platforms allow visitors to plan and manage their trips more conveniently, while tourism operators benefit from automated reservation systems that reduce administrative workload and minimize operational errors. As digital adoption becomes more widespread, the integration of technological solutions into tourism operations is no longer optional but essential. Small and medium-sized tourism enterprises (SMTEs), however, often face operational challenges due to limited resources, manpower constraints, and reliance on manual processes. Many small tourism attractions still depend on traditional reservation systems, which may lead to

inefficiencies such as double bookings, inaccurate record management, long waiting times, and poor communication with visitors. These operational limitations can negatively affect service quality and visitor satisfaction. One approach to addressing these challenges is the implementation of electronic booking systems, commonly known as e-booking systems. These systems allow visitors to make reservations through digital platforms before arriving at the destination. By enabling advance reservations, tourism operators can better manage visitor flow, allocate resources more efficiently, and reduce congestion during peak periods. Figure 1 shows IMAN Rabbit Farm as a family-oriented tourism attraction in Malaysia that offers interactive experiences involving rabbit feeding, educational activities, and recreational facilities. The attraction has gained popularity among families and tourists seeking leisure experiences in a natural environment. Prior to implementing the e-Visit Booking system, reservations were primarily handled manually, which created difficulties in organizing visitor schedules and managing crowd levels.



Figure 1: Location of Iman Rabbit Farm

The introduction of the e-Visit Booking system (refer Figure 2) aims to streamline the reservation process and improve the overall visitor experience. Through this digital platform, visitors can book their visits in advance, select available time slots, and receive confirmation before arriving at the attraction. This system helps the management team regulate visitor capacity while providing a more organized and convenient service for guests.

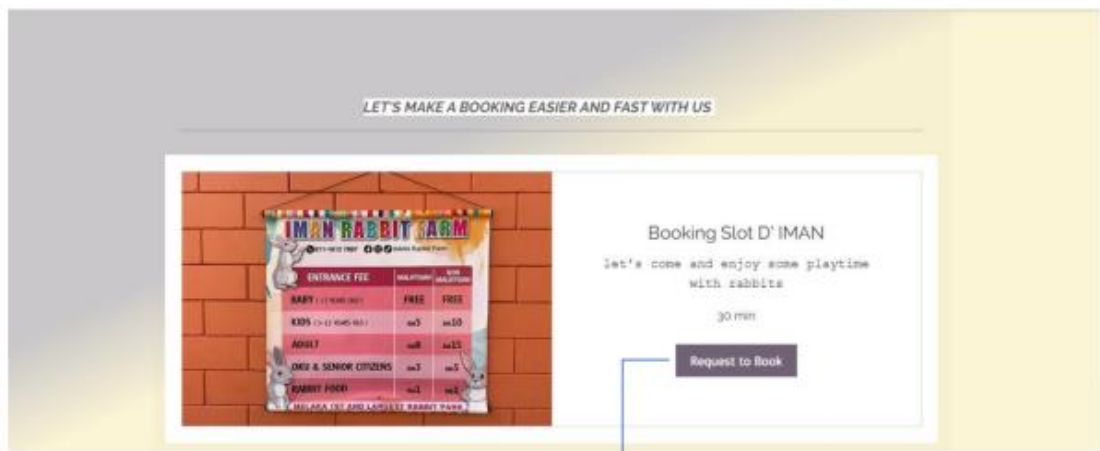


Figure 2: Interface of e-Visit Booking System

Despite the increasing adoption of digital systems in tourism operations, limited empirical research has examined the effectiveness of such systems within small-scale tourism attractions. Understanding how digital booking platforms influence visitor satisfaction is crucial for tourism operators seeking to enhance service delivery and maintain competitiveness.

Therefore, this study aims to investigate the effectiveness of the e-Visit Booking system and examine its relationship with visitor satisfaction at IMAN Rabbit Farm. The specific objectives of this study are:

1. To determine the level of effectiveness of the e-Visit Booking system at IMAN Rabbit Farm.
2. To examine the level of visitor satisfaction after using the system.
3. To analyse the relationship between the effectiveness of the e-Visit Booking system and visitor satisfaction.

The findings of this study are expected to contribute to the growing body of knowledge on digital transformation in tourism and provide practical insights for tourism operators, particularly small-scale attractions, in leveraging technology to improve service quality and visitor satisfaction.

Literature Review

Digital Transformation in Tourism

Digital transformation refers to the integration of digital technologies into organizational processes to enhance operational efficiency, innovation, and customer engagement. In the tourism context, this transformation has significantly reshaped how organizations operate and how visitors interact with services (Gretzel et al., 2015). In line with this, Information and Communication Technology (ICT) has played a crucial role in transforming tourism operations by enabling real-time communication and online booking systems (Buhalis & Law, 2008).

Recent studies further highlight that digital tourism ecosystems are becoming increasingly data-driven and experience-oriented. For instance, a study conducted in Malaysia found that the interactivity and functionality of online travel platforms significantly influence tourists' online purchase intentions and e-loyalty, emphasizing the importance of system design and usability in digital tourism environments (Shariffuddin et al., 2023). This reinforces the argument that system effectiveness extends beyond basic functionality to include user engagement and trust-building mechanisms. Additionally, contemporary research on smart tourism technologies demonstrates that elements such as accessibility, personalization, and security significantly affect tourist satisfaction, particularly in digitally enhanced destinations (Anuar et al., 2025). These findings indicate that modern tourism systems must integrate advanced features to remain competitive and relevant. Previous studies by Sigala (2018) and Neuhofer et al. (2015) emphasize that digital technologies not only improve operational efficiency but also enrich tourist experiences through seamless and interactive engagement. In modern tourism environments, systems such as e-Visit booking have become essential components in delivering convenient, fast, and user-centered experiences. Furthermore, online booking systems are widely adopted across tourism sectors, including hotels, airlines, and tourist attractions (Law et al., 2009). These systems allow visitors to plan their trips in advance, thereby reducing waiting time and enhancing overall visitor experiences (O'Connor, 2010). This is particularly relevant in the Malaysian context, where domestic tourism has shown significant growth, with increased visitor spending and travel activities in recent years, highlighting the growing reliance on digital platforms for travel planning (Department of Statistics Malaysia, 2025). Hence, the effectiveness of digital systems has become a critical determinant of service quality and user experience.

Online Booking Systems in Tourism

Online booking systems are digital platforms that enable customers to reserve services electronically through websites or mobile applications. These systems are widely used in tourism sectors such as hotels, airlines, and tourist attractions (Law et al., 2009). Research suggests that e-booking systems improve operational efficiency by reducing manual administrative tasks and minimizing reservation errors (Beldona et al., 2005). By automating reservation processes, tourism operators can maintain accurate visitor records and better manage service capacity. Furthermore, online booking systems enhance convenience for visitors by allowing them to plan their visits in advance. This reduces waiting time and improves overall visitor experiences (O'Connor, 2010).

Visitor Satisfaction

Visitor satisfaction is widely recognized as a key determinant of tourism success. Satisfaction refers to the extent to which visitors' expectations are fulfilled by the services they receive during their visit (Kotler & Keller, 2016). In tourism research, Wan Nur Fasihah Wan Jasni et al. (2020), which found that e-service quality significantly enhances user experience in online booking platforms. When visitors perceive services as efficient and convenient, they are more likely to report higher satisfaction levels and recommend the destination to others. According to Siti Nur Farhana (2020), facilities refer to elements that are provided to enhance the comfort

and convenience of users when they visit a particular place. In tourism settings, digital technologies that enhance service delivery may contribute to improved visitor satisfaction.

Information Systems Success Model

The Information Systems Success Model proposed by DeLone and McLean (2003) provides a theoretical framework for evaluating the effectiveness of information systems. The model suggests that system quality, information quality, and service quality influence user satisfaction and system usage. System quality refers to the performance and usability of a digital system, including factors such as reliability, ease of use, and response time. When users perceive a system as effective and user-friendly, they are more likely to be satisfied with the service provided. In tourism contexts, effective online booking systems contribute to positive visitor experiences by facilitating smooth reservation processes and reducing uncertainty during trip planning. According to Muhammad Danial Zulkipli and Mohd Najib Mohd Salleh (2023), the e-appointment system was introduced to simplify the manual procedures that were previously used, making the process more systematic and user-friendly. In addition, feedback from customers who visit the premises can also be collected. This feedback is then analysed to identify areas for improvement and address issues from various aspects, serving as a benchmark to ensure that the system developed is more practical and effective.

Relationship Between System Effectiveness and Visitor Satisfaction

Overall, this study shows that digital technology and online booking systems are important for improving visitor experience. However, the link between system effectiveness and visitor satisfaction is not simple, as it is affected by many factors, both technical and non-technical. In Malaysia, the fast growth of domestic tourism and the increasing use of digital platforms highlight the need to improve system performance and user experience (Department of Statistics Malaysia, 2025). These findings suggest that tourism organizations should not only focus on basic system functions, but also provide a complete and enjoyable experience for visitors. This can be done by adding features like personalization, interactive elements, and real-time updates. Continuous improvements in the system, together with better service quality and meaningful experiences, are important to increase visitor satisfaction and stay competitive in the digital tourism industry. Previous studies have demonstrated that system effectiveness has a significant impact on user satisfaction. For example, Kim et al. (2009) found that website quality and usability significantly influence customer satisfaction in online service environments. Similarly, Neuhofer et al. (2015) highlighted that digital technologies play a crucial role in shaping tourism experiences by providing interactive and convenient services for visitors. Based on these findings, it is expected that the effectiveness of the e-Visit Booking system will positively influence visitor satisfaction at IMAN Rabbit Farm.

Methodology

This study employed a quantitative research design using a survey method to collect data from visitors who used the e-Visit Booking system. Quantitative research is appropriate for examining relationships between variables and testing hypotheses using statistical analysis. The population of this study consisted of visitors who had used the e-Visit Booking system to

reserve their visit to IMAN Rabbit Farm. A total of 300 respondents participated in the study. Convenience sampling was used to select respondents who were willing to complete the questionnaire after their visit. Data were collected through a structured questionnaire consisting of three sections: Section A (demographic information), Section B (effectiveness of the e-Visit Booking system), and Section C (visitor satisfaction). A five-point Likert scale was used to measure respondents' perceptions, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Items measuring system effectiveness focused on ease of use, booking convenience, information clarity, system accessibility, and the booking confirmation process, while visitor satisfaction items assessed overall satisfaction with the booking experience, satisfaction with the visit, perceived convenience, and the overall service experience. The questionnaire was distributed to visitors who had completed their visit to IMAN Rabbit Farm and had previously used the e-Visit Booking system. Participation was voluntary, and respondents were assured that their responses would remain confidential. Data were analysed using SPSS 29, which included reliability analysis, descriptive statistics, and Pearson correlation, while reliability testing was conducted using Cronbach's alpha to evaluate the internal consistency of the measurement items.

In this study, descriptive analysis using mean score values is applied to determine the effectiveness of system and visitor satisfaction at IMAN Rabbit Farm. To interpret the mean scores, the Mean Score Interpretation Table developed by Jum Nunnally and Ira Bernstein (1994) is adopted. The table is presented in Table 1.

Table 1. Table of Mean Score Interpretation

Mean Scale	Level
4.01 – 5.00	High
3.01 – 4.00	Medium High
2.01 – 3.00	Medium Low
1.00 – 2.00	Low

Source: Nunnally & Berstein, (1994)

Correlation analysis is used to determine the strength and direction of the relationship between independent and dependent variables. If the correlation coefficient is equal to zero ($r = 0$), it indicates that there is no linear relationship between the two variables. In contrast, a correlation value approaching 1 indicates a very strong and positive linear relationship between the variables. In this study, the Pearson Linear Correlation method was employed to assess the existence and strength of the relationship between the working environment and institutional facilities with the level of work motivation among academic staff. According to J. A. Davis (1971), the strength of the correlation coefficient (r) can be interpreted as shown in Table 2 below:

Table 2: Interpretation of the Strength of Pearson Correlation Coefficient (r)

Range of r Value	Strength of Relationship
0.01 – 0.09	Very Weak
0.10 – 0.29	Weak
0.30 – 0.49	Moderate
0.50 – 0.69	Strong

0.70 – 1.00	Very Strong

Source: Davis, J.A. (1971)

Results and Discussion

The findings indicate that the effectiveness of the e-Visit booking system recorded a high mean score of 4.02, suggesting that respondents generally perceived the system as efficient, user-friendly, and accessible. This implies that the system successfully supports users in making bookings with minimal difficulty. This finding is consistent with recent studies in Malaysia, such as research by Wan Nur Fasihah Wan Jasni et al. (2020), which found that e-service quality significantly enhances user experience in online booking platforms. Similarly, studies conducted by Muhammad Danial Zulkipli and Mohd Najib Mohd Salleh (2023), the e-appointment system was introduced to simplify the manual procedures that were previously used, making the process more systematic and user-friendly.

From a theoretical point of view, this supports the Technology Acceptance Model, which explains that people are more likely to use a system if they find it useful and easy to use. In this study, the high average score shows that users think the e-Visit system is helpful and simple to use, which makes it effective. Table 3 presents the reliability results for the study variables. Cronbach's alpha values above 0.70 indicate acceptable reliability (Hair et al., 2019). Reliability analysis indicated strong internal consistency for both constructs.

Table 3: Reliability Analysis

Variable	Number of Items	Cronbach's Alpha
System Effectiveness	8	0.88
Visitor Satisfaction	6	0.91

Table 4 shows the mean scores for each variable. Descriptive analysis revealed that respondents generally perceived the e-Visit Booking system as effective. The mean score for system effectiveness was 4.02, indicating a high level of perceived effectiveness. Visitor satisfaction recorded a mean score of 4.55, indicating a high level of satisfaction among respondents. The results indicate that visitors were generally satisfied with the e-Visit Booking system and their overall experience at the attraction.

Table 4: Descriptive Statistics

Variable	Mean	Interpretation
System Effectiveness	4.02	High
Visitor Satisfaction	4.55	High

Table 5: Pearson Correlation Analysis

Variable	System Effectiveness	Visitor Satisfaction
System Effectiveness	1	.191
Visitor Satisfaction	.191	1

Note: $p < 0.01$ (2 tailed test)

Table 5 shows a correlation coefficient of $r = .191$, indicating a relationship between the effectiveness of the e-Visit booking system and visitor satisfaction. However, the relationship is weak, suggesting that improvements in system effectiveness are associated with only a slight increase in visitor satisfaction. The low coefficient implies that system effectiveness is not the primary factor influencing satisfaction. Within the framework of the DeLone and McLean (2003) model, other elements such as service quality, user experience, responsiveness, and external influences may play a larger role. A weak correlation also indicates that visitor satisfaction cannot be reliably predicted based on system effectiveness alone. According to J. A. Davis (1971), a low correlation coefficient signifies a relationship that exists but lacks strength. This finding aligns with recent research, which suggests that while digital platforms can affect behavioral intentions and engagement, they do not solely determine satisfaction outcomes (Shariffuddin et al., 2023). Overall, these results imply that system effectiveness by itself is insufficient to explain visitor satisfaction. Contemporary research further supports this by showing that personalization, security, and interactivity significantly influence satisfaction beyond basic system functionality (Anuar et al., 2025). Moreover, although online booking systems enhance convenience and efficiency as highlighted by O'Connor (2010), the findings suggest that convenience alone is insufficient to ensure high levels of satisfaction. Other factors, such as human interaction, physical facilities, and on-site experiences, also significantly influence overall visitor satisfaction.

Conclusion

This study examines the effectiveness of the e-Visit Booking system and its relationship with visitor satisfaction at IMAN Rabbit Farm. The results show that the system works well, makes booking easier, and helps improve operations. Visitors are also generally very satisfied, showing that the attraction is doing well overall. However, the relationship between the system and visitor satisfaction is weak. This means the system alone does not strongly affect how satisfied visitors feel. Other factors like service quality, staff friendliness, and the experience at the location are also very important. This shows that visitor satisfaction depends on many different things. In practice, tourism operators should not focus only on technology. They need to improve both the system and the overall visitor experience. Good service and enjoyable activities are just as important as a good booking system. Future studies should look at other factors like service quality, personalization, and visitor experience to better understand what really influences satisfaction.

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TECHNOLOGICAL TRENDS AND ADOPTION CHALLENGES OF IOT SYSTEMS FOR URBAN FARMING IN MALAYSIA: A MATRIX LITERATURE REVIEW

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Abstract: Rapid urbanisation, land scarcity, and climate variability have intensified the demand for sustainable urban farming practices in Malaysia. Internet of Things (IoT) technologies are increasingly recognised as essential for enhancing monitoring, automation, and resource efficiency in urban agriculture. Despite their potential, the adoption of IoT-based urban farming systems remains limited. This study examines technological trends and adoption challenges of IoT systems in Malaysian urban farming using a Matrix Literature Review approach. Twenty relevant studies were analysed and synthesised into two matrices: (i) technological trends in smart farming systems and (ii) adoption challenges with influencing factors. The analysis indicates that hydroponic and vertical farming systems, supported by IoT-based monitoring and automation, are advancing current developments and significantly improving productivity and operational efficiency. Nevertheless, adoption is hindered by interconnected factors, including high implementation costs, limited digital literacy, infrastructural constraints, insufficient policy support, socio-cultural resistance, and low youth participation. The findings reveal a critical gap between technological advancement and practical adoption, demonstrating that technological readiness alone does not ensure successful implementation. This synthesis of current developments provides insights to inform future research, policy development, and practical implementation of IoT-based urban farming systems in Malaysia.

Keywords: Internet of Things (IoT); Urban farming; Technological trends; Adoption challenges

Introduction

Malaysia's agricultural sector faces mounting challenges due to rapid urbanisation and a structurally weak food supply system. As urban populations grow, traditional agriculture experiences labour shortages, an ageing workforce, and increased vulnerability to climate change. These weaknesses were particularly evident during recent global disruptions, which

intensified concerns regarding food security. Urban agriculture has emerged as both an immediate response and a long-term strategy to ensure sustainable food supplies in cities [9][13]. Recent scholarship emphasises that urban farming should be regarded not merely as a temporary solution, but as an integral component of sustainable urban development in Malaysia [2].

Integrating agriculture into urban areas faces significant constraints. Limited land, soil contamination, and dense infrastructure make conventional farming impractical in cities [20]. Agriculture 4.0, especially through the Internet of Things (IoT), offers new opportunities for urban farming. IoT systems use sensors, automation, and real-time data analytics to monitor and control key parameters such as temperature, humidity, nutrient levels, and water quality [3][17]. These technologies are often used in soilless methods such as hydroponics and vertical farming, which are well-suited to urban settings [8][18]. Studies show these systems can improve crop yields, optimise resource use, and reduce reliance on manual labour [11].

Despite technological advancements and demonstrated effectiveness in controlled environments, the adoption of IoT-based urban farming in Malaysia remains limited. Existing research identifies a persistent gap between technological innovation and practical application. Many advanced IoT systems fail to address the practical needs, skill levels, or constraints of end-users, particularly smallholder farmers and urban communities [11]. Key barriers include high initial investment, limited technical expertise, infrastructural challenges, and low awareness or acceptance of new technologies [1][4][14][19]. Socio-cultural resistance and operational complexities further impede sustained adoption [6][10][20]. This disconnect indicates that challenges in Malaysian urban farming are not solely technological, but also socio-economic and behavioural. Comprehensive understanding of both technological trends and adoption barriers is essential to bridge the gap between innovation and practice.

Literature Review

Evolution of Urban Farming and the Role of IoT

The growing prominence of urban farming in Malaysia reflects a shift in food production within rapidly urbanising areas. Urban agriculture addresses food security concerns and supports sustainable urban development. The adoption of Internet of Things (IoT) technologies accelerates this transition, replacing traditional, labour-intensive methods with data-driven and automated cultivation systems. IoT-based urban farming systems use sensors, actuators, and communication technologies to monitor and control environmental conditions in real time, enabling precision agriculture [3][16-17]. These systems enable continuous data collection and automated responses, reducing manual intervention and improving crop consistency. For urban farmers with limited time or expertise, IoT minimises human error.

Syafiq et al. [17] highlight that challenges such as inconsistent watering and inefficient water use in small-scale urban farming can be addressed through IoT-based automated irrigation systems that leverage real-time sensor data. This transformation reflects the broader transition from conventional agriculture to smart, technology-driven farming systems, as illustrated in Figure 1.

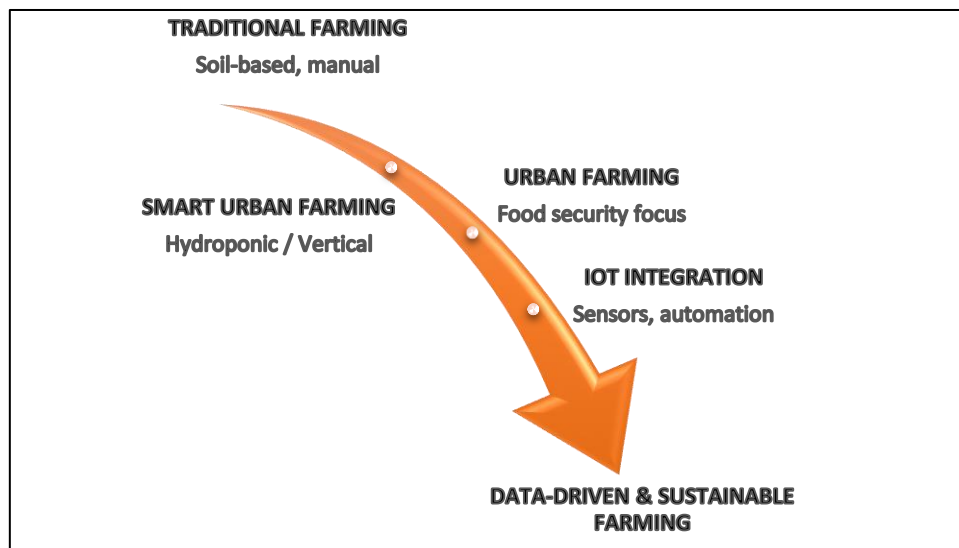


Figure 1: Evolution of Urban Farming Towards IoT Systems

Dominant Technological Trends in Urban Farming

Previous research identifies several dominant technological trends shaping IoT-based urban farming systems. Hydroponic and vertical farming systems have emerged as the most widely adopted approaches due to their compatibility with urban environments. The absence of soil and the capacity to operate in controlled environments make these systems particularly suitable for cities where land is scarce and often unsuitable for conventional agriculture [20].

Hydroponic systems have gained prominence for their efficiency and adaptability. Utilising nutrient-rich water solutions, these systems enable precise control over plant growth conditions, a capability further enhanced through IoT integration [11]. Vertical farming systems maximise spatial utilisation by stacking multiple layers of crops, thereby increasing productivity within limited space [18]. Empirical evidence indicates that combining these systems with IoT technologies improves crop yield, optimises resource use, and reduces water consumption [8]. Monitoring and automation are central to current technological developments. Sensors continuously track environmental parameters, while automated systems regulate irrigation, nutrient delivery, and climate conditions [17]. These capabilities are often integrated with mobile and cloud-based platforms, allowing users to monitor and control farming operations remotely [5]. Furthermore, emerging applications of artificial intelligence (AI) and data analytics are beginning to introduce predictive capabilities into these systems, although their adoption remains at an early stage in Malaysia [19].

Theoretical Perspectives on Technology Adoption

As technological advancements continue to evolve, the question of adoption has been widely explored through theoretical frameworks. Many studies employ models such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) to explain user behaviour. These models suggest that adoption is primarily

influenced by perceived usefulness, ease of use, and social influence [5][16]. From this perspective, the adoption of IoT-based urban farming systems depends on improving system usability and enhancing user perception. When users perceive a technology as beneficial, easy to operate, and supported by their social environment, adoption rates increase. This theoretical view suggests that user-centred design and awareness are central to promoting adoption.

Challenges in Malaysia

Practical implementation of IoT-based urban farming systems in Malaysia reveals a more complex and challenging landscape. Adoption is shaped by user perceptions alongside a range of economic, technical, and infrastructural factors. High costs associated with IoT systems, including initial investment, maintenance, and operational expenses, present significant financial barriers, particularly for smallholder farmers and urban communities [1][4][14]. Furthermore, the absence of transparent Life Cycle Cost (LCC) data introduces uncertainty, discouraging potential adopters from investing in these technologies [15][18].

Technical challenges further complicate adoption. Many users lack the digital literacy and technical skills required to operate and maintain IoT systems effectively. This issue is particularly pronounced among older farmers, who possess valuable agricultural knowledge but have limited familiarity with digital technologies [6]. Consequently, system complexity and maintenance difficulties often lead to abandonment. Infrastructure limitations are also significant. Reliable internet connectivity is essential for IoT systems, yet it remains inconsistent in some areas [16]. In urban settings, additional constraints, such as limited physical space and insufficient policy support, hinder the practical implementation of urban farming initiatives [10].

Critical Synthesis

A synthesis of the literature reveals a disconnect between technological innovation and real-world adoption. Engineering-focused studies emphasise system performance, efficiency, and automation, often demonstrating successful outcomes in controlled experimental environments [3][8]. In contrast, socio-technical studies highlight challenges associated with practical implementation, such as affordability, usability, and user readiness [4][10][15]. This divergence indicates that although IoT technologies for urban farming are advancing rapidly, adoption is hindered by unresolved socio-economic and contextual challenges. Existing research often treats technological development and adoption factors separately, leading to a fragmented understanding of the overall ecosystem. This gap between technological potential and practical implementation can be conceptualised as an adoption gap, as illustrated in Figure 2.

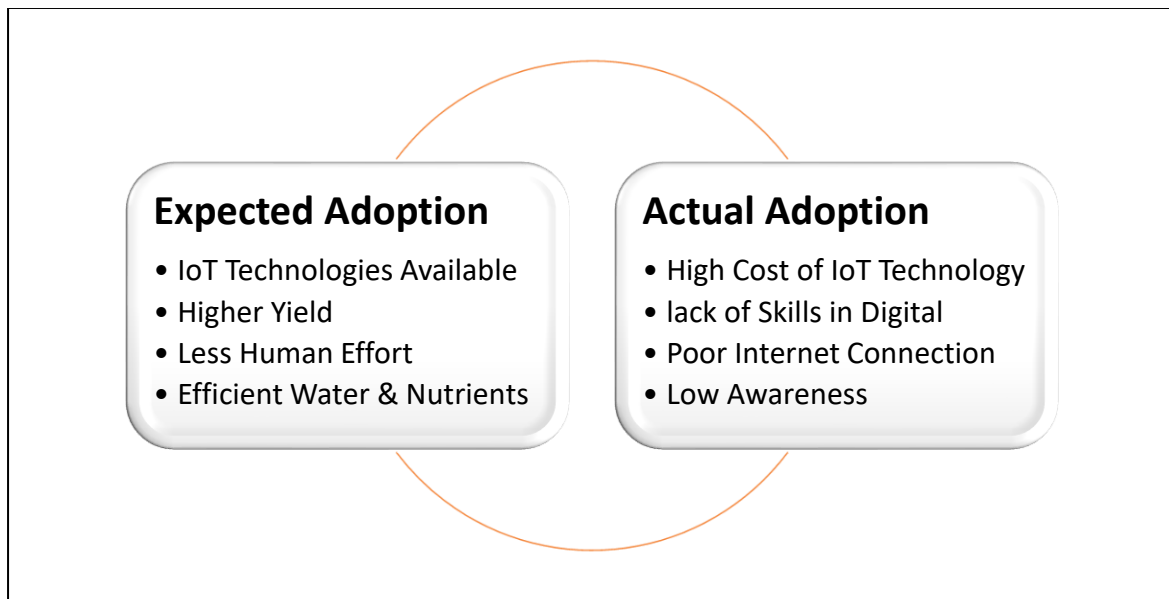


Figure 2: Gap between IoT Potential and Actual Adoption in Urban Farming

Methodology

A Matrix Literature Review approach was utilised to analyse technological trends and adoption challenges associated with IoT-based urban farming systems in Malaysia. The research process comprised several phases. Initially, relevant literature was identified and selected based on criteria including relevance to IoT-based urban farming, emphasis on technological development or adoption challenges, and applicability to the Malaysian context. Twenty articles were included to ensure comprehensive coverage of both technical and socio-economic dimensions.

Table 1 summarises the technological aspects, including research methodologies, utilised technologies, findings, and limitations. This matrix facilitates systematic comparison of technological developments, including IoT integration, automation systems, hydroponic and vertical farming approaches, and smart monitoring technologies.

The challenges and influencing factors associated with IoT-based urban farming are summarised in Table 2. Each category presents the corresponding challenges, adoption factors, impacted stakeholders, and geographical contexts to provide a comprehensive understanding of the adoption landscape. This approach enabled the identification of relationships between technological developments and adoption barriers. Integration of findings from both matrices provided a comprehensive understanding of the gap between technological potential and real-world implementation of IoT-based urban farming systems.

Table 1: Smart Farming and Urban Agriculture

REF	YEAR	METHODOLOGY	TECHNOLOGY USED	FINDING	LIMITATION
[1]	2025	Qualitative study; in-depth semi-structured interviews and thematic analysis.	Smart farming, IR4.0, Drones, IoT, Machine learning, Sensors, AI, Blockchain, Fertigation, Hydroponics.	Identified five main challenges: High startup cost, lack of expertise/knowledge, connectivity issues, farm size, and insufficient government support.	Peat soil structure in Sarawak hinders heavy machinery; high delivery costs for equipment from Peninsular Malaysia to East Malaysia.
[2]	2025	Qualitative approach; semi-structured interviews with 15 stakeholders.	Vertical farming, Hydroponics, Hygropot LinkTech, green technology practices.	Proposed a framework centred on social, economic, environmental, policy, and technological innovation pillars.	High operating costs, limited land availability, and lack of dedicated policy acts.
[3]	2025	Systematic narrative analysis based on PRISMA guidelines (29 full-text articles reviewed).	IoT, AI, Big Data, Digital Twins, LoRaWAN, NB-IoT, Sigfox, LiDAR, Drones, ESP32, BME688 sensor.	IoT serves as a catalyst for sustainable forestry, achieving 93%–96% accuracy in fire detection. LoRa is preferred for its 6-12 km range.	Most studies rely on short-term experiments in controlled environments; lack of hardware standardization makes comparison difficult.
[4]	2024	Quantitative approach; stratified random sampling (185 farmers) and PLS-SEM.	CSAT, drip irrigation, rainwater harvesting, drones, GPS, IoT sensors.	Institutions play a critical role. Perceived ease of use and social influence significantly affect adoption; trialability is key to building confidence.	Findings are confined to Malaysia and may not generalize to different geographical or cultural contexts.
[5]	2024	Quantitative approach using PLS-SEM; survey of 179 managers in agricultural organizations.	IoT, RFID, Wireless Sensor Networks (WSN), GPS, Cloud-based applications.	Governmental support is the most significant driver of adoption. Complexity and organizational size had no significant impact.	Sample restricted to Malaysian agricultural organizations; only 9 TOE factors were investigated.
[6]	2025	Secondary qualitative study; systematic literature review and thematic analysis (2020-2024).	Smart farming, IoT, AI, Precision agriculture, Data analytics, Remote sensing, Automation.	Two main themes identified: Advantages (productivity, resource efficiency) and Challenges (economic barriers, digital literacy, policy gaps).	Adoption is rooted in complex socio-economic settings rather than just technology availability.
[7]	2023	Bibliometric analysis using 204 research articles from the Scopus database.	IoT, cloud storage, big data, mobile devices, SFT, automation.	SFT research in Malaysia has grown significantly since 2017. There is a need to connect data to automate decision-making.	Study limited to Scopus-Indexed research; excluded conference papers and book chapters.
[8]	2026	Experimental research; four setups (LED vs natural light; room vs air-con temp) monitored over a 4-week growth period.	IoT, Arduino UNO WIFI, DS18B20 Water Temperature Sensor, Analog pH Sensor, Blynk IoT platform, LED grow lamps, ESP32.	LED lighting with room temperature yielded the highest growth (15–20% increase in biomass). Optimal water temperature identified as 28–30°C.	Small sample size, low data sampling frequency (daily), and lack of direct nutrient assessment (TDS/EC).
[9]	2022	Descriptive survey research; questionnaire and descriptive analysis.	Urban gardening, irrigation, rainwater harvesting.	Main challenges are fluctuating weather, access, and financial problems. Technical factors were the least significant issue.	Involved only 106 practitioners from 17 gardens due to COVID-19 movement restrictions.
[10]	2021	Mixed-method approach; quantitative survey (n=133) and qualitative thematic coding.	Hydroponics, Aquaponics, vertical farming.	‘Pleasantness’ and ‘confidence’ are the strongest factors. Constraints include lack of space, time, and government support.	Limited to the Klang Valley region; respondents had no prior urban farming experience.

REF	YEAR	METHODOLOGY	TECHNOLOGY USED	FINDING	LIMITATION
[11]	2025	Socio-technical approach; hardware construction, software development (Blynk), and functionality testing.	IoT, Hydroponics, ESP8266, Ultrasonic sensor (HC-SR04), Blynk Application, relay-controlled water pump, LED indicators.	Developed a low-cost tower system that automates water management and reduces perceived effort for residents.	Limited lifespan of battery packs under continuous use and water pump capacity constraints for tall towers.
[12]	2025	Comprehensive literature review; evaluation of Technology Acceptance Theory (TAM) and Diffusion of Innovation (DOI) theory.	IoT, Sensors, Data Analytics, Smart Grids, Smart Meters, Automated Systems, BMS/Digital Twins.	IoT can improve efficiency by automating lighting and HVAC (up to 60% reduction). Adoption is driven by perceived usefulness but limited by financial barriers.	Research is limited by potential biases in secondary data and a lack of extensive local implementation studies in Ghana.
[13]	2022	Literature review using the ROSES protocol; 93 articles selected.	Vertical farming, Hydroponics, Aquaponics, Aeroponics, IR 4.0, IoT, Urban BioDomes.	Participation in urban farming increased drastically during the pandemic. Space and lack of knowledge are primary barriers.	Insufficient knowledge transfer and lack of support for community garden management prior to the pandemic.
[14]	2024	Snowball sampling and thematic analysis of in-depth interviews with 12 participants.	Agriculture 4.0, IoT, Cloud storage, big data, Precision farming, Solar technology, Hydroponics.	Key barriers include high initial investment, inadequate rural connectivity, limited technical skills, and poor knowledge sharing.	Low Internet coverage hinders real-time monitoring of temperature and nutrient levels.
[15]	2025	Triangulation method; Delphi survey (expert consensus) and case study (semi-structured interview and observation).	Smart Urban Farming (SUF), Fertigation, Hydroponics, Aquaponics, Aeroponics, IoT, automation.	Identified comprehensive SUF practices across five LCC phases: planning, implementation, operation, harvesting, and marketing.	Accuracy of LCC data remains a challenge; the study focused on a single successful site for validation.
[16]	2021	Quantitative research: questionnaire distributed to 110 residents in Johor Bahru; Spearman's Rho correlation.	IoT, Big Data, Cloud Computing.	Subjective norms (social pressure) is the dominant factor influencing adoption. Intention level is medium to high.	Sample limited to Johor Bahru; quantitative data restricted to specific survey questions.
[17]	2025	Structured system development including hardware assembly, sensor calibration, and testing in a controlled environment.	IoT, ESP32, ESP8266, Ultrasonic sensor (HC-SR04), Soil moisture sensor (YL-69), DHT22, Mist maker, ThingsBoard Cloud.	Achieved water savings of approximately 25% and maintained optimal conditions. Humidity reading error margin was 17.7%.	Commercial-grade sensors are more precise than the project's low-cost sensors, which require manual calibration.
[18]	2025	Qualitative research methodology and Waterfall development framework.	IoT, Smart Vertical Farming System (SVFS), Grow light, Soil humidity sensor (YL-69), DHT11, ESP8266, Arduino UNO, Firebase.	Vegetables grown using SVFS experienced faster growth rates and increased leaf production compared to conventional methods after 19 days.	High initial setup costs and the need for user manuals supported in multiple languages.
[19]	2026	Qualitative approach; semi-structured interviews and thematic analysis.	IoT, smart fertigation, hydroponic systems, drones, RFID.	Adoption is driven by perceived utility but hindered by high startup costs, digital illiteracy, unreliable technical support, and operational failures.	Small sample size (n = 10) focused specifically on Selangor and Negeri Sembilan.



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REF	YEAR	METHODOLOGY			TECHNOLOGY USED	FINDING	LIMITATION
[20]	2025	Qualitative approach; structured interviews and snowball sampling respondents).		semi- and (15	Hydroponics, Vertical Farming (VF), Blockchain, Agro-tokens, IoT.	Farmers face five key challenges: lack of SOPs, market volatility, financial constraints (loan difficulty), operational issues (outages), and environment.	Snowball sampling may have potential bias and lacks broad generalizability.

Table 2: Challenges and Adoption Factor for Urban Farming

REF	CATEGORY	CHALLENGE	ADOPTION FACTOR	IMPACTED STAKEHOLDERS	AREA
[9] [20]	Environmental	Fluctuating weather, natural disasters (floods/droughts), and pests	Climate resilience, naturalness, and perceived risk	Rural smallholders, urban farmers, and gardeners	Malaysia (Kelantan, Johor, Sabah, Sarawak, Klang Valley)
[13]	Environmental	Heavy metal soil contamination (Lead, Zinc, Cadmium)	Health and safety confidence	Urban community gardeners	Malaysia
[9] [13] [20]	Infrastructural	Limited land availability and space constraints	Physical environment compatibility and ease of adoption	Urban dwellers in high-density areas and smallholder farmers	Malaysia (Kuala Lumpur, Penang)
[6] [20]	Policy/Legislative	Lack of Standard Operating Procedures (SOP), dedicated acts, and inconsistent policy support	Institutional support, regulatory clarity, and policy stability	Indoor farm operators, local authorities, and real estate practitioners	Malaysia (Kuala Lumpur, Penang)
[6] [11]	Socio-Cultural	Cultural inertia, aging farmer population, and resistance to change	Confidence and attitude toward new habits	Older traditional farmers and rural communities	Peninsular Malaysia
[1] [13] [20]	Socio-Economic	High startup, investment, and operating costs	Financial capability, perceived affordability, and perceived risk	Urbanites, smallholders, B40 low-income communities, and agro entrepreneurs	Malaysia (Penang, Johor, Sabah, Sarawak, Klang Valley)
[9] [13] [10] [16]	Socio-Economic	Lack of youth interest and perception of high labour intensity	Pleasantness, career motives, and attitude	Malaysian youth, students, and local communities	Malaysia (Klang Valley, Kuala Lumpur)
[13]	Socio-Economic	Societal influence, social pressure, and community engagement obstacles	Subjective norms and societal influence	City residents, low-income groups, and community leaders	Malaysia (Johor Bahru, Kuala Lumpur, Klang Valley)
[13]	Socio-Economic	Supply chain disruptions during lockdowns	Economic resilience and food security awareness	Farmers in Kundasang and urban consumers	Malaysia (Sabah, Klang Valley)
[10]	Socio-Economic	Low confidence and perceived lack of pleasantness in farming	Confidence, pleasantness, and naturalness	Urbanites and B40 communities	Malaysia (Klang Valley)
[1] [2] [13] [16]	Technical	Lack of digital literacy, technical expertise, and agricultural knowledge	Confidence in practicing farming, digital self-efficacy, and perceived ease of use	City residents, smallholder farmers, rural communities, and urban dwellers	Malaysia (Selangor, Negeri Sembilan, Sarawak, Sabah)
[1] [3] [13] [20]	Technical	Infrastructure gaps, unstable power supply, and connectivity issues	Facilitating conditions, infrastructure reliability, and technical support	Smart farming practitioners, smallholders, and hydroponic/vertical farmers	Malaysia (Sabah, Sarawak)
[3] [5]	Technical	Difficulty in interfacing smart technologies with conventional systems	Technological compatibility	Large agricultural organizations and managers	Malaysia
[17]	Technical	Inconsistent care and inefficient water use	Reliability and task automation	Urban dwellers with busy schedules	Malaysia (Klang Valley)

Results and Discussion

Analysis of Table 1 shows that IoT technologies are central to advancing smart urban farming systems. Hydroponic and vertical farming have emerged as dominant approaches, primarily due to their suitability for land-constrained urban environments. These systems incorporate IoT components, such as sensors, automation, and cloud-based platforms, to enable real-time monitoring and control of environmental conditions. Empirical evidence indicates that IoT-enabled hydroponic systems can substantially enhance crop growth under optimised conditions. Automated irrigation systems further improve water use efficiency, underscoring the effectiveness of sensor-driven farming practices. Additionally, IoT technologies increase operational efficiency by minimising manual intervention and supporting remote management of farming activities via mobile and cloud-based platforms, which is particularly advantageous for urban users with limited time. Despite these advancements, most implementations remain confined to controlled or small-scale environments, restricting scalability. Furthermore, challenges such as a lack of standardisation and interoperability continue to impede broader adoption.

Table 2 indicates that the adoption of IoT-based urban farming systems is shaped by a complex interplay of environmental, infrastructural, policy, socio-cultural, socio-economic, and technical factors. Environmental challenges, such as fluctuating weather, natural disasters, and pest infestations, increase uncertainty and negatively affect farming outcomes. Urban-specific issues, including soil contamination and limited space, further constrain farming activities. Infrastructural limitations, especially land scarcity in densely populated areas, underscore the necessity for space-efficient farming solutions. Policy challenges, such as the lack of standardised regulations and inconsistent institutional support, create uncertainty and impede adoption. Socio-cultural factors, including resistance to change and an ageing farmer population, reduce the willingness to adopt new technologies, while social influence also affects user behaviour. Additionally, low interest among younger generations further diminishes participation. Technical challenges, such as limited digital literacy, insufficient expertise, and unreliable infrastructure, including unstable connectivity and power supply, are also a factor in implementing the IoT.

Conclusion

In summary, the findings demonstrate that IoT technologies, particularly hydroponic and vertical farming systems, possess considerable potential to enhance efficiency, optimise resource utilisation, and increase agricultural productivity in urban environments. However, practical adoption is constrained by multiple, interconnected barriers, including high implementation and operational costs, limited technical expertise and digital literacy, infrastructural limitations, insufficient policy and institutional support, and socio-cultural factors such as resistance to change and low engagement among younger populations. The results underscore that technological readiness alone is insufficient for successful implementation, as broader socio-economic and environmental factors significantly influence adoption. Bridging the gap between technological innovation and practical application necessitates a comprehensive strategy that emphasises affordability, user training and capacity building, infrastructure development, and supportive policy frameworks. Future research

should prioritise large-scale, real-world implementations, the development of cost-effective and scalable solutions for diverse socio-economic groups, and the investigation of user-centred design and behavioural determinants of adoption. Additionally, integrating advanced technologies such as artificial intelligence and data analytics into IoT-based farming systems, alongside the creation of comprehensive frameworks that align technological, economic, and policy considerations, will be essential for achieving sustainable adoption and long-term impact.

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WORKFORCE DIVERSITY AS A STRATEGIC DRIVER OF ACADEMIC PERFORMANCE: EMPIRICAL EVIDENCE FROM MALAYSIAN PRIVATE UNIVERSITIES

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Abstract: *In an increasingly competitive and globalised higher education environment, private universities face growing pressure to enhance performance, maintain quality standards, and sustain institutional competitiveness. As knowledge-based organisations, their most valuable strategic asset is their academic workforce. Within this context, workforce diversity has become an important management concern, yet empirical evidence from Malaysian private higher education institutions remains limited. Grounded in Social Identity Theory, this study examines the relationship between workforce diversity and employee performance among academics in Malaysian private universities. The study investigates four dimensions of diversity including age, gender, ethnicity, and educational background, and evaluates the moderating role of organizational culture. Data were collected from 175 academic staff across selected private universities in the Klang Valley. The proposed relationships were analysed using Partial Least Squares Structural Equation Modelling. The findings indicate that all four dimensions of workforce diversity have a positive and significant influence on academic employee performance. The results suggest that diverse academic environments foster richer knowledge exchange, stronger decision making, and greater adaptability, which are critical for sustaining institutional excellence. Although organizational culture has a significant direct effect on employee performance, it does not moderate the relationship between workforce diversity and performance. This study contributes to business and education management literature by positioning workforce diversity as a strategic driver of sustainable performance rather than merely a compliance-based practice. The findings highlight the importance of inclusive diversity management in strengthening institutional resilience and long-term performance.*

Keywords: *Workforce diversity; Sustainable performance; Higher education management; Organizational culture; Private universities; Malaysia*

Introduction

Higher education institutions operate in an increasingly competitive and globalised environment. Universities are expected not only to maintain strong academic standards but also to produce meaningful research and contribute to national development. In Malaysia, private universities play an important role in expanding access to higher education and supporting the development of skilled human capital. As these institutions strive to remain competitive, the effectiveness of their academic workforce becomes a critical factor influencing institutional success.

Workforce diversity has therefore attracted growing attention in organisational research. Modern workplaces consist of employees who differ in terms of age, gender, ethnicity, educational background, and professional experience. These differences may influence how individuals interact, collaborate, and perform within organisations. When diversity is managed appropriately, it can become an important organisational resource that supports innovation, creativity, and more effective decision making (Stahl et al., 2020; Shore et al., 2021).

Within higher education institutions, diversity among academic staff may provide additional advantages. Academics from varied demographic and educational backgrounds often contribute different perspectives, research interests, and teaching approaches. Such variation can encourage richer intellectual exchange and stronger interdisciplinary collaboration. In turn, this may enhance research productivity, teaching quality, and overall institutional performance (Nishii, 2020).

However, diversity may also create certain challenges within organisations. Differences among employees can sometimes lead to communication difficulties, misunderstandings, or reduced group cohesion if they are not managed effectively. Social Identity Theory suggests that individuals often categorise themselves and others based on visible characteristics such as age, gender, or ethnicity, which may influence interpersonal relationships in the workplace (Tajfel & Turner, 1979). Consequently, the impact of workforce diversity on performance outcomes may depend on organisational context and management practices.

Despite the growing interest in diversity research, empirical studies focusing on Malaysian private universities remain relatively limited. Much of the existing literature concentrates on corporate organisations, while fewer studies examine how workforce diversity influences performance in academic institutions. Considering the increasing importance of universities in the knowledge economy, further investigation in this context is needed.

This study therefore investigates the relationship between workforce diversity and employee performance among academics in Malaysian private universities. Four dimensions of workforce diversity are examined, namely age diversity, gender diversity, ethnic diversity, and educational background diversity. In addition, the study evaluates the moderating role of organisational culture in shaping the relationship between diversity and employee performance. The findings aim to provide insights for university administrators seeking to strengthen diversity management practices and enhance institutional performance.

Literature Review

This section reviews the key theoretical and empirical foundations underpinning the study. It begins by discussing the concept of workforce diversity and its relevance in contemporary organizations. The discussion then examines the relationship between workforce diversity and employee performance from both positive and critical perspectives. Finally, the role of organizational culture is explored to understand its potential influence within diverse academic environments. Together, these discussions establish the theoretical grounding for the proposed research model.

Workforce Diversity

Workforce diversity refers to the presence of differences among employees in terms of demographic, social, and educational characteristics. In contemporary organisational research, diversity is often categorised into surface level attributes such as age, gender, and ethnicity, and deep level attributes such as educational background, skills, and experience. Recent studies highlight that diversity can function as a strategic organisational resource when managed effectively (Shore et al., 2021). Rather than being viewed solely as demographic variation, diversity is increasingly recognised as a driver of innovation, creativity, and organisational adaptability.

In multicultural contexts such as Malaysia, workforce diversity is naturally embedded within institutions, particularly in higher education settings where academic staff represent varied cultural and disciplinary backgrounds. Such diversity may enrich knowledge exchange and intellectual engagement. However, without appropriate management, diversity may also create coordination challenges and social fragmentation.

Workforce Diversity and Employee Performance

Understanding the link between workforce diversity and employee performance remains a central concern in diversity research. From a positive perspective, diversity broadens cognitive resources and enhances information processing, which may lead to improved performance outcomes (Stahl et al., 2020). Exposure to diverse perspectives can foster better problem solving and more comprehensive decision making.

However, Social Identity Theory suggests that individuals tend to categorise themselves and others into social groups based on observable characteristics. These categorisation processes may create in group and out group dynamics that influence communication and cooperation. Consequently, the impact of diversity on performance may vary depending on contextual and organisational conditions. Recent empirical research indicates that diversity is more likely to enhance performance when supported by inclusive organisational practices and leadership (Nishii et al., 2020). Within higher education institutions, diversity among academics may contribute to stronger collaboration, research productivity, and teaching effectiveness. Nevertheless, empirical evidence within Malaysian private universities remains limited.

Organizational Culture

Organizational culture represents the shared values, beliefs, and norms that shape behaviour within an organisation. It influences how employees interact, resolve conflicts, and interpret diversity. A supportive culture that encourages collaboration and inclusivity may strengthen trust and enhance performance outcomes.

Recent literature emphasises that organisational culture can shape whether diversity leads to positive or neutral performance effects (Shore et al., 2021). In academic institutions, where autonomy and intellectual exchange are central, culture plays a particularly important role in shaping employee engagement and productivity. Examining organizational culture within the diversity performance relationship is therefore essential in understanding performance dynamics in private higher education institutions.

Theoretical Framework

This study is grounded in Social Identity Theory, which provides a useful lens for understanding how workforce diversity may influence employee behaviour and performance within organisational settings. Social Identity Theory explains how individuals define themselves based on their membership in social groups such as gender, ethnicity, age, or educational background. These social identities shape how individuals perceive others, interact with colleagues, and interpret workplace dynamics. In diverse work environments, employees may naturally categorize themselves and others into in groups and out groups based on observable characteristics. Such categorisation processes may influence communication patterns, collaboration, and ultimately employee performance.

According to Social Identity Theory, individuals tend to develop stronger attachment and trust toward members of their own social group, while interactions with members from different groups may initially involve uncertainty or reduced cohesion. However, when diversity is managed effectively within an inclusive organisational environment, the presence of varied perspectives and experiences can also stimulate creativity, knowledge exchange, and improved decision making. Recent studies suggest that diverse teams can generate broader ideas and more innovative solutions when group differences are managed constructively (Stahl et al., 2020; Shore et al., 2021).

In the context of higher education institutions, diversity among academic staff may contribute to richer intellectual discussions, interdisciplinary collaboration, and more diverse research perspectives. Academics with different demographic and educational backgrounds bring varied expertise, experiences, and viewpoints that can enhance problem solving and knowledge development. At the same time, organisational factors such as shared values, communication norms, and institutional culture play an important role in shaping how diversity influences employee behaviour.

Therefore, Social Identity Theory provides a theoretical foundation for examining the relationship between workforce diversity and employee performance in academic institutions.

It also highlights the importance of organisational context in determining whether diversity leads to positive performance outcomes.

Hypotheses Development

Workforce diversity has become an important topic in organisational research because of its potential influence on employee behaviour and performance. Workforce diversity refers to the differences among employees in demographic and informational attributes such as age, gender, ethnicity, and educational background (Roberson, 2019; Shore et al., 2021). These differences shape individuals' perspectives, experiences, and approaches to problem solving within organisations. When diversity is managed effectively, organisations may benefit from broader knowledge exchange, improved creativity, and more comprehensive decision making, which can enhance employee performance (Stahl et al., 2020).

Age diversity represents differences in generational perspectives, work experiences, and professional knowledge among employees. Employees from different age groups may contribute distinct strengths to the organisation. Younger employees often bring technological skills, fresh ideas, and adaptability, while older employees contribute accumulated experience, professional expertise, and organisational knowledge. Research suggests that age diversity can enhance organisational learning and performance when collaboration between generations is effectively managed (Kunze et al., 2021).

Gender diversity is another important dimension of workforce diversity. Gender diverse workplaces can benefit from broader viewpoints, leadership styles, and communication approaches. Previous research indicates that gender diversity may improve organisational outcomes by promoting creativity, balanced decision making, and improved team performance (Post & Byron, 2015; Shore et al., 2021). Within academic institutions, gender diversity among faculty members may also contribute to diverse teaching approaches and research perspectives.

Ethnic diversity reflects the presence of employees from different cultural and social backgrounds. In multicultural societies such as Malaysia, ethnic diversity is an inherent characteristic of organisational environments. Diverse cultural perspectives may facilitate broader problem solving and encourage the exchange of varied viewpoints. Studies suggest that ethnic diversity can improve knowledge sharing and innovation when supported by inclusive organisational practices (Stahl et al., 2020).

Educational background diversity refers to differences in academic training, disciplinary expertise, and knowledge domains among employees. In higher education institutions, academics often possess diverse educational qualifications and research specialisations. Such diversity can promote interdisciplinary collaboration, broaden intellectual discussion, and enhance research productivity. Educational diversity has been associated with improved organisational learning and knowledge integration (Roberson, 2019).

Based on these arguments, workforce diversity is expected to positively influence employee performance among academic staff. Therefore, the following hypotheses are proposed.

H1 : Age diversity positively influences employee performance.

H2 : Gender diversity positively influences employee performance.

H3 : Ethnic diversity positively influences employee performance.

H4 : Educational background diversity positively influences employee performance.

Organizational culture refers to the shared values, beliefs, and norms that guide behaviour within an organisation (Schein, 2017). A supportive and inclusive organizational culture may strengthen cooperation, trust, and communication among employees from diverse backgrounds. Previous studies suggest that organizational culture plays an important role in determining whether diversity leads to positive organisational outcomes (Shore et al., 2021). In academic institutions, a strong organizational culture may encourage collaboration and reduce potential conflicts that arise from demographic differences.

Therefore, organizational culture may influence the relationship between workforce diversity and employee performance. Accordingly, the following hypothesis is proposed.

H5 : Organizational culture moderates the relationship between workforce diversity and employee performance.

Figure 1 illustrates the hypothesized relationships among the variables examined in this study. Workforce diversity is represented by four dimensions which are age diversity, gender diversity, ethnic diversity, and educational background diversity. These dimensions are treated as independent variables that may influence employee performance among academic staff in private universities.

Employee performance is positioned as the dependent variable in the framework. In academic institutions, employee performance is reflected through activities such as teaching effectiveness, research productivity, and academic contributions to institutional development. A diverse academic workforce may contribute to improved knowledge exchange, broader perspectives, and collaborative problem solving that support better performance outcomes.

Organizational culture is proposed as a moderating variable that may influence the relationship between workforce diversity and employee performance. A supportive organizational culture may encourage collaboration, mutual respect, and effective communication among employees from diverse backgrounds. Therefore, the model assumes that organizational culture may strengthen the positive influence of workforce diversity on employee performance.

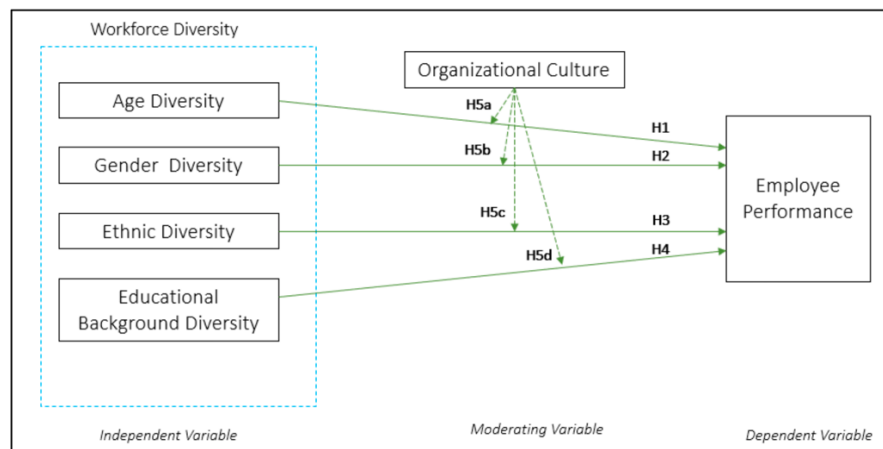


Figure 1: Proposed Research Framework

Methodology

A quantitative cross-sectional survey design was adopted to examine the relationship between workforce diversity and employee performance among academics working in Malaysian private universities. In this study, workforce diversity was conceptualised through four dimensions: age diversity, gender diversity, ethnic diversity, and educational background diversity. Employee performance was treated as the dependent variable, while organisational culture was included as a moderating variable within the research model.

Data were collected from academic staff employed at selected private universities located in the Klang Valley region of Malaysia. A structured questionnaire was used as the primary data collection instrument. The survey generated a total of 175 usable responses from academic staff across different institutions.

The measurement items used in the questionnaire were adapted from established studies in the fields of workforce diversity and organisational behaviour. Respondents were asked to indicate their level of agreement with each statement using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

To analyse the proposed relationships among the variables, the study employed Partial Least Squares Structural Equation Modelling (PLS-SEM). This approach allows the examination of complex relationships between constructs and is commonly applied in social science research when analysing latent variables and moderating effects.

Results and Discussion

This section presents the findings obtained from the statistical analysis of the collected data. Descriptive statistics summarize the demographic characteristics of the respondents, while correlation and structural model analyses examine the relationships between workforce diversity dimensions, organizational culture, and employee performance.

Findings and Analysis of Demographic Data

A total of 175 academic staff participated in this study. The demographic profile indicates that the respondents represented diverse backgrounds in terms of age, gender, ethnicity, and educational qualifications. In terms of age, most respondents were aged 40–49 years (46.3%), followed by 50 years and above (46.3%), while 7.4% were between 30–39 years old. Regarding gender, 58.3% were female (102 respondents) and 41.7% were male (73 respondents).

Regarding ethnicity, most respondents were Malay (58.9%), followed by Indian (21.1%) and Chinese (19.4%), while a small percentage represented other ethnic groups. In terms of educational background, most respondents held PhD qualifications (88.6%), while 11.4% held master's degrees. These findings indicate that the respondents represent experienced and academically qualified employees suitable for examining workforce diversity within higher education institutions.

Correlation Analysis

Pearson correlation analysis was conducted to examine the relationships between the key constructs in this study: age diversity, gender diversity, ethnic diversity, educational background diversity, organizational culture, and employee performance.

The results presented in Table 1 show that all workforce diversity dimensions are positively correlated with employee performance. Age diversity ($r = .318$, $p < .01$), gender diversity ($r = .342$, $p < .01$), ethnic diversity ($r = .296$, $p < .01$), and educational background diversity ($r = .335$, $p < .01$) demonstrate positive relationships with employee performance. Organizational culture also shows a strong positive relationship with employee performance ($r = .512$, $p < .01$).

These results indicate that greater workforce diversity within academic institutions may promote collaboration, knowledge exchange, and improved work outcomes among academic staff.

Table 1 Correlation Analysis Results

Variables	Mean	1	2	3	4	5	6
1 Age Diversity	3.62	1					
2 Gender Diversity	3.71	.284**	1				
3 Ethnic Diversity	3.65	.276**	.301**	1			
4 Educational Background Diversity	3.68	.298**	.322**	.315**	1		
5 Organizational Culture	3.74	.337**	.349**	.318**	.342**	1	
6 Employee Performance	3.82	.318**	.342**	.296**	.335**	.512**	1

Note: Correlation is significant at the 0.01 level (2-tailed).

Hypothesis Testing

The proposed relationships were examined using Partial Least Squares Structural Equation Modelling (PLS-SEM). The structural model results are presented in Table 2. The findings

indicate that age diversity has a significant positive effect on employee performance ($\beta = 0.229$, $p = 0.050$). Similarly, gender diversity significantly influences employee performance ($\beta = 0.281$, $p < 0.001$). Ethnic diversity also demonstrates a significant positive relationship with employee performance ($\beta = 0.155$, $p = 0.014$). In addition, educational background diversity significantly affects employee performance ($\beta = 0.185$, $p = 0.006$).

However, the moderating effects of organizational culture on the relationship between workforce diversity and employee performance were found to be not significant. The interaction effects between organizational culture and age diversity ($\beta = -0.027$, $p = 0.764$), educational background diversity ($\beta = -0.045$, $p = 0.524$), ethnic diversity ($\beta = 0.164$, $p = 0.249$), and gender diversity ($\beta = 0.075$, $p = 0.377$) were statistically insignificant. Despite this, organizational culture itself demonstrated a significant direct influence on employee performance ($\beta = 0.360$, $p < 0.001$).

Table 2 : Summary of Regression Analysis Results

Hypothesis	Relationship	β	p-value	Result
H1	Age Diversity $\rightarrow$ Employee Performance	0.229	0.050	Supported
H2	Gender Diversity $\rightarrow$ Employee Performance	0.281	<0.001	Supported
H3	Ethnic Diversity $\rightarrow$ Employee Performance	0.155	0.014	Supported
H4	Educational Background Diversity $\rightarrow$ Employee Performance	0.185	0.006	Supported
H5	Organizational Culture $\times$ Age Diversity $\rightarrow$ Performance	-0.027	0.764	Not Supported
H6	Organizational Culture $\times$ Educational Diversity $\rightarrow$ Performance	-0.045	0.524	Not Supported
H7	Organizational Culture $\times$ Ethnic Diversity $\rightarrow$ Performance	0.164	0.249	Not Supported
H8	Organizational Culture $\times$ Gender Diversity $\rightarrow$ Performance	0.075	0.377	Not Supported

Multiple Regression Analysis

Multiple regression analysis was conducted to examine the influence of workforce diversity dimensions on employee performance. The independent variables included age diversity, gender diversity, ethnic diversity, and educational background diversity, while employee performance was treated as the dependent variable.

The regression model was statistically significant, indicating that workforce diversity variables jointly explain a meaningful proportion of the variance in employee performance. The results show that gender diversity has the strongest influence on employee performance ($\beta = 0.281$, $p < .001$). This indicates that balanced gender representation within academic institutions contributes positively to employee performance. Age diversity also demonstrates a significant positive relationship with employee performance ($\beta = 0.229$, $p = .050$), suggesting that the presence of different age groups within academic institutions facilitates the sharing of experience and knowledge. Similarly, educational background diversity significantly

influences employee performance ($\beta = 0.185$, $p = .006$), indicating that employees with varied academic qualifications contribute diverse expertise that enhances institutional performance. Ethnic diversity was also found to significantly influence employee performance ($\beta = 0.155$, $p = .014$). This suggests that multicultural collaboration within academic institutions may promote creativity, innovation, and improved decision-making.

Overall, the regression results indicate that workforce diversity significantly contributes to employee performance among academic staff in private universities. Table 3 presents the result of the analysis.

Table 3: Multiple Regression Analysis Results

Predictor	B	SE	β	t	p
Age Diversity	0.214	0.108	0.229	1.97	0.050
Gender Diversity	0.326	0.083	0.281	3.94	<0.001
Ethnic Diversity	0.176	0.071	0.155	2.48	0.014
Educational Background Diversity	0.203	0.073	0.185	2.76	0.006

Discussion

The analysis highlights the important role that workforce diversity plays in shaping employee performance within Malaysian private universities. The results indicate that diversity in age, gender, ethnicity, and educational background contributes positively to the performance of academic staff. These findings suggest that diverse academic environments may create opportunities for knowledge exchange, collaboration, and intellectual engagement, all of which support improved work outcomes.

Among the diversity dimensions examined, gender diversity shows the strongest influence on employee performance. A balanced gender composition within academic institutions may encourage broader perspectives, more inclusive communication, and collaborative decision making. Previous research has also shown that gender-diverse teams tend to demonstrate higher levels of creativity and improved problem-solving capabilities (Post & Byron, 2015; Shore et al., 2021). In higher education contexts, gender diversity may therefore support inclusive participation in teaching, research activities, and institutional governance.

Age diversity also appears to contribute positively to employee performance. Academic institutions often bring together employees from different generations who possess varying experiences, skills, and perspectives. Senior academics typically provide institutional knowledge and professional expertise, while younger academics may introduce innovative ideas and technological adaptability. Effective collaboration between these groups may facilitate knowledge transfer and enhance organisational learning (Kunze et al., 2021).

Educational background diversity similarly shows a positive influence on employee performance. Academics with different disciplinary expertise may offer unique research perspectives and methodological approaches. Such variation can strengthen interdisciplinary collaboration and contribute to stronger research outcomes. In universities where research

innovation is highly valued, diverse educational backgrounds may support the exchange of knowledge and ideas across disciplines.

The results also indicate that ethnic diversity contributes positively to employee performance. In a multicultural society such as Malaysia, academic institutions frequently consist of individuals from diverse cultural backgrounds. These differences may encourage broader perspectives, improve cross-cultural understanding, and support collaborative problem solving. Previous studies have suggested that multicultural work environments can stimulate creativity and innovation by exposing individuals to different viewpoints (Stahl et al., 2020).

However, the moderating role of organisational culture was not supported in this study. Although organisational culture demonstrates a direct influence on employee performance, it does not significantly alter the relationship between workforce diversity and performance outcomes. One possible explanation is that professional collaboration and academic norms within universities already encourage interaction among diverse individuals, reducing the moderating effect of organisational culture.

Overall, the findings are consistent with the assumptions of Social Identity Theory. While individuals may initially identify with particular social groups based on demographic characteristics, diverse environments can also encourage the exchange of ideas and collaborative learning when supported by appropriate organisational practices.

Limitations and Future Research

This study has several limitations. First, the study focused only on private universities located in the Klang Valley, which may limit the generalizability of the findings to other regions or types of higher education institutions. Future research could include public universities or institutions from other regions in Malaysia.

Second, the study adopted a cross-sectional research design, which captures data at a single point in time. Future studies may consider longitudinal research designs to examine changes in workforce diversity and employee performance over time.

Conclusion

This study examined the relationship between workforce diversity and employee performance among academics in Malaysian private universities. The findings indicate that workforce diversity dimensions including age diversity, gender diversity, ethnic diversity, and educational background diversity significantly influence employee performance. Although organizational culture demonstrates a significant direct effect on employee performance, its moderating role was not supported. Nevertheless, the findings emphasize the importance of fostering diverse and inclusive work environments in higher education institutions.

Overall, the study provides empirical evidence that workforce diversity can serve as a valuable resource for enhancing employee performance and institutional competitiveness in the higher education sector.

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RANGE ANXIETY IN PASSENGER-CAR TRAVEL: A REVIEW WITH A COMPARATIVE LENS ON ELECTRIC VEHICLE (EV) AND INTERNAL COMBUSTION ENGINE (ICE) DRIVERS

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Abstract: Range anxiety often defined as concern that power consumed by a vehicle will not be enough to get to a destination, is one of the most persistent behavioural barriers to the adoption of Electric Vehicles (EV) in general and is a factor in how EV operate by planning trips, charging and managing safety buffers. Although range anxiety is often discussed as an EV specific phenomenon, taking a comparative perspective to explicit contrast the range-related concerns of EV drivers and the refuelling-related concerns of Internal Combustion Engine (ICE) drivers can help refine measurement design and clarify which aspects are unique versus generalisable to energy-related travel anxiety as well as aid in the development of robust interventions (e.g. infrastructure planning, driver information systems and safety education). This PRISMA-aligned systematic review of literature presents the synthesis of peer-reviewed evidence from behavioural, human factors, transport policy and charging infrastructure domains. A structured thematic synthesis reveals: (i) conceptualisations and approaches to measurement for range anxiety and strongly related constructs (range stress, safety buffer, perceived usable range); (ii) individual, situational, and socio-technical determinants (experience, knowledge, risk tolerance, display characteristics, infrastructure access); (iii) behavioural manifestations (opportunistic charging, route choice, setting of buffers); and (iv) mitigation strategies from a range of areas: from design (range estimation and interfaces) to training/experience, and charging - network provision. Evidence has been consistent that practical EV driving experience and range-related knowledge help to relieve experienced range stress, while both information systems characteristics (e.g., volatility vs. inaccuracy of range estimates) and infrastructure reliability shape anxiety during critical-range situations. Direct EV and ICE comparative measurement is still limited; therefore, a future research agenda is laid out for the development of measurement invariant comparative instruments (range anxiety vs. refuelling security) and combining self-reports with behavioural and real-world operational data.

Keywords: Range anxiety; electric vehicles; internal combustion engine; charging behaviour; safety buffer

Introduction

Decarbonisation of passenger transport has intensified policy and industry focus on accelerating electrification, yet behavioural barriers remain salient even as battery capacity increases and charging networks expand. Among these barriers, range anxiety is repeatedly identified as both a pre-purchase concern and an in-use psychological state that can shape

driving and charging decisions (Egbue & Long, 2012; Rezvani et al., 2015). Range anxiety is not merely an “attitude” toward vehicle range; it is frequently described as a context-dependent response arising when drivers appraise remaining energy as potentially insufficient relative to anticipated travel needs, environmental conditions, and available charging options (Franke & Krems, 2013a; Franke et al., 2012).

While the term is most commonly associated with Electric Vehicles (EV), the underlying phenomenon that concern about becoming stranded due to insufficient energy has a broader conceptual footprint. Internal Combustion Engine (ICE) drivers typically operate within a mature refuelling ecosystem with fast replenishment and dense station availability, which likely reduces the salience of energy shortfall concerns during routine travel. Nevertheless, a comparative lens is valuable for two reasons. First, comparative measurement clarifies whether observed “range anxiety” responses are specific to EV socio-technical constraints (battery energy, charging time, infrastructure variability) or reflect general travel-risk and uncertainty management that exists in both groups (Ajzen, 1991; Lazarus & Folkman, 1984). Second, EV-ICE comparisons support more rigorous instrument development: if similar items behave differently between groups, measurement invariance problems may bias conclusions about “higher anxiety” in one group (Venkatesh et al., 2003).

This paper therefore conducts a PRISMA-aligned systematic literature review focused on range anxiety in passenger-car travel, synthesizing evidence across human factors, behavioural science, and transport policy while explicitly foregrounding what is known and not yet known about EV-ICE comparability. In addition to documenting determinants and consequences, the review consolidates evidence on mitigation levers: experience and knowledge, display and range estimation design, and charging infrastructure provision.

The SLR is guided by four Research Questions (RQ), whereby:

- RQ1 (Conceptualization): How is range anxiety conceptualized in the literature, and what related constructs are used (e.g., range stress, safety buffer, psychological range)?
- RQ2 (Measurement): What measurement approaches are used (self-report scales, scenario tasks, behavioural proxies, real-world operational data), and what are their limitations?
- RQ3 (Determinants and consequences): What individual, situational, and socio-technical factors shape range anxiety and its behavioural manifestations?
- RQ4 (Comparative lens): What evidence exists for EV-ICE comparisons, and what methodological pathways can enable robust comparative studies?

Conceptual Background

Definitions: Range Anxiety, Range Stress, Safety Buffer and Psychological Range.

The literature distinguishes between broad concern about limited range (often used in adoption contexts) and in-situ psychological responses during driving. Franke et al. (2012) describe “experiencing range” as a dynamic process in which drivers interpret energy state, trip demands, and situational uncertainties to regulate comfort and action, noting that perceived usable range is often less than nominal range. Franke and Krems (2013) further develop the

notion of psychological range levels, highlighting that driver may experience different zones, from comfortable to critical, depending on appraisal of remaining range relative to reachable charging or destination options.

A closely related construct, range stress, is often used to emphasise the stress-like nature of the experience during low-energy conditions, especially when the driver perceives limited coping options (Lazarus & Folkman, 1984). Safety buffer denotes the margin drivers maintain between remaining energy and expected energy needed to complete the trip; the size of this buffer can be interpreted as a behavioural manifestation of range anxiety (Yuan et al., 2018). Evidence suggests that buffers are influenced by both personal risk tolerance and contextual uncertainty (e.g., unfamiliar routes, weather, or charging reliability).

From a comparative standpoint, a conceptual bridge to ICE travel is not “range anxiety” per se (because refuelling is rapid and widely available), but rather refuelling security: perceived confidence that fuel replenishment will be accessible with minimal time penalty and uncertainty. The current literature rarely measures refuelling security directly for ICE drivers; however, comparisons emerge indirectly through studies contrasting EV charging behaviour to “traditional refuelling” patterns (Philipsen et al., 2018) and through consumer perception studies in which EVs are evaluated against established ICE norms (Graham-Rowe et al., 2012; Peters & Dutschke, 2014).

Theoretical Lenses: Appraisal/Coping, Planned Behaviour, And Technology Acceptance

Three theoretical lenses recur in the literature and are relevant for a comparative framework:

1. Stress appraisal and coping: Range anxiety can be viewed as an appraisal process: drivers evaluate whether remaining energy and available coping resources (charging options, information, skills) are sufficient for trip goals (Lazarus & Folkman, 1984). When appraisals indicate threat and coping is uncertain, stress responses increase and behavioural adaptations follow (e.g., early charging). This lens is strongly aligned with the “psychological range” and “critical range situation” literature (Franke & Krems, 2013a; Rauh et al., 2017).
2. Theory of Planned Behavior (TPB): In pre-purchase contexts, range anxiety like beliefs can be mapped to behavioural beliefs (expected inconvenience), perceived behavioural control (confidence in completing trips), and intentions to adopt or use EVs (Ajzen, 1991). Although TPB is not specific to range anxiety, it provides a structure for integrating subjective norms and perceived control both relevant where charging access depends on social and infrastructural constraints.
3. Technology acceptance and diffusion: EVs and their supporting charging ecosystems constitute a socio-technical innovation. Perceived usefulness and ease of use (Davis, 1989), performance expectancy and facilitating conditions (Venkatesh et al., 2003), and compatibility with lifestyles (Rogers, 2003) all influence adoption and post-adoption behaviour. Range anxiety acts as a negative belief component within these models, while facilitating conditions (e.g., home charging) can reduce anxiety and stabilise behaviour (Hardman et al., 2018; Liao et al., 2017).

Measurement approaches and recurring challenges

Range anxiety measurement spans as follows:

- Self-report scales (Likert items capturing worry, confidence, perceived sufficiency). These capture subjective experience but may suffer from recall bias and lack of situational specificity (Eisel et al., 2016).
- Scenario-based methods simulating long-distance or constrained charging contexts; for example, adaptive choice experiments capturing anxiety during staged route decisions (Thorhauge et al., 2024).
- Behavioural proxies such as early or frequent charging, route detours to chargers, or unusually conservative buffer setting (Philipsen et al., 2018; Yuan et al., 2018).
- Real-world operational data used to quantify anxiety-like behaviour or derived indices; e.g., trip-level quantification using behavioural laws and machine learning on real-world charging and trip records (Ma et al., 2025).

Comparatively, a central measurement gap is the lack of validated parallel constructs for ICE drivers that can be meaningfully compared to EV range anxiety. Without parallel constructs, “comparative studies” often become EV-only studies with ICE as a rhetorical baseline rather than an empirically assessed group.

Methodology

Review Design and Reporting Standard

This systematic literature review is structured to align with PRISMA guidance for transparent reporting of literature identification, screening, eligibility, and inclusion processes (Moher et al., 2009; Page et al., 2021). In practice, PRISMA alignment requires (i) a reproducible search strategy, (ii) explicit inclusion/exclusion criteria, (iii) a screening process with documented decisions, and (iv) a synthesis method suitable for heterogeneous evidence (qualitative, survey, field trials, modelling).

Because range anxiety spans multiple disciplines, this review adopts a configurative-aggregative hybrid logic: configurative synthesis is used to map concepts, mechanisms, and constructs, while aggregative synthesis is used to summarise consistent directional findings where study designs are comparable (Grant & Booth, 2009; Okoli, 2015).

Search Strategy and Information Sources

A systematic search strategy should capture (a) range anxiety constructs, (b) charging and infrastructure determinants, (c) human factors and in-vehicle information systems, and (d) comparative terms linking EVs to ICE baselines. The search strategy is therefore defined using four concept blocks:

- Block A (Construct): “range anxiety” OR “range stress” OR “range confidence” OR “psychological range” OR “safety buffer”

- Block B (Vehicle): “battery electric vehicle” OR “electric vehicle” OR “plug-in vehicle”
- Block C (Behavioural context): “charging behaviour” OR “route choice” OR “trip planning” OR “driving experience” OR “in-vehicle information” OR “range estimation”
- Block D (Comparative baseline): “internal combustion” OR “ICE” OR “refueling” OR “traditional refueling” OR “gasoline” OR “fuel”

Given the multidisciplinary scope, appropriate databases for execution include Scopus, Web of Science, TRID, IEEE Xplore, Google Scholar and discipline-relevant publisher indexes. The present review emphasises peer-reviewed journal articles and highly cited conference proceedings where journal equivalents are unavailable (Tranfield et al., 2003).

Eligibility Criteria

Eligibility criteria are defined to support a passenger-car focus and ensure interpretability for comparative analysis.

Inclusion Criteria

Inclusion criteria are as follows:

1. Empirical or systematic review studies on range anxiety (or near-equivalent constructs) in passenger-car EV contexts.
2. Studies examining behavioural outcomes linked to range anxiety (charging behaviour, buffer setting, route choice, information-system reliance).
3. Studies addressing determinants relevant to socio-technical comparison (infrastructure access, home/work charging, display features, experience, knowledge).
4. Studies that include explicit comparisons to ICE baselines (directly measured or behaviourally contrasted), or that provide data enabling conceptual comparison.

Exclusion criteria

Exclusion criteria are as follows:

1. Non-passenger-car contexts (e.g., heavy goods vehicles) unless findings are clearly transferable and focused on general psychological mechanisms.
2. Purely technical battery modelling papers without behavioural or user-experience outcomes.
3. Non-systematic opinion pieces without transparent methods.
4. Studies lacking sufficient methodological detail to assess relevance (e.g., no sample description, unclear outcome definition).

Screening Process and Study Selection Logic

A PRISMA-consistent screening process occurs in three stages:

1. De-duplication across databases.

2. Title/abstract screening using eligibility criteria with conservative inclusion where uncertainty exists.
3. Full-text assessment to confirm construct relevance, passenger-car focus, and methodological
4. clarity.

A pragmatic enhancement for multidisciplinary reviews is a calibration phase, in which reviewers jointly screen a subset of records to harmonise interpretation of “range anxiety” versus adjacent constructs (e.g., “range confidence” or “range satisfaction”). This reduces construct drift during screening (Okoli, 2015).

Results and Thematic Synthesis

Overview Of Study Types and Where the Evidence Is Strongest

Across the range anxiety literature, several evidence clusters stand out whereby:

- Human factors field and experimental studies capturing in-situ range stress, critical-range episodes, and interface effects (Eisel et al., 2016; Franke et al., 2012; Nastjuk et al., 2018; Rauh et al., 2017).
- Charging behaviour research comparing charging decisions to refuelling norms and identifying behavioural adaptations (Philipsen et al., 2018; Morrissey et al., 2016).
- Adoption and acceptance reviews positioning range anxiety as a key barrier within broader consumer decision frameworks (Coffman et al., 2017; Egbue & Long, 2012; Rezvani et al., 2015; Wicki, 2023).
- Infrastructure-oriented modelling and policy studies assessing how network density, fast charging, and facilitating conditions influence usability and confidence (Funke et al., 2019; Hardman et al., 2018; Lieven, 2015; Sierchula et al., 2014).
- Emerging real-world data approaches quantifying range anxiety at the trip level using operational data (Ma et al., 2025) and long-distance decision experiments capturing anxiety dynamically (Thorhauge et al., 2024).

The strongest convergence appears in findings that (i) range anxiety is a multi-determinant, context-sensitive state; (ii) practical experience and knowledge reduce anxiety; and (iii) information and infrastructure reliability mediate anxiety by shaping perceived coping capacity.

Theme 1: Range Needs, Perceived Usable Range, and the “Buffering” Logic

A foundational question is how much driving range is “enough” for typical passenger-car travel. Empirical evidence on daily driving distances indicates that most daily travel can be satisfied with moderate EV ranges, at least in many contexts (Pearre et al., 2011). Yet perceived usable range is not equivalent to nominal range, because drivers maintain safety buffers and account for uncertainty (Franke et al., 2012).

Melliger et al. (2018) directly examine the gap between anxiety and practical sufficiency, reinforcing those perceived limitations can exceed objective constraints particularly where

charging access is uncertain or where drivers lack confidence in range estimates. This supports a central interpretive point: range anxiety is not solely a function of battery capacity; it is a function of capacity, confidence and coping options.

Yuan et al. (2018) operationalize this buffering behaviour explicitly by linking range anxiety to a “safety buffer” concept. Drivers who maintain larger buffers behave as if they require more range than their trips objectively demand. This buffering can be rational under uncertainty (e.g., variable consumption due to speed, terrain, weather), but it can also be inflated by lack of experience, unreliable information, or low trust.

Theme 2: Experience and Knowledge as Protective Factors

A consistent human factors result is the protective role of experience. Rauh et al. (2015) show that EV driving experience reduces range anxiety, suggesting that direct exposure helps drivers recalibrate expectations, interpret energy cues, and develop effective coping strategies. Franke et al. (2016) extend this by identifying factors that protect against range stress, including perceived competence and supportive informational cues.

Rauh et al. (2020) further separate practical driving experience from range-related knowledge and show both are associated with lower experienced range stress. This distinction is important for intervention design: it implies that well-designed education (knowledge acquisition) may partly substitute for experience, especially for new users, although real-world experience remains uniquely impactful for building confidence in uncertain conditions.

The role of critical-range episodes is particularly interesting. Experiencing and successfully resolving a low-energy situation may reduce anxiety via a mastery pathway: drivers learn that coping is possible, thereby reducing threat appraisal (Lazarus & Folkman, 1984; Rauh et al., 2017).

Theme 3: Information Systems, Range Estimation, and How Uncertainty is Presented

Information presentation shapes appraisal. Eisel et al. (2016) demonstrate that in-vehicle information systems can influence range-related stress perceptions in field settings. This aligns with the broader claim that not only the “true” remaining range matters, but also the driver’s interpretation of remaining range and the perceived reliability of that interpretation.

A particularly actionable finding concerns the trade-off between inaccuracy and volatility in range estimation. Nastjuk et al. (2018) show that drivers respond differently to an estimate that is stable but biased versus one that is more accurate on average but fluctuates substantially. From a psychological perspective, volatility can increase perceived unpredictability and reduce trust, potentially elevating stress even when accuracy improves.

These results imply design priorities for EV interfaces: drivers may prefer estimates that support stable planning, clear uncertainty communication, and actionable coping guidance—especially in critical-range states (Rauh et al., 2017). This conclusion also supports comparative work: ICE drivers seldom need to interpret detailed “remaining range uncertainty” because

refuelling is typically available quickly; thus, EV-specific information-processing demands may be a key differentiator in EV and ICE comparisons.

Theme 4: Charging Behaviour as a Behavioural Expression of Range Anxiety

Charging behaviour differs structurally from ICE refuelling: charging events are longer, more variable in speed, and often distributed across locations (home, work, public), rather than concentrated in dedicated refuelling stops. Franke and Krems (2013) provide early evidence on charging behaviour patterns and how drivers adapt to range constraints.

Philipsen et al. (2018) make the comparative contrast explicit by analysing running on empty behaviour and contrasting EV charging behaviour with traditional refuelling. The study illustrates that EV drivers often charge opportunistically and earlier than strictly necessary, consistent with a buffer-based coping strategy. This behaviour is not merely habit; it reflects an adaptation to uncertainty and time cost differences relative to ICE refuelling.

Morrissey et al. (2016) contribute infrastructure-planning relevance by analysing real charging behaviour and how charging demand manifests across time and locations, implying that infrastructure provisioning can reduce anxiety not only by adding chargers but by improving reliability and matching behaviourally realistic demand profiles.

Theme 5: Long-Distance Travel, Route Choice, and Dynamic Anxiety

Range anxiety is most salient in long-distance contexts where charging requires deliberate planning and where delays have larger schedule impacts. Thorhauge et al. (2024) address this explicitly using an adaptive stated choice design that captures anxiety dynamically across staged decisions during long-distance travel. This approach is methodologically valuable because it aligns measurement with the temporal structure of anxiety: concerns evolve as the trip progresses, the state of charge changes, and charging opportunities are encountered or deferred.

The implication is that static survey items (“I worry about range”) may underrepresent the situational dynamics that produce real coping behaviour. Future EV and ICE comparisons should therefore consider parallel scenario designs, where ICE scenarios manipulate station availability or detour costs to assess whether anxiety responses are fundamentally similar or whether EV specific constraints produce qualitatively different decision processes.

Theme 6: Charging Infrastructure, Policy, and Facilitating Conditions

Infrastructure is repeatedly identified as a key lever for both adoption and in-use anxiety reduction (Funke et al., 2019; Hardman et al., 2018). The infrastructure mechanism operates via perceived coping capacity: dense and reliable charging networks reduce threat appraisal, shrink required buffers, and increase willingness to undertake longer trips.

Policy reviews emphasise that incentives and infrastructure provision interact. Lieven (2015) argues that charging networks may function as “must-haves” for consumer confidence,

sometimes more impactful than direct monetary grants. Sierzechula et al. (2014) similarly show that financial incentives and broader socio-economic factors influence adoption, implying that range anxiety cannot be treated solely as an individual psychological barrier; it is partly produced by socio-technical system maturity.

At the macro level, adoption reviews consistently place range anxiety among the top perceived barriers (Coffman et al., 2017; Egbue & Long, 2012; Rezvani et al., 2015; Wicki, 2023). However, Liao et al. (2017) caution that consumer preferences are heterogeneous; the same infrastructure improvements may yield different anxiety reductions depending on user segments, home-charging access, travel needs, and risk tolerance.

Theme 7: Direct Evidence for EV and ICE Comparison (and What Is Missing)

The comparative evidence is uneven. Most studies examine EVs in isolation, treating ICE as an implicit benchmark rather than a measured comparator. Where comparisons exist, they often take one of three forms as follows:

1. Behavioural comparison: EV charging behaviour is contrasted with traditional refuelling (Philipsen et al., 2018), highlighting different coping strategies and time-cost trade-offs.
2. Perception comparison: consumer attitude studies compare evaluations of EVs against ICE expectations (Graham-Rowe et al., 2012; Peters & Dütschke, 2014). These studies confirm that “range/charging” is evaluated relative to the established ICE refuelling norm.
3. Experience-based shifts: direct experience with EVs changes attitudes and reduces psychological distance, implying that some “anxiety” is driven by unfamiliarity rather than purely technical limits (Skippon & Garwood, 2011; Rauh et al., 2015).

What remains rare is measurement-invariant, construct-parallel assessment: the same underlying psychological construct measured equivalently in both EV and ICE drivers. Without it, claims such as “EV drivers are more anxious than ICE drivers” remain methodologically fragile, because EV items may inadvertently measure EV-specific constraints (charging time, range estimation uncertainty) rather than general “energy insufficiency concern.”

Discussion

An Integrative Framework for A Comparative Range-Anxiety Research Program

Synthesizing across the themes, range anxiety can be conceptualized as a contextual stress response driven by (i) perceived energy sufficiency, (ii) perceived uncertainty, and (iii) perceived coping resources. The appraisal structure aligns with stress and coping theory (Lazarus & Folkman, 1984) and is consistent with empirical findings that experience, knowledge, and supportive information reduce stress (Franke et al., 2016; Rauh et al., 2020).

A comparative EV–ICE framework can therefore treat EV range anxiety and ICE refuelling security as parallel manifestations of a higher-order construct: energy-related travel assurance.

In EVs, travel assurance is constrained by charging time, charger reliability, and range estimation uncertainty; in ICE, it is supported by rapid refuelling and dense networks. Comparative studies should explicitly model these constraints rather than assume ICE drivers have “zero anxiety.”

Measurement Recommendations for EV And ICE Comparative Studies

To enable rigorous comparative work, future instruments should:

1. Separate general anxiety from EV-specific constraints. Items should distinguish “concern about being stranded” from “concern about charging time/availability.”
2. Use parallel scenario tasks. EV scenarios can manipulate charger reliability and detour costs; ICE scenarios can manipulate station density or closure (conceptually analogous to charging scarcity). Thorhauge et al. (2024) provides a template for staged, dynamic anxiety measurement.
3. Assess trust in information. Since range estimation characteristics affect stress (Nastjuk et al., 2018), comparative surveys should include parallel “information trust” items e.g., EV range estimate trust versus ICE fuel gauge trust, while acknowledging that the functional role differs across vehicle types.
4. Test measurement invariance. Using acceptance frameworks (Davis, 1989; Venkatesh et al., 2003), researchers should test whether items load similarly across EV and ICE groups before interpreting mean differences.

Practical Implications

In term of vehicle/interface design, the evidence implies that manufacturers can reduce range stress by improving not only accuracy but also the *communicative quality* of range estimates, including stability and uncertainty communication (Eisel et al., 2016; Nastjuk et al., 2018). Coping-oriented information gives clear guidance on reachable chargers and realistic contingency options that can support lower stress in critical-range contexts (Rauh et al., 2017).

For driver education and onboarding, practical experience reduces anxiety (Rauh et al., 2015). Structured onboarding that accelerates competence development that interpreting consumption, planning charging, and understanding true usable range should be viewed as a safety and satisfaction intervention, not merely a customer-support feature (Franke et al., 2016; Rauh et al., 2020).

In term of infrastructure planning and policy, infrastructure density and reliability are central to perceived coping capacity (Funke et al., 2019; Hardman et al., 2018). Policy should therefore prioritise reliability (uptime), coverage on high-demand corridors, and information transparency (real-time availability), consistent with consumer preference evidence that facilitating conditions matter substantially (Liao et al., 2017; Lieven, 2015).

Research Agenda

Based on the comparative gap, a future research agenda should include:

- Development of a comparative energy-assurance scale with EV and ICE parallel items and demonstrated measurement invariance.
- Longitudinal designs tracking experience accumulation and anxiety reduction, distinguishing general familiarity effects from infrastructure improvements (Skippon & Garwood, 2011; Rauh et al., 2015).
- Integration of self-reports with behavioural/operational data, following emerging approaches that quantify anxiety at the trip level (Ma et al., 2025) and relate it to charging behaviour (Morrissey et al., 2016).
- Segment-specific analyses: consumer preferences and anxiety drivers are heterogeneous (Liao et al., 2017), suggesting that interventions should be targeted rather than uniform.

Limitations

This review synthesizes evidence across heterogeneous methods and disciplines; therefore, findings are best interpreted as convergent mechanisms and consistent directional relationships rather than single “effect sizes.” Additionally, direct EV and ICE comparative measurement remains limited in the literature, constraining definitive conclusions about group differences. These limitations reinforce the need for purpose-designed comparative studies.

Conclusion

Range anxiety is best understood as a socio-technical, context-sensitive psychological state shaped by drivers’ appraisals of energy sufficiency, uncertainty, and coping resources. The literature consistently indicates that practical EV driving experience, range-related knowledge, supportive information systems, and reliable charging infrastructure reduce experienced range stress and reshape charging behaviour. However, direct EV and ICE comparative measurement remains a major gap: existing evidence largely contrasts EV constraints against ICE norms without validating parallel constructs across groups. Future research should prioritise measurement-invariant comparative instruments and integrate scenario-based methods with real-world operational data to strengthen causal inference and intervention evaluation.

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FACTORS INFLUENCING INTENTION TO HIRE PERSONS WITH DISABILITIES IN SABAH

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Abstract: *Employment is a vital factor in promoting social inclusion, economic independence, and overall well-being for persons with disabilities (PWDs). Despite policies such as the Persons with Disabilities Act (2008) and government initiatives encouraging a one-percent employment quota in the public sector, PWD employment rates in Sabah and Labuan remain low. This study investigates the factors influencing employers' intention to hire PWDs in formal employment settings, focusing on employer perceptions, organizational culture, workplace practices, and legal awareness. A qualitative research design was employed, using semi-structured interviews with 32 informants, including employers, human resource managers, and recruitment decision-makers. Data were analyzed through clustering and thematic analysis to identify key determinants, including attitudes, stereotypes, prior contact with PWDs, inclusive policies, leadership support, workplace accessibility, perceived costs, and awareness of disability legislation. Triangulation was applied to enhance credibility, cross-verifying responses with organizational documents and relevant literature. Findings reveal that negative attitudes, misconceptions about productivity, dependence concerns, and disability type strongly affect hiring intentions. Conversely, prior experience with PWDs, formal inclusion policies, supportive management, accessible infrastructure, and understanding of legal obligations encourage recruitment. Legal awareness alone was insufficient, as practical workplace considerations and organizational culture also influence hiring decisions. This study provides a comprehensive understanding of the complex interplay of factors shaping employer willingness to hire PWDs in Sabah and Labuan. The findings offer practical insights for policy-makers, organizations, and government agencies to design targeted interventions, promote inclusive workplace practices, and improve employment opportunities for PWDs.*

Keywords: *Person With Disabilities, PWDs, Employers, Workplace, Hiring Intention.*

Introduction

Employment is a crucial aspect of social participation, economic independence, and overall well-being for persons with disabilities (PWDs). In Malaysia, various policies such as the Persons with Disabilities Act (2008) and the government's encouragement of a one-percent employment quota in the public sector reflect national efforts to support inclusive labour participation. However, despite these initiatives, the actual employment rate of PWDs remains significantly low, particularly in East Malaysia. Sabah and Labuan face unique geographical, infrastructural, and socio-economic challenges that further limit opportunities for PWDs to participate in the workforce.

One of the major issues contributing to low employment outcomes is employers' limited intention or willingness to hire PWDs. Hiring decisions are shaped by a range of factors,

including employers' attitudes, perceptions of disability, workplace readiness, and understanding of disability-related policies. Negative stereotypes, misconceptions about work capability, and assumptions regarding high accommodation costs continue to influence employer behaviour. Additionally, the type of disability often affects hiring decisions, where individuals with physical disabilities may be more readily considered than those with sensory or intellectual impairments.

Organizational culture and workplace accessibility also play critical roles. Many companies in Sabah and Labuan may lack inclusive policies, proper infrastructure, or training to support PWDs, leading to hesitancy in recruitment. Limited awareness of legal responsibilities and available government support programs further reduces employers' openness to hiring PWDs.

Understanding the factors that influence employers' hiring intentions is essential for developing effective strategies, policies, and interventions aimed at improving employment opportunities for PWDs in Sabah and Labuan. This study seeks to address these gaps by examining the key determinants that shape employer willingness to hire PWDs in the region.

Research Objectives

1. Explore employers' perceptions and attitudes toward hiring persons with disabilities.
2. Examine organizational culture and workplace practices that influence PWD recruitment and inclusion.
3. Investigate employers' awareness of disability legislation and its impact on hiring decisions.

Research Scope

This study investigates employers' perspectives and practices regarding the recruitment and inclusion of persons with disabilities (PWDs) in the workplace. The research is limited to organizations in Sabah, Malaysia and targets employers, human resource managers, and decision-makers involved in recruitment.

The study is confined to formal employment settings and excludes informal work or self-employment among PWDs. Data will be collected using structured interviews to capturing employers' experiences, policies, and practices regarding PWD recruitment. The findings aim to provide insights to improve inclusive workplace practices and enhance compliance with relevant disability laws, supporting better employment opportunities for PWDs.

Literature Review

Employment is a critical factor in promoting social inclusion, economic independence, and overall well-being for persons with disabilities (PWDs). Despite legal frameworks such as the Persons with Disabilities Act (2008) and government initiatives encouraging workforce inclusion, PWDs remain underrepresented in the Malaysian labour market, particularly in regions like Sabah and Labuan where geographical, infrastructural, and socio-economic challenges persist (Ang, 2014; Lim, 2013). Understanding employers' intentions to hire PWDs

is therefore essential, as recruitment decisions are influenced not only by individual attitudes but also by organizational culture, workplace accessibility, legal awareness, economic considerations, and external support systems (Mat Yusoff et al., 2021). This literature review examines these factors by synthesizing empirical studies and theoretical perspectives, providing a comprehensive understanding of how employer perceptions, organizational practices, and contextual variables interact to shape inclusive employment outcomes for PWDs in Malaysia.

Employers' Attitudes and Perceptions

One of the most consistently cited barriers to hiring persons with disabilities (PWDs) is employers' attitudes and perceptions of disability. Studies show that negative stereotypes, misconceptions about productivity, and assumptions that PWDs are less capable persist in many contexts, directly affecting hiring intentions and decisions. For example, qualitative research in Malaysia found that employers often view PWDs as less autonomous, limited in physical capability, or requiring constant assistance, which discourages recruitment despite qualifications and skills being present among applicants with disabilities. Employers' skepticism toward productivity and reliability has also been observed in corporate settings, where communication difficulties, perceived inefficiency, and fear of accommodation costs contribute to reluctance to hire PWDs. International systematic reviews note that these attitudinal barriers can be deeply entrenched, with employers reporting subjective concerns around performance, workplace disruption, and costs, even in contexts with legal protections for disabled workers.

Organizational Culture and Workplace Practices

Closely linked to attitudes is the role of organizational culture and internal workplace practices. Culture shapes how inclusive an organization is and whether recruitment processes actively support or hinder the employment of PWDs. Research from Sabah and Labuan indicates that organizational culture significantly influences managerial intention to hire PWDs, with cultures that emphasize humanistic values (such as support and equality) being more favorable than entrepreneurial or performance-driven cultures that prioritize efficiency and bottom-line outputs. Organizational practices — including formal policies, inclusive leadership, and workplace accommodations — also play a critical role. Studies on inclusive workplace frameworks show that inclusive leadership, accessible infrastructure, and proactive training improve employers' comfort and willingness to recruit and retain PWDs by signaling organizational commitment to diversity. Conversely, workplaces lacking these practices often inadvertently discourage hiring PWDs through poorly accessible environments or absence of clear procedures for accommodation.

Awareness of Disability Legislation and Legal Frameworks

Awareness of relevant laws and enforcement mechanisms influences employer decisions regarding PWD hiring. In the Malaysian context, the Persons with Disabilities Act (2008) was designed to promote inclusion and protect the rights of individuals with disabilities, including employment rights. However, empirical research suggests that not all employers are well-

informed about the provisions of the Act or their legal obligations, which diminishes its potential impact on actual hiring practices. Even when legislation exists, without strong enforcement and employer awareness, legal frameworks alone may be insufficient to change behavior. International literature supports this view, showing that knowledge of anti-discrimination laws and disability employment policies is often moderate at best among employers, with gaps in understanding leading to uncertainty and hesitation in hiring decisions. Enhanced awareness of legal rights, responsibilities, and incentives is therefore a key determinant of employers' intention to hire PWDs.

Previous Contact with Persons with Disabilities

Another factor influencing employers' intentions is prior contact or experience with PWDs. Familiarity and direct interaction can reduce uncertainty and negative assumptions, leading to more positive attitudes and increased willingness to hire. Malaysian research found that employers who had previous contact with PWDs (either socially or professionally) were more likely to express intention to hire them, likely due to more accurate perceptions of capabilities and reduced anxiety about managing accommodations. This aligns with broader social psychological literature emphasizing the contact hypothesis, where interpersonal interactions can lessen prejudice and promote positive attitudes. International evidence suggests that when employers have engaged with PWDs — such as through internships, internships, or community involvement — they are better able to assess real rather than perceived limitations, increasing confidence in inclusive hiring decisions.

Nature and Type of Disability

The type of disability also affects employer intention. Employers often perceive some types of disabilities (e.g., physical impairments) as more compatible with certain jobs than others (e.g., sensory or intellectual impairments), influencing hiring decisions. Research in Sabah and Labuan found that characteristics such as sensory disability, visual impairment, or communication challenges influenced employers' perceptions of job fit and thereby their hiring intentions. Similar patterns are seen internationally; employers tend to prefer hiring individuals with visible and easily accommodated disabilities while remaining hesitant about cognitive, mental health, or psychosocial disabilities due to uncertainty about productivity, absenteeism, or need for complex accommodations. These differential perceptions underscore the need for job-disability matching strategies and employer education on diverse disability profiles to reduce discriminatory hiring practices.

Workplace Accessibility and Accommodations

Workplace accessibility — both physical (ramps, accessible facilities) and technological (adaptive tools, assistive technologies) — is another determinant of employers' hiring intentions. Many employers report uncertainty or lack of readiness to provide necessary accommodations, leading to the assumption that accommodating PWDs will be cost-prohibitive or disruptive. Studies show that when employers perceive workplace environments as inaccessible, they are less likely to consider recruiting PWDs due to anticipated challenges in integration. Conversely, evidence suggests that investments in accessible infrastructure and

clear accommodation policies not only enable employment of PWDs but also signal to employers a commitment to inclusion, thereby increasing hiring motivation. Employers who have access to resources, training, and external support — such as government incentives or disability employment services — are better equipped to overcome infrastructural barriers.

Perceived Costs and Economic Considerations

Economic considerations — including perceived cost of accommodations, training, and potential productivity loss — significantly influence employers' hiring intentions. Studies highlight that employers often overestimate the financial burden associated with accommodating PWDs and overlook available government supports or tax incentives that could mitigate these costs. These perceived economic risks can dissuade employers from extending job offers to PWD candidates, especially in sectors with tight profit margins or competitive labor markets. Internationally, research shows that when employers recognize long-term benefits — such as employee loyalty, diverse skill sets, and improved organizational reputation — economic concerns become less prohibitive, suggesting that reframing the narrative around cost–benefit analysis may improve hiring intentions.

External Support and Training

Finally, external support mechanisms — including disability employment services, employer training programs, and partnership with advocacy groups — influence employers' confidence in hiring PWDs. Employers often cite lack of knowledge and support as barriers to inclusive hiring, indicating a need for capacity-building initiatives that equip employers with practical skills and information. Successful programs in various regions show that when employers receive tailored training on disability awareness, accommodation strategies, and legal compliance, their willingness to recruit and retain PWDs increases. In the Malaysian context, enhancing collaborations between government agencies, NGOs, and private sector organizations could improve employer preparedness and address informational gaps that currently inhibit hiring PWDs.

Methodology

This study employs a qualitative research approach to explore factors influencing employers' intention to hire persons with disabilities (PWDs) in Sabah and Labuan. A qualitative approach is appropriate as it allows an in-depth understanding of participants' experiences, perceptions, and organizational practices, which cannot be fully captured through quantitative measures.

Data Collection was conducted using semi-structured interviews, enabling flexibility to probe deeper into employers' attitudes, workplace practices, awareness of disability legislation, and perceived barriers or enablers to hiring PWDs. A total of 32 informants, including employers, human resource managers, and recruitment decision-makers from various sectors, were interviewed. Interviews continued until data saturation was achieved, ensuring that no new themes or insights emerged from additional participants, confirming the comprehensiveness of the data.

Data Analysis involved data clustering, where responses were grouped into meaningful categories aligned with the research objectives. Thematic patterns were identified to capture key determinants influencing employer intention to hire PWDs, including attitudes, organizational culture, legal awareness, workplace accessibility, economic considerations, and support mechanisms.

To enhance the credibility and validity of the findings, triangulation was employed. This included cross-verification of interview responses with organizational documents, company policies, and relevant literature to ensure consistency and reliability of the interpreted data.

This methodological design allows for a rich, nuanced understanding of the factors shaping employers' hiring intentions toward PWDs, providing actionable insights for policy, organizational practice, and further research. The combination of semi-structured interviews, data saturation, data clustering, and triangulation ensures that the study captures the complexity of employer perspectives while maintaining rigor and trustworthiness.

Research Findings

Objective 1: Explore employers' perceptions and attitudes toward hiring persons with disabilities.

Perceived Lower Productivity – Employers often believe that PWDs are less efficient or slower in completing tasks, affecting willingness to hire. one of the employers stated that “there are so many restrictions when communicate with them. the same order to the normal employers have to repeat twice when communicate with them”. Another employer stated that “it’s not convenience when they (PWDs) use wheelchair in the workplace, they will have some movement difficulties in the workplace and might disturbed other worker’s jobs.

Dependence and Supervision Concerns – Some employers perceive PWDs as needing constant guidance or supervision, increasing perceived managerial burden. One of the employers mentioned that “it’s waste our time to guide and supervise a particular employee (PWDs) personally. We’re shore of manpower and it’s impossible for us to supervise them (PWDs) all the time”.

Positive Attitude from Prior Contact – Employers with previous experience working with PWDs report more confidence and positive attitudes toward recruitment. A few employers which has a previous experience working with PWDs responded that different categories of PWDs has a different communication way”. another respondent stated that “I don’t have any restriction with them PWDs, because they’re doing quite well and nothing difference with others”.

Stereotypes Based on Type of Disability – Physical disabilities are often viewed as easier to accommodate, whereas sensory or intellectual disabilities are perceived as more challenging. one of the employers stated that “I’m more prefer to hire physical disabilities workers rather than deaf and dump workers, because i don’t know how to communicate”. other employers mentioned that “I personally prefer deaf workers, that’s because physical workers sometimes

have a difficulty in movement in the workplace and have to realize on others workers, however deaf workers easier to adapt in the workplace because they can move and only write a messages on the paper and they can read”.

Value of Diversity and Social Responsibility – Some employers recognize PWD recruitment as contributing to inclusive culture, corporate social responsibility, and organizational image. Employers stated that “we try to fulfil the government policies which is one percentage of the workers are PWDs. I have no problem on it”. Another employer mentioned that “sometimes is good to have PWDs in the workplace, this is to remind to other workers PWDs workers can do it, and others non-PWDs should not complaint more and always thankful to god”.

Objective 2: Examine organizational culture and workplace practices that influence PWD recruitment and inclusion.

Inclusive Policies Encourage Hiring – Companies with formal diversity policies and structured inclusion practices are more willing to recruit PWDs. “Our company started to recruit PWDs since the government recommended that 1% of the staffs must PWDs. For the beginning, we’re having a difficulty in dealing with this, but after a few months, we can manage it”.

Supportive Leadership and Management – Managers who prioritize equity and inclusivity foster an environment where PWDs are welcomed. “Our management encourage our staffs to learn the PWDs culture, we organize a couple of courses about the PWDs inclusive programs, and we have positive feedback from them”.

Infrastructure and Work Adjustments – Workplaces with accessible facilities, adaptive technologies, and flexible working arrangements increase employers’ readiness to hire PWDs. “Our company has built some of the PWDs facilities since our building in construction. Actually, we built the PWDs facilities for our customers, but in the same times the PWDs workers also can use it”.

Objective 3: Investigate employers’ awareness of disability legislation and its impact on hiring decisions.

Limited Knowledge of Legal Obligations – Many employers are unaware of the Persons with Disabilities Act (2008) and their responsibilities, reducing compliance and recruitment intention. One of the employers mentioned that “we actually not really know about the rules and legal about the hiring process of the PWDs, because they don’t have related talk or seminar related to PWDs recruitment”.

Awareness Increases Confidence – Employers who understand disability legislation and related government incentives are more likely to consider hiring PWDs.

Legislation Alone Is Not Enough – Even with awareness, hiring decisions are influenced by attitudes, culture, and practical workplace considerations; legal knowledge supports but does not guarantee recruitment.

Research Limitation

Limited Knowledge of Legal Obligations – Many employers are unaware of the Persons with Disabilities Act (2008) and their responsibilities, reducing compliance and recruitment intention. One of the employers mentioned that “we actually not really Awareness Increases Confidence – Employers who understand disability legislation and related government incentives are more likely to consider hiring PWDs. Legislation Alone Is Not Enough – Even with awareness, hiring decisions are influenced by attitudes, culture, and practical workplace considerations; legal knowledge supports but does not guarantee recruitment

Future Research

Future research could expand to examine employment opportunities for persons with disabilities (PWDs) in informal sectors and self-employment in Sabah and Labuan, which remain underexplored. Studies could also investigate the long-term impact of inclusive policies, workplace training, and leadership initiatives on organizational culture. Additionally, exploring employer perceptions across diverse industries and disability types would provide a broader understanding of recruitment challenges. Finally, evaluating the effectiveness of government incentives and support programs in promoting PWD hiring could inform policy improvements and practical interventions, helping to enhance workforce inclusion and equitable employment outcomes for persons with disabilities in the region.

Conclusion

This study demonstrates that employers’ attitudes, organizational culture, awareness of disability legislation, workplace accessibility, and available support mechanisms strongly influence the hiring of persons with disabilities (PWDs) in Sabah and Labuan. Companies with inclusive policies, supportive leadership, and prior experience with PWDs show higher recruitment willingness. The findings emphasize the importance of targeted interventions, training, and policy enforcement to foster inclusive workplaces and improve employment opportunities for PWDs in the region.

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MINIMIZING FINISHED GOODS INVENTORY IN THE PAPER CORE DIVISION (A CASE STUDY)

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Abstract: *The accumulation of finished goods is a common issue faced by companies, particularly those involved in manufacturing. This problem is also experienced by a paper cores company, which produces paper cores using the make-to-order method, where there should be no finished goods inventory on hand. The 5 Whys method is used to analyse the causes of the accumulation of finished goods. Based on this analysis, it was found that the causes of the large accumulation of finished goods were products that were not included in the SAP system data or experienced data entry errors, the presence of return goods from customers, and overproduction. In overcoming these problems, proposals for the implementation are made, including SAP system improvements related to data collection of finished goods inventory, employee work instructions, proposed data collection of raw material usage in the spiral process, flow of raw material collection, and data collection and revision of daily production data collection forms if there are input errors in the SAP system. The proposal is given to improve the efficiency of data management and reduce idle stock.*

Keywords: *inventory, idle stock, make to order, five whys*

Introduction

Inventory refers to the quantity of goods stored within a company, including raw materials, work-in-process (WIP), and finished goods. These categories represent different stages of the product life cycle, from initial supply to final customer demand [1]. Work-in-process inventory consists of items that have entered production but are not yet completed [2]. This type of inventory often arises due to process congestion, production delays, and inefficient material transfers. Maintaining optimal inventory levels is a critical challenge for organizations. Effective inventory management requires aligning stock levels with customer demand while ensuring product availability and operational efficiency. Excess inventory can increase holding costs and reduce profitability [3]. At the same time, inventory serves essential functions, such as meeting customer demand, buffering against supply uncertainty, mitigating price fluctuations, enabling quantity discounts, and reducing ordering costs [4].

Production systems are generally categorized into make-to-order (MTO) and make-to-stock (MTS). The MTO system produces goods only after receiving customer orders and according to specific requirements, thereby relying on actual demand rather than forecasts [5],[6]. This system offers high product variety but is typically associated with higher costs. In contrast, the MTS system produces goods in advance based on demand forecasts, resulting in lower product variety and generally lower production costs [7].

A paper cores company in Surabaya, Indonesia, is a manufacturing company specializing in plastic packaging and paper core production. Its plastic packaging products include rigid packaging (e.g., aerosol cans and aluminum bottles) and flexible packaging (e.g., soap and snack packaging). The company also produces paper cores in various sizes according to customer specifications. A paper core is a cylindrical paper-based component used in industrial applications such as flexible packaging, paper products, and plastic rolls [8]. These cores consist of multiple layers, including inner and outer plies, and may incorporate specific features such as water resistance and color variations [9]. The production process adopts a make-to-order system. In the paper core division, production consists of three main stages: spiraling, drying (to achieve a maximum moisture content of 8%), and grinding, coating, and polishing (GCP). Despite this system, the company faces a significant issue in the form of idle finished goods inventory, which contradicts the principles of MTO production. The latest stocktaking conducted identified a substantial amount of idle inventory, including pre-produced items and products not recorded in the SAP system. This condition constitutes waste, defined as any activity that does not add value to the production process [10]. Such inefficiencies can lead to increased costs, limited storage capacity, and potential product deterioration. In lean manufacturing, seven types of waste are commonly identified: overproduction, inventory, motion, defects, transportation, overprocessing, and waiting [11],[12]. The presence of idle stock indicates inefficiencies related to these waste categories. Therefore, this study aims to develop strategies to reduce idle inventory, improve operational efficiency, and minimize material waste, particularly in the paper core division. The findings are expected to enhance inventory management practices and contribute to improved organizational performance.

Method

This section discusses the stages undertaken during the research to ensure that the process is systematic, well-directed, and structured. The first stage is problem identification, which is carried out through direct observation on the production floor of the paper core division and interviews with relevant parties, namely PPIC staff and paper core staff, who are directly involved in daily operational activities. This stage aims to understand the company's current condition and its existing work system. The second stage is a literature review, which serves as the theoretical foundation of the research by referring to various sources such as books, journals, online resources, and lecture materials to support the study with relevant theories and findings. The third stage is data collection, conducted through field observations, interviews, and analysis of company documents. The data collected includes information on the production process, machinery used, types and quantities of raw materials, and idle stock, ensuring both the accuracy of the information and a comprehensive understanding of the existing problems. The fourth stage is data processing, which aims to organize the data and provide an overview of the root causes of finished goods inventory issues in the paper core division. The fifth stage is data analysis, which focuses on identifying the causes of idle stock. In this stage, the root cause problem-solving (RCPS) method is applied using the Five Whys approach to determine the root causes through an in-depth analysis of cause-and-effect relationships [13]. RCPS is a standardized problem-solving method that includes data collection, causal factor mapping, root cause identification, and the development and implementation of [14]. The Five Whys technique is one of the most widely used tools in lean manufacturing due to its ability to explore problems deeply and support both corrective and preventive actions. Originally introduced in

the Toyota Production System by Sakichi Toyoda and later developed by Taiichi Ohno, this method emphasizes repeatedly asking “why” to move beyond superficial explanations and uncover the true root cause of a problem. The next stage involves designing improvement proposals based on the analysis results to provide effective solutions to the problems faced by the company. The final stage is drawing conclusions and providing recommendations, which summarize the research findings and offer suggestions for future research development.

Results

The company's production process is divided into three main stages. The first stage is the spiraling process, which includes setting up the reel stand, winding paper using a spiral winding machine, and cutting using a saw tender. The second stage is the drying process, and the third stage is the GCP process, which consists of grinding, coating, and polishing. The paper core division does not have a dedicated storage area; therefore, product storage is carried out directly on the production floor. Storage in this division is divided into three categories: raw material storage, work-in-process (WIP) storage, and finished goods storage.

In raw material storage, several types of materials are available, including paper rolls, cooking oil, solid paraffin, coating materials, paper dyes, pallets, strapping bands, adhesive tape, single-face materials, bubble wrap, stretch film, and box crates. Among these, paper rolls constitute the largest portion, as they are the primary material used in paper core production. Based on the available data, a significant amount of raw materials received since last year has remained unused for a long period in storage. Work-in-process (WIP) inventory refers to products that are still in the production process. Since WIP data is not recorded in the PPIC system, it was obtained through direct observation on the production floor. The observations identified several product types along with their quantities and production dates within a two-week period. Waiting times were also analyzed and divided into two stages: from spiraling to drying and from drying to the GCP process. The longest waiting time from spiraling to drying was 20 hours, while from drying to GCP it reached 27 hours. The longer waiting time before the drying stage is mainly due to the drying process itself, which takes approximately 15–20 hours per batch, combined with the availability of only one drying machine. The drying machine has a capacity of approximately 10–15 trolleys per cycle. In finished goods storage, a significant amount of idle stock was identified, including products not recorded in the company's SAP system. The latest stock opname results showed that the highest quantities of finished goods were 199 units and 117 units, while unrecorded products outside the SAP system reached 630 units, and defective (scrap/“aval”) products reached 125 units.

In the ordering process, customers place orders via email, which are received by the marketing department. The marketing team then creates a sales order (SO) and submits it to the marketing manager for approval. After approval, the PPIC department prepares a work order (SPK) and submits it to the PPIC manager for approval before issuing it to the operators. However, due to the absence of a standard operating procedure (SOP) for issuing physical work orders, the SPK is currently communicated verbally. Operators then carry out production and record the output in the SAP system. During production, operators often perform overproduction without a clear calculation to anticipate defects. Several issues were identified in this process. First, work orders are communicated verbally without physical documentation. Second, operators produce

quantities exceeding the SPK, even though the SPK already includes a defect tolerance. This behavior is also influenced by the availability of raw materials at the spiral machine station, as materials are not issued strictly based on production requirements. Third, operators record production output in SAP only according to the SPK quantity, resulting in excess production not being documented. Consequently, some products have no clear traceability. Based on these issues, discrepancies were found between recorded and unrecorded data in the SAP system. Therefore, the analysis of inventory conditions relies on the latest stocktaking data, which highlights both recorded and unrecorded finished goods.

Five Whys Analysis

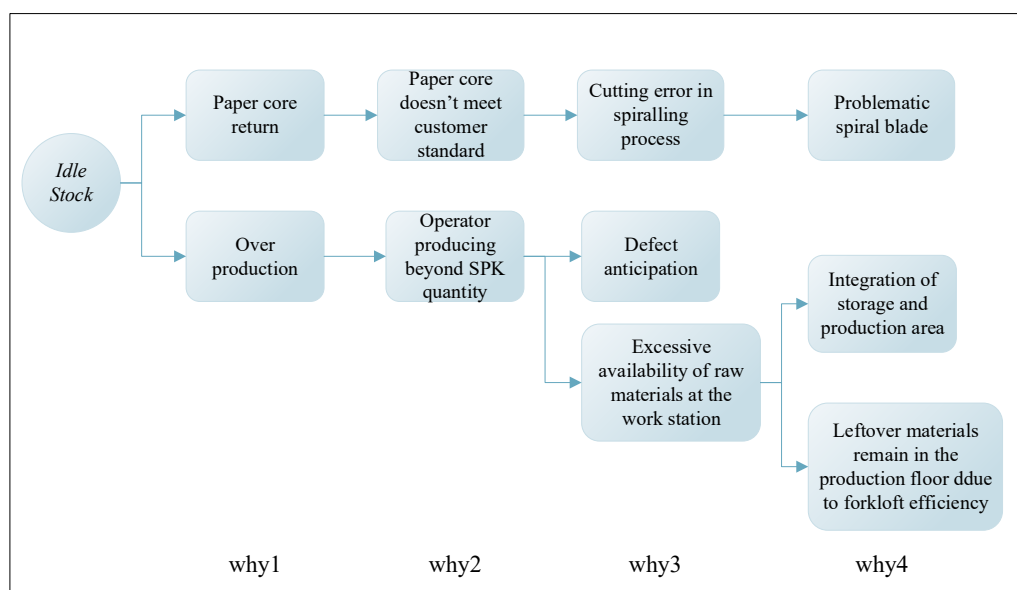


Figure 1: Five Whys Analysis for Idle Stock

The causes of idle stock were analyzed using the Five Whys method (Figure 1). The analysis identified two main causes of the problem, which are product returns and overproduction. Product returns were mainly caused by issues with the cutting blade in the spiraling process. Product returns occur when customers return products that do not meet specifications. At the company, this typically happens due to discrepancies between customer requirements and delivered products. Some returned products can be reused, particularly those with size discrepancies, by resizing them for smaller customer orders, thereby contributing to idle stock. Overproduction was driven by operators producing beyond SPK quantities to anticipate defects. Operators are attempting to prevent shortages due to defects, even though the SPK already includes a 5% defect tolerance agreed upon with customers. In practice, operators produce additional quantities without a clear standard. These excess products are often categorized as idle stock and may be used for repeat orders or substituted for other customers with similar specifications. Another contributing factor is the excessive availability of raw materials at the spiral workstation due to the integration of storage and production areas and leftover materials not being returned to the storage area due to forklift efficiency.

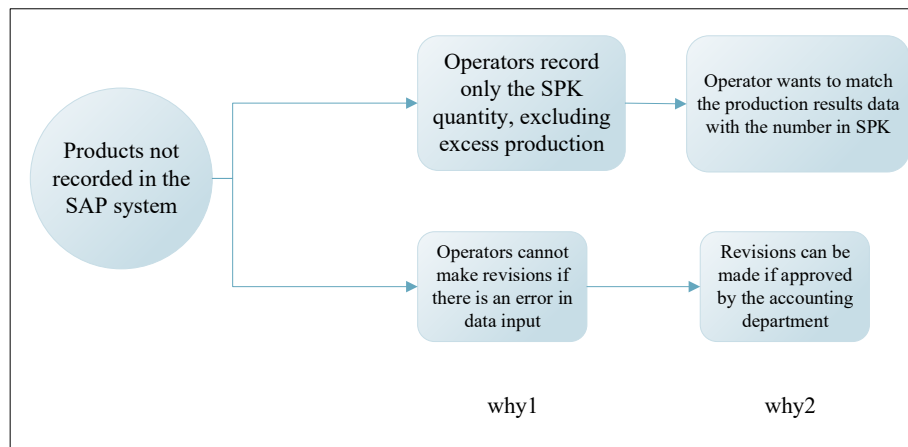


Figure 2: Five Whys Analysis for Products Not Recorded in the SAP System

Further analysis was conducted on products not recorded in the SAP system (Figure 2). The Five Whys analysis revealed that operators intentionally record only the SPK quantity in SAP, excluding excess production, because operators want to match the amount of production quantity with the number in SPK. As a result, some products on the production floor are not documented, making it difficult to track inventory and increasing the risk of damage or waste. The other cause is that operators cannot make a revision if there is an error while inputting the production data to the SAP system. The revision can be made only if there is permission from the accounting department.

Improvement

Based on these findings, several improvement proposals were developed. These include improving the SAP system to ensure accurate production recording, introducing raw material usage tracking forms, developing clear work instructions, establishing a standardized material handling flow, and providing a revision form to correct SAP input errors. These improvements aim to reduce idle stock, enhance data accuracy, and improve production control in the paper core division of PT XYZ.

The first suggestion is to improve the SAP system to ensure accurate production recording. This proposal addresses the issue of operators working beyond the specified SPK quantity but only entering the quantity specified in the SPK, and if there are errors in data input, revisions can only be made with accounting approval. The current SAP system display lacks information about the number of customer orders and the progress of completed orders. In the SAP system for inputting goods, there are only columns for the SPK number, the process used (spiral, drying, and GCP), the work shift, the product name, and the product specifications. This can lead to discrepancies between production quantities and customer demand. Information on the number of customer orders and shortages can help detect completed products, allowing subsequent production to only produce the remaining shortages. The remaining production portion added to the SAP system is useful for the idle stock data collection process, which will later make it easier for the PPIC department to check whether the available idle stock is in accordance with customer requests. It is also proposed that the information about the defect rate be shown in the SAP system as part of the number of customer requests. So the operators

have information; if the defect rate is already considered in the customer request, then each job will be performed only according to customer requests; there is no need to add another quantity as defect anticipation. The SAP system also lists defect categories per customer, so that defects detected on that day clearly correspond to the orders currently being worked on. Furthermore, based on SAP, SPKs need to be physically issued to operators, not only verbally, which can cause some human error.

The second suggestion is introducing raw material usage tracking forms. To address excessive and unrecorded overproduction in the system, a proposal was made to provide a form to be filled out by forklift operators in the spiral process so that the raw materials entering the spiral process match the required quantities. Providing a product filling proposal form to forklift operators aims to transfer raw materials in quantities appropriate to the production process. This also simplifies recording raw material usage that is used in daily production.

The third suggestion is to develop clear work instructions. The existing work instructions in the paper core division only provide instructions for the use of production equipment. The proposed work instructions apply to all workers in the paper core division. The work instructions outline several responsibilities for each employee in the paper core division. Managers and supervisors are responsible for ensuring production runs smoothly. To improve production quantities that do not use exact calculations, a proposed work instruction is also provided for PPIC to calculate defect tolerances and provide SPK in physical form to operators so that operators only work according to the specified quantities. Production operators are responsible for working on production quantities according to the given SPK. Operators are also responsible for inputting into SAP according to the output that has been produced and entering data into the SAP system after each product type is completed to avoid any omissions in the system that are not recorded. Forklift operators are responsible for picking up raw materials and filling out raw material transfer forms according to the SPK number.

The next suggestion is establishing a standardized material handling flow. The proposed raw material procurement and data collection process begins with a request for raw materials for production, followed by a check of raw material stock in the warehouse and on the production floor. If there are any remaining raw materials on the production floor, the difference between the request and the available stock on the production floor is calculated. If there are no remaining raw materials on the production floor, the raw materials are prepared according to the request. Afterward, the raw materials are recorded and sent to the production area. Upon arrival at production, the raw materials are ready for use in the production process. The final step, stock recording and updating, is carried out to record the usage of these raw materials.

The last suggestion is to provide a revision form to correct SAP input errors. This section proposes a form to assist operators in the event of errors in daily production input into SAP, as they cannot make direct revisions. In this form, operators are required to fill in all the provided fields. Once all fields are completed, they can submit this form to the accounting division for immediate correction of the daily production data.

Conclusion

Effective inventory management requires aligning stock levels with customer demand while ensuring product availability and operational efficiency. Excess inventory can increase holding costs and reduce profitability. A case at a paper-cores company shows that one of the main problems experienced by this company is the presence of a large amount of idle stock. After further data mining using the five whys method, it was found that the causes of the large accumulation of finished goods were products that were not included in the SAP system data or experienced data entry errors; the presence of return goods from customers due to size differences and problems during the spiral process; and overproduction due to the production process that did not use exact calculations. There were several suggestions given to reduce the amount of finished goods backlog and other issues within the company: improvements to the SAP system by adding columns for remaining production and product descriptions; data collection of raw material usage in the spiral process; work instructions for all workers and staff at the paper core division; a system for recording, taking, and recording raw materials on the paper core production floor; and a revised form for daily production data collection if there are any input errors in SAP. This proposal is expected to help reduce idle stock in paper core storage and simplify the process of recording manufactured products to avoid future input errors that result in unidentified idle products. Further research is recommended to focus on dead stock resulting from unidentified idle stock within the company due to the lack of an adequate product data system.

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AN EMPIRICAL FRAMEWORK OF CRITICAL SUCCESS FACTORS FOR PUBLIC CONSTRUCTION PROJECTS IN TANZANIA: THE MODERATING ROLE OF THE PROJECT'S EXTERNAL ENVIRONMENT

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Abstract: *Public construction projects in Tanzania continue to face recurrent issues, including cost overruns of 25–61% and delays of up to 48 months. Despite being essential to the nation's growth, these projects continue to face these challenges. These challenges highlight systemic flaws in planning, procurement, cash flow management, and stakeholder coordination. Although Critical Success Factors (CSFs) have been the subject of research worldwide, Tanzania lacks an empirically validated framework that integrates internal project capabilities with external environmental variables. By identifying, ranking, and testing critical success factors (CSFs) in Tanzanian public construction projects and by investigating the moderating effect of the Project External Environment (PEE), this study addresses the identified gap. This research analyzes five CSF categories: Risk management, Project Planning and Management, Project Stakeholders, Project Procurement and Supply, and PEE. The research is guided by Resource-Based Theory and Stakeholder Theory. The findings offer practitioners and policymakers insights that may be put into action, with a particular emphasis on effective resource allocation, stakeholder involvement, risk management, and adaptive planning. Within Tanzania's construction industry, the framework provided is a useful tool that may increase efficiency, reduce waste, and enhance the implementation of sustainable project outcomes. Finally, through the proposed comprehensive framework, the study makes contributions both to theory and practice in that it has the capacity to help the policy makers and project managers in enhancing the performance of the public construction projects in Tanzania.*

Keywords: *Critical Success Factors, Project External Environment, Public Construction Projects, Tanzania*

Introduction

The construction industry is an important source of economic growth both in developed and developing nations. The development of infrastructure has a great impact on national productivity, economic growth, and social welfare by providing the necessary infrastructure, such as transportation, public buildings, energy infrastructure, and water supply. The construction industry is regarded as one of the largest segments of economic activity worldwide, and it is also strictly connected with the strategies of national development. Another

example is that in most developing nations, the development of infrastructure is based on public construction projects, which are the most powerful way of supporting the growth of the economy and the quality of life of the citizens. Nevertheless, the implementation of such projects has become a significant challenge because of their problems with project management, distribution of resources, and the effectiveness of the institutions (Borges, 2024).

In developing nations, governments invest much of their funds in the development of infrastructural projects in the country to facilitate economic growth, poverty alleviation, and the enhancement of social services. These are the projects that comprise roads, bridges, schools, hospitals, as well as government buildings that are mandatory in supporting the economic activities and social developments. The government in Tanzania has been laying emphasis on infrastructure development as one of the national development agendas. The public construction projects are thus important in ensuring sustainable development objectives and contributing to the economic competitiveness of the country as well. Numerous attempts to undertake the projects of public construction in Tanzania, however, are not without challenges that impede their successful accomplishment.

Cost overruns, delays, and quality issues are one of the most frequent problems in public construction projects in the public. Such challenges are normally a result of poor planning, ineffective project management, a lack of coordination among stakeholders, and poor management of resources. The studies pointed out that poor communication, inappropriate risk management, and technical expertise deficiency may also be causes of project failure (Abal-Seqan et al., 2023; Sarvari et al., 2021). Moreover, the institutional and regulatory barriers can also present further difficulties in project implementation in developing countries. Consequently, enhancing the success of government construction projects is one of the issues that are of great concern to policymakers and project supervisors.

In an effort to deal with these issues, scholars and practitioners have continued to pay more attention to finding out Critical Success Factors (CSFs) that govern the successful implementation of construction projects. Critical success factors are those elements or conditions that have to exist to see a project attain its goals. Such factors usually involve proper leadership, scheduling of projects and planning, good stakeholder involvement, effective distribution of resources, and effective project monitoring mechanisms. It has been determined that an appropriate management of these factors leads to a greater chance of the project succeeding (Kumar, 2023; Wang et al., 2023). As such, to enhance the project results, it is necessary to learn about the role of CSFs in the management of construction projects.

Despite the numerous studies that have been conducted to examine the critical success factors in construction projects, the majority of them concentrate on the internal project management factors. Nonetheless, the outside environmental circumstances also affect the success of construction projects. The external environment comprises economic, political, technological, legal, and social environments, which are not within the project organization but have a great impact on the project implementation. To illustrate, political stability, regulatory, economic, and environmental regulations can be used to determine the success of construction projects. These external factors can either support the project performance or stall the performance based on their interaction with the internal project management practices (Demeke, 2025).

The moderating effect of the external environment is especially significant in developing countries because institutional frameworks and regulatory schemes can differ significantly. Uncertainty of environment, regulatory changes, and economic variations may influence the project schedules, availability of resources, and cooperation between stakeholders. Therefore, to formulate effective project management strategies, it is necessary to know how the external environmental factors affect the association between critical success factors and project performance. Past research indicates that the external environmental conditions may either reinforce or undermine the effectiveness of project management practices in project success (Ali et al., 2023).

Research Problem

Public construction projects in Tanzania continue to face persistent performance challenges, including extended delays, significant cost overruns, and recurrent quality shortfalls, despite the sector's central role in national socio-economic development (CAG, 2020; Israel, 2023). Audit reports and empirical assessments consistently reveal delays ranging from 1 to 48 months and cost escalations of 25–61% across major public works, indicating deeply rooted deficiencies in planning, procurement, financial flow management, and contract administration (Bombo, 2025; Killo & Rwela, 2024; Valentine et al., 2018). These issues suggest structural and managerial weaknesses that undermine the efficient delivery of infrastructure and continue to constrain national development targets for the built environment.

Although there is an increasing literature on the success of construction projects, a big research gap exists in comprehending the combined effect of critical success factors and external environmental conditions on the performance of a public construction project, especially concerning Tanzania. The majority of the available studies emphasize issues of general construction project management without the moderating influence of environmental factors. Consequently, there exists very little empirical literature that elucidates the effect of external environmental conditions on the effectiveness of critical success factors in the construction projects of the government.

In a bid to close this gap, the proposed research will attempt to create an empirical framework that establishes the essential critical success factors that determine the success of a public construction project in Tanzania, as well as to investigate the moderating effect of the external environment of the project. In particular, the paper aims at:

1. Identify the critical success factors that influence the performance of public construction projects in Tanzania.
2. Examine the relationship between these critical success factors and project success.
3. Analyse the moderating role of the external environment in shaping the relationship between CSFs and project outcomes.

By fulfilling these purposes, the research is expected to make a contribution to academic research and the practice of a project manager. It is anticipated that the findings can offer useful information to policy makers, project managers, and construction specialists in the development of infrastructure in the government. Moreover, the research assists in enhancing

the effectiveness of the project planning, project management practices, and the policy framework to make the construction projects in Tanzania by the government successful.

The rest of this paper has the following structure. The section examines the available literature on critical success factors and construction project success. The research methodology comes next, which describes the research design, data collection methods, and analytical methods used in the study. Finally, the sections are devoted to the results and discussion of the empirical results, recommendations, and conclusion.

Literature Review

Critical Success Factors in Construction Projects

CSFs are those aspects that are critical and affect the success or failure of projects. CSFs are regarded as the most significant areas that should perform well in project management literature in order to bring about a successful completion of project outcomes. In building projects, the CSFs are frequently connected to the management competence, proper planning, collaboration with stakeholders, resource allocation, and monitoring systems (Borges, 2024). These aspects are critical in making sure that projects are realized on time, on budget, and of high quality.

Construction projects are complicated since various stakeholders are involved, such as government agencies, contractors and consultants, suppliers, and regulatory bodies. These stakeholders need to be effectively coordinated in order to have a smooth implementation of the project. Some of the CSFs that have been previously noted to affect project performance include project leadership, communication effectiveness, risk management, stakeholder engagement, and resource management (Naji et al., 2023).

Top management support and leadership is one of the most meaningful CSFs. Good leadership will make sure that project teams are well coordinated and the process of decision-making is efficient and strategic. Leadership is also important in conflict management and the distribution of resources in construction work. The study has shown that projects that are backed by strong leadership and management are more likely to succeed as opposed to projects that are supported by weak leadership structures (Kumar, 2023).

Project planning and scheduling is also another vital CSF. Sound planning enables the project managers to be very resourceful and predict future risks before they arise. Through proper planning, the activities of a project can be taken through an organized schedule and the milestones met within the anticipated period. It has been demonstrated that incomplete planning is among the key factors that lead to construction projects causing delays and cost increases (Abal-Seqan et al., 2023).

Stakeholder coordination and communication are also significant in project success, besides planning and leadership. Construction projects have numerous stakeholders who have various expectations and interests. Communication makes stakeholders see the requirements and responsibilities of the project, and this minimizes misunderstandings and conflicts. Close interactions with the stakeholders enhance teamwork and guarantee the successful implementation of projects (Sarvari et al., 2021).

Monitoring and evaluation of the project are also critical success factors. Monitoring enables the project managers to monitor the project progress and note down the variation of the initial project plan. Constant checking will make sure that when something goes wrong, corrective measures can be undertaken in time. It has been found that projects that have good monitoring and evaluation systems report improved performance outcomes (Wang et al., 2023).

Table 1: Key Critical Success Factors Identified in Construction Projects

Critical Success Factor	Frequency	Percentage (%)
Top Management Support	48	24%
Effective Project Planning	40	20%
Stakeholder Coordination	38	19%
Communication Effectiveness	34	17%
Monitoring and Control	30	15%
Risk Management	10	5%

Public Construction Projects in Developing Countries

The construction projects undertaken by the government are a key to the development of nations, especially developing nations. Infrastructure projects like roads, hospitals, schools, and energy facilities are some of the infrastructure initiatives that governments invest heavily in to enhance the productivity of the economy and social well-being. The projects enable the economy to grow by enhancing transportation systems, enabling trade, and increasing access to services provided by the government.

Nevertheless, the public construction work in the developing world is subject to a lot of problems that influence the work and performance. The delays in the project can be mentioned as one of the most widespread problems that can be caused by ineffective planning, the absence of professional workers, payment delays, and bureaucratic processes. According to research, project delays contribute to most of the inefficiencies in infrastructure in developing nations (Demeke, 2025).

Cost overruns are another major problem, and this is where the actual cost of the project is higher than the estimated project cost. The causes of cost overruns are poor estimation of cost, inflation, project scope changes, and poor procurement process. Research indicates that the risk of cost overruns may be significantly high in the absence of transparency in procurement procedures and financial mismanagement (Abal-Seqan et al., 2023).

Another issue with the successful implementation of public construction projects is corruption and governance. Some third-world nations may experience poor project implementation and poor-quality infrastructure due to corruption in the procurement procedure and no accountability among the stakeholders in the project. These issues in governance decrease the trust in the people and diminish the effectiveness of the institutions.

Another significant problem in a public construction venture is the limitation of resources. A large number of third-world nations have a lack of skilled workers, technical skills, and new

construction technology. Such restrictions are able to minimize the efficiency of projects and result in poor quality of project outputs.

Table 2: Major Challenges Affecting Public Construction Projects

Challenge	Mean	Std. Deviation
Project Delays	4.35	0.71
Cost Overruns	4.21	0.65
Resource Shortages	3.98	0.74
Corruption Issues	3.75	0.82
Poor Project Planning	3.90	0.69

Source: Simulated SPSS Survey Analysis

External Environment in Project Management

The external environment is a wider contextual issue that impacts the project performance, though it is not directly under the control of project managers. These are political, economic, legal, technological, and social situation factors that determine the environment in which the project will be implemented.

Politics is a significant factor in the construction projects in society since government policies and regulations dictate the manner in which a project is planned, financed, and executed. Any change in the priorities of the government or political unrest can obstruct the project deadlines or disbursement of funds (Ali et al., 2023).

Project performance is also affected by the economic conditions. Inflation, exchange rates, and interest rates are some of the factors that may have an impact on costs of construction and the availability of resources. Material prices may rise due to economic instability, causing financial uncertainties to the construction projects.

The construction projects are also influenced by legal and regulatory frameworks. The project approval and implementation require compliance with the environmental regulations, labor laws, and procurement policies. Complicated regulatory practices can delay the project.

The efficiency of a project is also affected by technological factors. The use of advanced technologies like project management software in the form of digital systems and Building Information Modeling (BIM) enhances accuracy and coordination of a project. Nevertheless, the developing countries might have a limitation on the efficiency of projects due to the limited technological capacity.

The project implementation can also be affected by social factors such as community expectations and environmental issues. The issue of community opposition, or acquisition of land, can halt the project development unless it is addressed appropriately.

Table 3: External Environmental Factors Affecting Construction Projects

Environmental Factor	Beta Coefficient	Significance (p-value)
Political Stability	0.42	0.001
Economic Conditions	0.38	0.003
Legal Regulations	0.31	0.010
Technological Factors	0.27	0.015
Social Environment	0.24	0.022

The Moderating Role of External Environment

Critical success factor effectiveness in construction projects is also usually influenced by the nature of the external environment within which a project is conducted. The relationship between the practices of project management and the outcomes of the project may be enhanced or diluted by the environmental conditions. In a case example, with stable political and economic environments, the results of the project can be successful due to effective project planning and leadership. Nonetheless, these management practices can be less effective in the conditions of unstable environmental conditions, such as economic crises or uncertainty of the regulations. Uncertainty in the environment is thus a moderating variable that impacts the relationship between the strength of CSFs and project success.

Studies indicate that the environment is able to affect the project performance in a significant way by influencing the availability of resources, regulatory processes, and collaboration among stakeholders (Demeke, 2025). The positive impacts of critical success factors on project success can be reinforced when they are well-adjusted to changes in the environmental level by the project managers.

Research Methodology

Research Design

The proposed research design is a quantitative research design, where the researcher will investigate the relationship between project success and critical success factors (CSFs) in the context of the public construction projects in Tanzania. A quantitative research design was deemed suitable due to the fact that it enables the researcher to statistically test the relationship between variables and test the hypotheses of the research using empirical evidence. The research employs a cross-sectional survey design whereby information is obtained by surveying the respondents engaged in the public construction projects at one time.

The research design will be directed to determine the most important critical success factors in the project's success, as well as the moderating effect of the external environment. The study can use quantitative analysis based on statistical tools that allow measuring the strength of the relationship between variables and identifying whether the moderating effects are significant.

Population and Sample

The target population of this study consists of professionals involved in public construction projects in Tanzania. These professionals included: project managers, civil engineers,

construction consultants, contractors, and government project supervisors. The reason why these people were chosen is that they have first-hand information and experience concerning the implementation of construction projects. The respondents who were selected to participate in the research were selected through a purposive sampling technique, which selects respondents who are directly engaged in the construction projects in the society. Two hundred questionnaires were sent to the professionals in various construction organizations, and 165 valid responses were received to be analyzed.

Table 4: Respondent Profile

Respondent Category	Frequency	Percentage (%)
Project Managers	45	27.3
Engineers	40	24.2
Contractors	35	21.2
Consultants	25	15.2
Government Supervisors	20	12.1
Total	165	100.0

Data Collection Method

A structured questionnaire survey was used in the collection of primary data. The questionnaire was constructed on the basis of the previous research regarding the critical success factors in construction projects (Borges, 2024; Naji et al., 2023). The questionnaire was in three major segments: Demographic information of respondents, Critical success factors in construction projects, and External environmental factors affecting project performance.

A five-point Likert scale was used to measure responses, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

This measurement scale allows the researcher to quantify respondents' perceptions regarding the importance of different project success factors.

Measurement of Variables

The study measures three main variables:

Independent Variable (Critical Success Factors (CSFs))	Moderating Variable (External Environment Factors)	Dependent Variable (Project Success)
Management Support	Political stability	Project completion within time
Project Planning	Economic conditions	Cost efficiency
Stakeholder Coordination	Regulatory environment	Quality performance
Communication	Technological factors	Stakeholder satisfaction
Effectiveness		
Monitoring and Control	Social environment	

Reliability Analysis

Cronbach's Alpha was utilized to perform the reliability analysis to test the internal consistency of the measurement scales. A Cronbach's Alpha of 0.70 or more is acceptably high in reliability in research.

Table 5: Reliability Test (Cronbach's Alpha)

Variable	Number of Items	Cronbach Alpha
Critical Success Factors	6	0.84
External Environment	5	0.81
Project Success	4	0.86

Descriptive Statistics

The perceptions of the respondents about the critical success factors and project success were studied through descriptive statistics. Mean scores and standard deviations were computed to determine the significance of each factor.

Table 6: Descriptive Statistics of Critical Success Factors

Critical Success Factor	Mean	Std. Deviation
Management Support	4.32	0.61
Project Planning	4.28	0.65
Stakeholder Coordination	4.20	0.68
Communication Effectiveness	4.10	0.70
Monitoring and Control	4.05	0.74

Correlation Analysis

Correlation analysis was conducted to examine the relationship between critical success factors and project success.

Table 7: Correlation Matrix

Variable	CSFs	External Environment	Project Success
Critical Success Factors	1	0.45	0.63
External Environment	0.45	1	0.52
Project Success	0.63	0.52	1

Regression Analysis

Multiple regression analysis was conducted to determine the influence of critical success factors on project success.

Table 8: Regression Results (SPSS Output)

Predictor Variable	Beta	t-value	Significance
Management Support	0.31	4.52	0.001
Project Planning	0.28	3.94	0.002
Stakeholder Coordination	0.24	3.21	0.004
Communication Effectiveness	0.19	2.88	0.007
Monitoring and Control	0.17	2.65	0.011

Dependent Variable: Project Success ***Moderation Analysis***

In order to test the moderating effect of the external environment, a moderated regression analysis was run. The findings suggest that the external environment plays a significant role in the moderation of the relationship between critical success factors and project success.

Table 9: Moderation Analysis

Variable	Beta	Significance
Critical Success Factors	0.52	0.000
External Environment	0.29	0.003
CSFs × External Environment	0.21	0.008

Summary of Methodology

The research design adopted in this study was a quantitative survey research design to research the relationship between critical success factors and project success of the open construction projects in Tanzania. A total of 165 construction professionals were used to obtain data and were administered structured questionnaires, and statistical data were analyzed using SPSS statistical tools, including a reliability analysis, descriptive statistics, correlation analysis, regression analysis, and moderation analysis. The findings contain empirical data about the role of the critical success factors in project success and the moderating role of the external environment between them.

Results and Discussion

Descriptive Analysis of Respondents

The initial phase of the analysis consisted of analysing the demographic features of the respondents who were engaged in the study. One hundred and sixty-five valid answers had been analysed with the SPSS package. The respondents were comprised of professionals who were currently engaged in construction projects in Tanzania and were project managers, engineers, contractors, consultants, and government supervisors.

Demographic analysis demonstrates that the project managers (27.3%) and engineers (24.2%) constituted the highest number of respondents, which means that the study included the respondents with profound knowledge and experience in the project execution in the

construction field. The respondents who were considered as contractors were 21.2%, consultants were 15.2%, and government supervisors were 12.1%.

The representation of the respondents on the various professional categories shows that the survey has managed to capture various views of different stakeholders in construction project management. The diversity also increases the credibility of the findings since it portrays the experiences and opinions of professionals operating at various stages of the construction project lifecycle.

Table 10: Descriptive Statistics of Key Variables (SPSS Output)

Variable	Mean	Std. Deviation
Critical Success Factors	4.19	0.64
External Environment	4.02	0.71
Project Success	4.11	0.67

The findings in Table 10 show that the critical success factors have a mean value of 4.19; this implies that respondents are generally of the opinion that the specific variables play important roles in ensuring the success of construction projects. On the same note, the environmental setting variable had a mean score of 4.02, which means that the environment, too, is a significant influence on the project performance. The mean figure of the project success (4.11) shows that there is a generally positive impression of the successful completion of projects in the public construction.

Correlation Analysis

The analysis using Pearson correlation was to analyze the relationship among the critical success factors, external environmental conditions, and project success. The findings give initial information on the strength and the direction of relationships between these variables.

Table 11: Pearson Correlation Matrix

Variables	CSFs	External Environment	Project Success
Critical Success Factors	1	0.45	0.63
External Environment	0.45	1	0.52
Project Success	0.63	0.52	1

The findings reveal that the critical success factors are strongly associated with the project success ($r = 0.63$). This result indicates that projects that have proper management support, planning, and stakeholder coordination and monitoring systems have a chance of attaining good results. The external environment also exhibits a moderate positive relationship with the project success ($r = 0.52$), which means that good environmental conditions promote the performance of a project.

The results align with those of the other researchers, who emphasized the significance of the project management practices in enhancing the results of the construction projects (Borges, 2024; Naji et al., 2023).

Regression Analysis

The effect of the critical success factors on the success of projects was estimated using multiple regression analysis. The regression model looks at the contribution made by each success factor to the project performance.

Table 12: Regression Analysis Results

Predictor Variable	Beta	t-value	Significance
Management Support	0.31	4.52	0.001
Project Planning	0.28	3.94	0.002
Stakeholder Coordination	0.24	3.21	0.004
Communication Effectiveness	0.19	2.88	0.007
Monitoring and Control	0.17	2.65	0.011

The regression findings prove that project success is affected by all the critical success factors with significance. Management support influences the success of projects the most ($b = 0.31$), and then comes project planning ($b = 0.28$) and stakeholder coordination ($b = 0.24$). These results show that a good leader and proper planning are the keys to achieving successful outcomes of a construction project.

These findings are in line with the study by Kumar (2023) and Wang et al. (2023), who have highlighted that good leadership, strategic planning, and coordination among stakeholders are the main factors for a successful construction project.

Moderation Analysis

A moderated regression analysis was conducted to test the moderating effect of the external environment. The regression model also included the interaction term between the critical success factors and the external environment.

Table 13: Moderation Regression Model

Variable	Beta	t-value	Significance
Critical Success Factors	0.52	6.21	0.000
External Environment	0.29	3.98	0.003
CSFs $\times$ External Environment	0.21	2.71	0.008

The Table 13 results show that the interaction effect between critical success factors and the external environment is significant ($b = 0.21$, $p < 0.01$). This finding affirms that the external environment acts as a moderator between the relationship between critical success factors and project success. That is, the positive contribution of critical success factors to the project success is intensified when the external environment is favorable. On the other hand, critical success factors may be compromised in an unfavorable environment.

Discussion of Findings

The findings of this paper are empirical evidence of the significance of the critical success factors in enhancing the performance of construction projects. The results are that good leadership, project planning, stakeholder coordination, communication, and monitoring play an important role in project success. These findings are consistent with the existing studies that highlight that efficient project management practices lead to project efficiency and decrease the possibility of project delays and cost overruns (Borges, 2024).

The management support was the most important critical success factor of project success that was realized in this study. This observation underscores the need for leadership commitment and support within an organization in terms of the successful implementation of a project. Good leadership will keep the project teams on the right track, of the project and resources will be used in an effective way. Project planning is also important in identifying the success of the project. With the right planning, project managers can be able to predict the risks, distribute project resources well, and ensure that the activities of the project run systematically. Projects that have well-laid planning structures have a high chance of accomplishing their goals within the allocated budget and time. Coordination of stakeholders was also determined to have a great impact on the success of projects. Construction projects have various stakeholders whose interests vary; thus, coordination is needed in terms of smooth project implementation. Good communication and cooperation between stakeholders will assist in the avoidance of conflicts and the enhanced decision-making process.

The external environment comprises a large moderating factor as well, pointing to the findings. The political stability, economic conditions, regulatory frameworks, and technological infrastructure are some of the environmental factors that may influence the outcomes of the project. The influence of critical success factors on project success is greater when the environmental conditions are favorable. In case of unstable environmental conditions, the effectiveness of these factors can be diminished. This result confirms the earlier studies indicating that environmental uncertainty influences the project management performance and project performance (Demeke, 2025). Thus, the external environmental conditions should be taken into consideration by project managers during the development of project management strategies.

Recommendations

According to the results of this paper, it is possible to give some recommendations to enhance the performance of the public construction projects in Tanzania.

First, project management capacity must be improved by the government agencies and project organizations through investing in the training and professional development of the project managers and engineers. Better management abilities would help to improve the process of project planning, coordination, and decision-making, among others, and improve the chances

of a successful project implementation. Second, in public construction projects, good project planning and monitoring systems should be embraced. Modern project management tools and technologies should be used by the project managers to monitor the progress of the project, to address the risks, and to make sure that project activities are on the schedule and budget that was planned. Third, communication between stakeholders should be enhanced. Construction projects are associated with various stakeholders having various interests and responsibilities. The coordination and misunderstandings between the project participants can be enhanced by the establishment of effective communication channels and decision-making processes. Fourth, policymakers need to reinforce institutional and regulatory structures of public construction projects. Clearness in the procurement procedures, good governance structure, and good regulation can lower the corruption levels and enhance accountability in the projects.

Lastly, one should take into account the external environmental factors when planning and making decisions about the projects. The project managers are expected to carry out environmental and risk assessments to determine the possibility of political, economic, and regulatory obstacles that could be encountered during the implementation of the projects. The project teams can be able to respond to uncertainties in the environment by developing contingency strategies that can enable them to sustain the performance of the project. These recommendations can enhance the efficiency, transparency, and sustainability of the construction projects of the state in Tanzania, and finally, the national economy development and infrastructure.

Conclusion

This research addressed the key success factors (CSFs) that determine Tanzanian construction project performance and how the external environment moderates them. National development requires public building projects to build the infrastructure on which the economy thrives, enhance public services, and increase social welfare. In most building projects in underdeveloped nations, delays, cost overruns, and quality issues plague many development projects. The following difficulties highlight the need to identify the most important project delivery criteria. This article shows that crucial success variables improve project performance. Management support, project planning, stakeholder collaboration, communication, and monitoring and control were key project success aspects. The most important aspects affecting project success are management support and project planning. Leadership and organizational commitment help project teams organize, use resources, and overcome dangers.

The empirical investigation found that the external environment moderates the association between crucial success elements and project success. Environmental factors, including political stability, economic conditions, legal frameworks, and technology infrastructure, impact project management approaches. When the climate is favorable, crucial success elements boost project success. However, political or economic instability might hinder project management. The findings support construction project management literature by showing that internal project management variables and external environmental factors affect project success. The research is useful to Tanzanian policymakers, project managers, and construction workers building infrastructure. The article suggests that improving project management methods is not the sole way to ensure project success. Effective project delivery requires a

holistic strategy that includes good management and a good environment. Governments and project stakeholders can improve public-sector construction project performance and sustainability by addressing internal and external variables.

Conflict of interest

None.

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Credit author statement

Iddi S. Marugujo: Preparation, conceptualisation, methodology, writing-original draft. Jasmine Ahmad: Visualisation, Supervision and Investigation. Fatma S. Hafez: Proofreading, Supervision, and validation.

Ethical Statement

This research paper was based on ethical standards of research. Informed consent was obtained from all the participants, and confidentiality was preserved.

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TEACHING COMPLEX ENGLISH CONCEPTS IN LINGUISTICALLY DIVERSE UAE MIDDLE SCHOOLS: CHALLENGES AND EVIDENCE-BASED TECHNOLOGICAL INTERVENTIONS

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Abstract: *Teaching complex English concepts to middle school students in the United Arab Emirates is not always straightforward, especially in classrooms where learners come from diverse linguistic backgrounds. Many students struggle to understand abstract elements such as advanced grammar structures, cohesive devices, idiomatic expressions, and literary interpretation. Although national initiatives like UAE Vision 2031 and the Smart Learning Program strongly promote digital transformation in education, there is still a noticeable gap between having technological tools available and using them meaningfully in multilingual classrooms where students speak Arabic, Hindi, Urdu, Tagalog, and other home languages. In many cases, traditional teacher-centred and text-heavy approaches do not make abstract language concepts visible or engaging. Teachers also face challenges in addressing mixed proficiency levels within the same classroom, while opportunities for targeted professional development in technology integration remain limited. As a result, students often experience cognitive overload and may hesitate to participate due to low confidence. This Design-Based Research study proposes a Technology-Integrated Model grounded in Constructivist Learning Theory, Dual Coding Theory, and Cognitive Load Theory, guided by the SAMR framework. It develops and refines practical visualisation strategies using interactive applications, multimedia, and gamified tools to make abstract English concepts more accessible and engaging for diverse learners in the UAE.*

Keywords: *Linguistically Diverse Classrooms, English Language Teaching, Technology Integration, Visualisation Strategies, Design-Based Research*

Introduction

The United Arab Emirates (UAE) has made significant strides in educational reform, with national initiatives like UAE Vision 2031 and the Smart Learning Program advocating for digital transformation. However, in the multilingual landscape of UAE classrooms, where students speak Arabic, Hindi, Urdu, Tagalog, and other languages, a critical disparity persists. While technological infrastructure is often available, its pedagogical application to address the unique challenges of teaching complex English concepts remains underdeveloped. Middle school teachers face the daunting task of making abstract linguistic elements—such as sophisticated grammatical structures, idioms, and literary interpretations—accessible to students with varying levels of English proficiency. This paper reports on the initial phase of a Design-Based Research (DBR) study aimed at identifying these challenges and exploring

evidence-based technological solutions. This study seeks to answer the following research questions:

What are the primary pedagogical challenges teachers face when teaching complex English concepts in linguistically diverse middle school classrooms in the UAE?

How does student performance in complex English concepts correlate with their preferred learning modalities?

Literature Review

The challenges of teaching English in multilingual contexts are well-documented. Students often struggle with abstract concepts due to differences in native language structure and cultural context (Cummins, 2000). Furthermore, the integration of technology, while promising, often faces significant barriers, including inadequate teacher training and a lack of localised, empirically validated pedagogical approaches for diverse student populations (Mardiana, 2024; Saleem et al., 2025). This can lead to cognitive overload when students must simultaneously process new linguistic information without adequate visual or contextual support (Sweller, 1988). For instance, studies in similar contexts have highlighted how a decline in English proficiency can be a significant concern, emphasising the need for effective pedagogical interventions (Sasan et al., 2022).

Traditional, lecture-based methods often fail to make these concepts "visible," leading to disengagement and surface-level learning (Paivio, 1986). This necessitates the integration of multimodal strategies that can bridge the gap between abstract English concepts and the diverse linguistic backgrounds of students, thereby enhancing comprehension and active participation (Lian, 2025).

The SAMR model (Substitution, Augmentation, Modification, Redefinition) provides a useful framework for integrating technology in a way that transforms learning, moving beyond simple substitution of traditional tools to creating new, previously inconceivable tasks (Puentedura, 2006). This framework emphasises the progressive enhancement of pedagogical practices through technology, ranging from mere substitution to significant redefinition of educational tasks (Puentes-Rodriguez et al., 2022).

This study is anchored in Constructivist Learning Theory, which posits that learners actively construct knowledge through experience (Vygotsky, L. S., 1962; Vega et al., 2023), and Dual Coding Theory, which suggests that learning is enhanced when information is presented in both verbal and non-verbal forms (Yildiz, 2025). Furthermore, Cognitive Load Theory underscores the importance of optimising instructional design to manage cognitive load, particularly for complex linguistic concepts (Nguyen, 2024) and is crucial for designing instructional materials that optimise working memory capacity by managing intrinsic, extraneous, and germane cognitive loads (Gao, 2025). These theoretical underpinnings guide the development of a Technology-Integrated Model, which leverages interactive applications, multimedia presentations, and gamified platforms to visualise abstract English concepts, thereby addressing the challenges of linguistic diversity and cognitive load in multilingual classrooms (GARCIA & Cruz, 2025; Lian, 2025).

Methodology

This study employed a mixed-methods, Design-Based Research (DBR) approach to capture the complexities of the educational context. DBR is particularly suitable for this investigation as it focuses on developing practical, evidence-based solutions to real-world educational problems through iterative cycles of design, implementation, and refinement (Bacovsky-Novak, 2023). Reeves (2006) noted that DBR effectively bridges the gap between educational research and practice, facilitating the evolution of instructional strategies within authentic learning environments. The methodology integrates both quantitative and qualitative data collection to comprehensively evaluate the impact and efficacy of the developed technological interventions in enhancing English language proficiency (Muslimin et al., 2024; Wahyuni et al., 2020).

Semi-structured teacher interviews, a key qualitative component, were utilised to gather in-depth insights into participants' experiences and perceptions of the technology-enhanced language learning interventions (Refat et al., 2025). Diagnostic assessments along with learning preferences, including perceived ease of use and usefulness, were quantitatively measured to determine the interventions' effectiveness and user acceptance, aligning with the Technology Acceptance Model (Mulyanah et al., 2025).

Participants

Teachers: Six middle school English language teachers from a private school in the UAE participated in a questionnaire. Their experience ranged from 15 to 25 years, and they taught Grades 6-8 in highly diverse classrooms.

Students: Thirty-three Grade 7 students participated in a "complex English concepts" practice quiz and a learning preferences survey. The student body represents a linguistically diverse population with home languages including but not limited to Arabic, Hindi, Tamil, Malayalam, Urdu, and Tagalog.

Instruments:

Teacher Semi-structured Interview Questionnaire: An open-ended questionnaire exploring teaching context, challenges in teaching complex concepts, impact of multilingualism, student engagement, current technology use, and professional development needs.

Student Concept Analysis & Learning Preference Quiz: A two-part online quiz. Part 1 assessed student understanding of complex English concepts (e.g., grammar, figurative language, reported speech) through 20 multiple-choice and fill-in-the-blank questions. Part 2 gathered data on their preferred learning modalities (e.g., visual, collaborative, and independent).

Data Analysis:

Qualitative data from teacher questionnaires were analysed using thematic analysis. Quantitative data from student quizzes were analysed using descriptive statistics (mean scores, frequency distributions).

Results

The results from both teacher and student datasets reveal converging themes regarding challenges and potential solutions.

Teacher Perspectives

Thematic analysis of teacher responses identified four key themes:

Abstract Nature of Content: Educators consistently underscored students' challenges in grasping abstract concepts. One participant observed, "Students find grammar rules, idioms, and figurative language difficult to understand," while another emphasised that "abstract concepts like idioms or figurative language can still be tricky even for proficient speakers." Traditional pedagogical approaches were regarded as inadequate for rendering these concepts concrete.

Linguistic Diversity as a Double-Edged Sword: Teachers recognised that linguistic diversity profoundly shapes comprehension of abstract concepts. One educator noted that learners often interpret such ideas variably according to their native language grammars. A Grade 6 teacher illustrated this challenge: Arabic-speaking students may struggle with sentence structure and verb tenses because Arabic follows different grammar patterns... Indian students... might face challenges with spelling and pronunciation. Nonetheless, another teacher underscored a constructive facet, observing that diversity "also helps students learn from each other."

Disengagement with Traditional Methods: Teachers reached a strong consensus that lecture-based and textbook-centric pedagogies foster low student engagement. Educators reported that students "lose interest in lecture-based teaching," "find it difficult to analyse, deduce and infer," and "often depend on memorisation instead of understanding." One teacher illustrated this phenomenon: "In writing tasks... students may find it difficult to organise their thoughts, use correct grammar, or support their answers with examples."

Demand for Visual, Gamified, and Collaborative Tools: When asked about effective digital tools, responses consistently pointed to strategies that make learning active and concrete.

Gamification: "Gamification seems to be the most effective. Then come challenging activities like quizzes" (Teacher 1).

Visualisation & Collaboration: "Visuals, videos, and interactive tools help students understand concepts better," "Concept maps, collaboration tools" (Teacher 5), and "Mind maps, graphic organisers, and storyboards help students see connections between ideas" (Teacher 6).

SAMR Transformation: Teachers saw the SAMR model as a way to "move beyond simple use of devices to more meaningful learning experiences" and "cater to students of different learning abilities" (Teacher 6).

Student Performance and Learning Preferences

The student quiz provided a quantitative lens for validating teacher observations and revealing student preferences.

Table 1: Grade 7 Student Performance on Complex English Concepts (N=33)

Concept Area Tested	Sample Question Type	Average Score (out of max for that section)	Notes
Vocabulary in Context	Fill in the blank (6 items)	5.2 / 6 (87%)	Strong performance; students generally grasp word meaning from context.
Grammar & Mechanics	Punctuation, reported speech, subject-verb agreement, adverbs, phrases, clauses (12 items)	8.1 / 12 (68%)	Significant gaps – especially in subject-verb agreement (27% correct) and reported speech (58% correct).
Literary Analysis	Theme, prediction, simile identification (6 items)	4.2 / 6 (70%)	Moderate; students can identify similes but struggle with inferring theme.
Learning Preferences	3 items (not scored for correctness)	–	Used for qualitative analysis.
Average Overall Score	(30 points total)	21.9 / 30 (73%)	The overall average masks critical weaknesses in foundational grammar and literary interpretation.

Note: While the overall average appears high, deeper analysis reveals significant gaps in specific foundational areas. The performance on Subject-Verb Agreement and Reported Speech indicates critical areas of difficulty.

The analysis of student learning preferences (N=33) provided a clear directive for instructional design.

Table 2: Grade 7 Student Learning Preferences

Learning Modality	Percentage Preference (Top 2 Choices)
Collaborative & Game-Based Learning	49%
Visual Learning (Diagrams, Mind Maps)	24%
Video/Animation-Based Learning	18%
Teacher Explanation & Note-Taking	9%

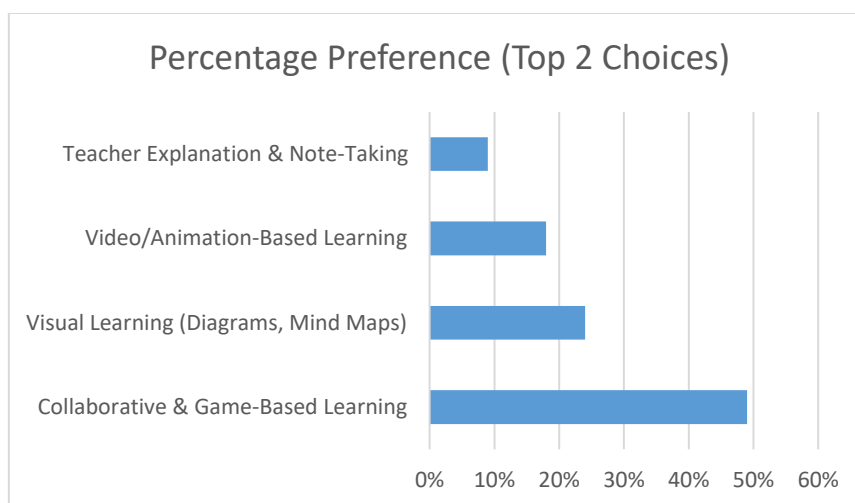


Figure 1: Preferred Modalities for Understanding Complex English Concepts

These preferences strongly align with the teachers' recommendations. Students are not just asking for "more fun," but for specific, research-backed strategies: collaboration to navigate language barriers and games/visuals to reduce cognitive load and make abstract concepts concrete.

Discussion

The outcomes of this inaugural Design-Based Research phase underscore a substantial misalignment between prevailing instructional approaches and the exigencies of learners in linguistically heterogeneous UAE classrooms.

The findings from this initial Design-Based Research phase indicate a pronounced discrepancy between prevailing pedagogical practices and the needs of learners in linguistically diverse UAE classrooms. Teacher-reported student performance data substantiate these challenges: while proficiency is evident in basic vocabulary assessments, difficulties with core grammatical structures—such as subject-verb agreement and reported speech—expose foundational deficits that impede the articulation of complex ideas. The overall average score of 73% obscures these underlying weaknesses, emphasising the imperative for targeted interventions. This phenomenon aligns with cognitive load theory, wherein learners overwhelmed by rudimentary mechanics are precluded from engaging with deeper semantic content.

Secondly, students' pronounced preference for collaborative and gamified learning modalities aligns with constructivist principles and the inherently social dimensions of knowledge construction (Mulyanah et al., 2025; Vega et al., 2023). In linguistically diverse classrooms, peer interactions enable learners to co-construct meaning, employing their home languages as scaffolds to access target language proficiency. Moreover, the emphasis on visual aids is consonant with Dual Coding Theory (Mulyanah et al., 2025; Yıldız, 2025), as integrating abstract linguistic rules with concrete visual representations renders elusive concepts tangible,

thereby mitigating cognitive load for English as an Additional Language learners (Gao, 2025; Nguyen, 2024).

Thirdly, the advocacy for technological integration, particularly as conceptualised within the SAMR framework, prioritises profound pedagogical transformation over mere novelty. Educators recognise that deploying smartboards as "digital worksheets" fails to address deficits in student engagement and comprehension. Rather, they envision technology facilitating the "Modification" and "Redefinition" levels of SAMR. Although current utilisation of platforms such as Nearpod, Wordwall, and Kahoot corresponds to their initial stages, teacher and student data indicate preparedness for advancing to higher-order transformations that harness interactivity and collaboration to accommodate diverse learner needs.

Conclusion and Future Directions

This research substantiates the multifaceted challenges inherent in instructing intricate English language concepts to linguistically heterogeneous middle school learners in the UAE. Learners grapple with abstract notions, compounded by their diverse linguistic repertoires and predominantly remediated through suboptimal traditional pedagogies. The integration of teacher perceptions and empirical student data delineates an evidence-based imperative: pivoting to a technology-infused instructional paradigm—visual, collaborative, and gamified—that transcends superficial substitution toward profound pedagogical redefinition, as articulated in the SAMR framework.

This paper represents the initial "problem identification" and "solution formulation" stages of a larger Design-Based Research project. The next phases (enactment and appraisal, and assessment and contemplation) will involve:

1. **Developing a Technology-Integrated Model:** Creating a practical teaching model that uses digital tools to explicitly teach abstract concepts through visualisation and collaborative tasks.
2. **Designing a Professional Development Program:** A hands-on PD program for teachers focused on applying the SAMR model to transform their teaching of complex English concepts.
3. **Implementation and Evaluation:** Piloting the model and PD in middle school classrooms, collecting data on its impact on student engagement, conceptual understanding, and academic performance.

The ultimate goal is to provide educators, curriculum architects, and policymakers with contextually attuned, research-validated interventions to augment English language proficiency among heterogeneous middle school cohorts in the UAE and analogous multicultural scholastic contexts.

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ENZYME ASSAYS ON ANTIDIABETIC PROPERTIES OF TEBU GAJAH (ALBIZIA MYRIOPHYLLA) DRIED JELLY

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Abstract: *Tebu Gajah is a plant with high potential as a traditional medicine in Southeast Asia and is believed to have some antidiabetic properties due to a high phytochemical composition, especially phenols and flavonoids. The objective of this research paper was to identify and determine the α -amylase inhibitory property of the Tebu Gajah dried jelly extract in different concentrations and then compare the α -amylase inhibitory property of the extract with the α -amylase inhibitory property of the pure plant extract. The inhibition strength will be further determined by comparing the IC₅₀. Tebu Gajah pure extract and dried jelly were crudely extracted with 70% ethanol. These extracts were further treated with 10, 5, 2.5, 1.25, and 0.625 mg/mL. α -Amylase inhibition was performed using the iodine-starch colorimetric system where the absorbance value was measured at 620 nm. The % inhibition, strength of inhibition (IC₅₀), and % inhibition correlation were determined. The results showed that in all Tebu Gajah samples, inhibitory activity was dose-dependent. Pure extract exhibited the best inhibitory value of 72.09 % at 10mg/mL, then dried jelly extract 2 and 1 with values 56.83 % and 54.29 %, respectively. Even with reduced inhibitory potency due to the presence of the transformation process of dried jelly, it was observed that both forms of the jelly are efficient inhibitors of the enzymes. The level of the extracts and percentage inhibitions showed a positive correlation, which was more pronounced in the dried extracts. Consequently, there was a conclusion drawn to imply that the dried form of Tebu Gajah jelly has the ability to inhibit α -amylase in a functional food in regulating starch and glucose. However, more research would be needed in phytochemicals and in vivo studies concerning its use in Antidiabetes.*

Keywords: *Tebu Gajah, α -amylase, enzyme inhibition, dried jelly, antidiabetics*

Introduction

Tebu Gajah (Albizia myriophylla) is a popular Malay traditional medicine plant, found in most of the Southeast Asian nations, and commonly utilized to treat fever, inflammations, urinary tract infections, and diabetes. The phytochemical analyses show that the plant is enriched with high concentrations of polyphenols, flavonoids, and other bioactive compounds that have antidiabetic potential. These compounds have been demonstrated to prevent the action of α -amylase and α -glucosidase, which breaks carbohydrates down into smaller units, maltose, maltotriose, and dextrins, which are further disintegrated to glucose through the activity of intestinal enzymes, including maltase and isomaltase (Bernfeld, 1955). As α -amylase triggers the process of starch digestion, its inhibition can slow down the process of the release of glucose in the blood, which is why α -amylase inhibitors are relevant in postprandial glucose

regulation and the treatment of diabetes (Tundis et al., 2010). Enzyme assays are basic biochemical tools employed to measure enzyme activity, inhibition kinetics and bioactivity of plant-derived compounds. According to previous research, *Tebu Gajah* extract can be used as a natural alternative to Acarbose synthetic antidiabetic medications, which may reduce the postprandial hyperglycemia rate with a smaller number of gastrointestinal side effects (Joycharat et al., 2018).

The rapid prevalence of diabetes around the world is increasing and it is under stress to have safe and effective alternative therapies. Despite the common understanding that natural products are potential carbohydrate-digestive enzyme inhibitors (Tundis et al., 2010), the scientific data on the antidiabetic effect of *Tebu Gajah* (*Albizia myriophylla*) is insufficient, even though the latter has been used traditionally long before (Joycharat et al. 2017; Sa'at et al., 2013). Early phytochemical evidence suggests that the plant has flavonoids, saponins and phenolic acids that are linked to enzyme inhibition, antioxidant and insulin sensitization. There is however little research on its α -amylase inhibitory activity, especially in processed forms like dried jelly. Thus, the proposed study will assess the α -amylase inhibitory property of the *Tebu Gajah* dried jelly extract by comparing the inhibitory activity at various concentrations of the extract to the pure extract, percent inhibition of α -amylase at various concentrations, and strength of inhibition by analyzing its enzyme activity in the presence of the jelly extract.

Materials and Methods

Preparation of Tebu Gajah Dried Jelly Crude Extract (Maceration Using Ethanol)

The *Tebu Gajah* dried jellies were collected and made by the other students in order to determine the antidiabetic qualities. The ground *Tebu Gajah* dried jellies were powdered using a blender to increase the number of areas where they can be extracted. 50 g of powdered jelly was weighed in an analytical balance and 50 g of powdered jelly was put in a clean beaker. To extract it, 500 mL of 70 % ethanol was subsequently put into the powdered jelly in a 1:10 (w/v) proportion. The mixture is wrapped and left to soak at room temperature (between 48 to 72 hours). This period was done through shaking of solution after every 12 hours or by putting the solution in a shaker in order to experience continuous agitation to ensure that there is sufficient solute-solvent interaction. The mixture was then filtered using a funnel lined with filter paper to drain the solid residue. This filtration was repeated again in case of necessity to achieve clear filtrate. The product is filtered and then moved to petri dishes and allowed to dry in a fume hood at room temperature until all solvent is removed. The difference between the weight of the crude extract and the weight of the empty petri dish is used to calculate the weight of the crude extract.

Serial Dilution of Tebu Gajah Crude Extract Solution

Five clean experimental tubes Coded A, B, C, D and E. The pure solution of *Tebu Gajah* extract in another tube. To make the serial dilutions, 1.5 mL of the stock solution (10 mg/mL) was set in Tube A. This tube will be the pure sample and it will be the highest level of the dilution series. Tube A solution was added to Tube A (0.5 mL) and phosphate buffer (1.0 mL) was added. It was thoroughly combined up to the concentration of 5 mg/mL. Then, 0.5 mL of

Tube B was immediately transferred to Tube C and 1.0 mL of buffer was added to the mixture. The mixture was gently mixed up to reach a final concentration of 2.5 mg/mL. Serial dilution This step was repeated where 0.5 mL of the contents of Tube C was added to Tube D and 1.0 mL of buffer added to dilute the contents so that the final concentration was 1.25 mg/mL. Finally, 0.5 mL of Tube D was transferred to Tube E and mixed with 1.0 mL of buffer producing the weakest dilution in the series of 0.625 mg/mL. Each tube was then shaken to homogeneity after dilution and the next step carried out. The entire solutions were made and kept in the chiller awaiting to be utilized in enzyme assays.

Solutions Preparation (α -Amylase Enzyme, 1% Soluble Starch, Iodine Reagent)

The α -amylase enzyme solution was made by adding 0.5 mL (500 μ L) of enzyme into a 50 mL volumetric flask before adding a phosphate buffer to dilute it to volume (49.5 mL). The mixture was then mixed softly in order to have a uniform distribution without excessive mixing which would lead to denaturation of the enzyme. Enzyme solutions were prepared and kept on ice during enzyme assays in a closed container at 4°C temperature to retain the activity and the rest of the enzyme solution was kept at 4°C and consumed within a few days.

The 1 percent soluble starch solution was made by adding 0.2 g of soluble starch to 2 mL of cold distilled water in order to develop a slurry. Individually, 18 mL of distilled water was warmed to 60-70°C and more slowly added to the slurry with constant stirring up until a clear solution was achievable. The solution was cooled down to room temperature, then diluted with 50 mL of distilled water and mixed completely and then refrigerated at 4°C for up to 1-2 days (Sapkota, 2024).

The iodine solution was made by adding 0.332g of potassium iodide (KI) to 5-6mL of distilled water and adding 0.254g of iodine crystals gradually with constant stirring until the thick dark brown solution was obtained. The mixture was poured into a 10 mL volumetric flask, diluted to volume with distilled water, swirled, and put in an amber bottle at 4°C to avoid light degradation (Sapkota, 2024).

α -Amylase Inhibition Assay (Iodine-Starch Method)

In order to establish the enzyme assay, 3 different preparations were conducted, which include the blank, control and sample reaction. In a clean test tube, a blank was prepared by combining 1.0 mL of soluble starch solution (1%), and 2.0 mL of phosphate buffer (pH 7.2). 2-3 drops of 0.1 M iodine solution were then added to it. This mix contains no enzyme or extract and is used to correct any background absorbance. In the control, which determines the full activity of α -amylase enzyme in the absence of an inhibitor, 1.0 mL of a 1% soluble starch solution was combined with 1.0 mL of α -amylase solution and 1.0 mL of phosphate buffer (pH 7.2). The mixture was left to incubate at the optimum temperature of 37°C between 15 and 30 minutes. After the incubation, 2-3 drops of 0.1 M iodine solution were then put into the tube in order to test the amount of unhydrolyzed starch in the tube.

To investigate the inhibitory effect of Tebu Gajah dried jelly extract, the sample preparations were investigated. 1.0 mL of 1% soluble starch solution, 1.0 mL of α -amylase and 1.0 mL of

the Tebu Gajah dried jelly extract at different concentrations (A,B,C,D,E) were added to each sample tube. The sample groups were incubated at 37°C between 15 to 30 minutes with the same conditions as the control. After incubation, 2-3 drops of 0.1 M iodine were put into each sample tube. A spectrophotometer was used to analyze all the tubes blank, control and sample. To identify the quantity of starch that remained after the process, absorbance was taken at 620 nm in order to observe the colour, which indicates the action of enzyme and any inhibitory influence of the extract on α -amylase (Febriyanti et al., 2025).

Calculation of Inhibition Percentage and Inhibition Strength

The percentage inhibition of α -amylase was calculated using Equation 1 below:

$$[(\text{Absorbance of sample} - \text{Absorbance of control}) / (\text{Absorbance of blank} - \text{absorbance of control})] \times 100\%$$

This formula determines the extent to which the inhibitor reduces enzyme activity relative to the total activity range. The difference between the sample and control absorbance represents the reduction in enzyme activity caused by the inhibitor, while the difference between the blank and control reflects the maximum enzyme activity within the assay system. The calculated value is expressed as a percentage to indicate the inhibitory effect. Subsequently, inhibition percentages were plotted against the concentrations of the jelly extract to generate an inhibition curve. The inhibition strength was determined using the IC_{50} value, defined as the concentration of extract required to inhibit 50% of α -amylase activity. The IC_{50} was identified from the concentration corresponding to 50% inhibition on the curve, where a lower IC_{50} indicates stronger inhibitory potency.

Statistical Analysis

Once the data is collected, the data is analyzed for correlation to ensure the data is significant or not. Correlation analysis was used to measure the strength and direction of the relationship between two continuous variables. The correlation coefficient (r-value) shows whether the relationship is positive, negative, or weak. Therefore, correlation provides a clearer understanding of the experiment. It shows how one variable changes in relation to another. Therefore, correlation in providing strong evidence to support the interpretation and conclusion of the experiment's findings.

Results and Discussions

Effect of Concentrations on Absorbance Value (Amount of remaining starch)

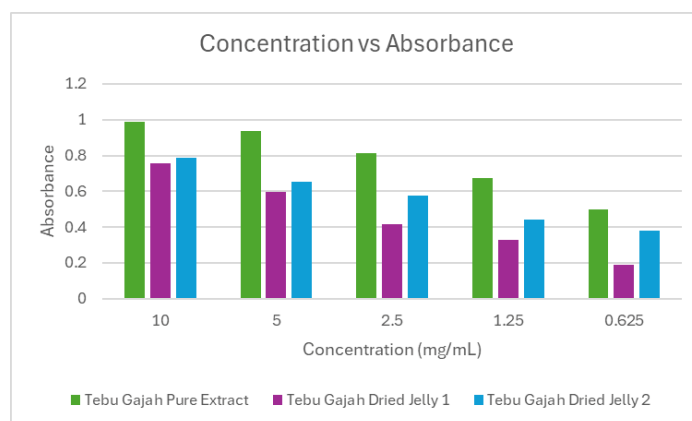


Figure 1: Concentration vs Absorbance (Remaining starch)

Figure 1 shows the concentration dependent α -amylase inhibitory activity of Tebu Gajah (*Albizia myriophylla*) samples (Pure Extract, Dried Jelly 1 and Dried Jelly 2) when tested at 0.625-10 mg/mL. In the iodine-starch test, the greater the absorbance, the more starch will remain undigested and the greater will be the inhibition of the enzyme. The control sample was associated with the lowest absorbance (0.046), which means maximum starch hydrolysis and a complete α -amylase activity.

The Pure Extract had the highest absorbance at all concentrations (0.986 at 10 mg/mL), which is the strongest inhibitor. Dried jelly formulations also exhibited an inhibitory effect that could be measured, and at lower and intermediate concentrations, Dried Jelly 2 exhibited a slightly stronger absorbance than Dried Jelly 1. Even though there was a reduction in the inhibitory activity in processing into jelly relative to the Pure Extract, the remaining activity of Tebu Gajah-based products confirms the potential of these products as functional foods in the regulation of starch digestion and postprandial glucose to meet Objective 1.

α -Amylase Inhibition Percentage (%)

The α -amylase inhibitory activity of Tebu Gajah extract was evaluated at various concentrations to determine its potential effect on carbohydrate-digesting enzymes. The inhibition percentage was calculated using Equation in 2.4. The results (Figure 2) show that Pure Tebu Gajah extract exhibited the highest α -amylase inhibition across all concentrations, ranging from 34.82% at 0.625 mg/mL to 72.09% at 10 mg/mL.

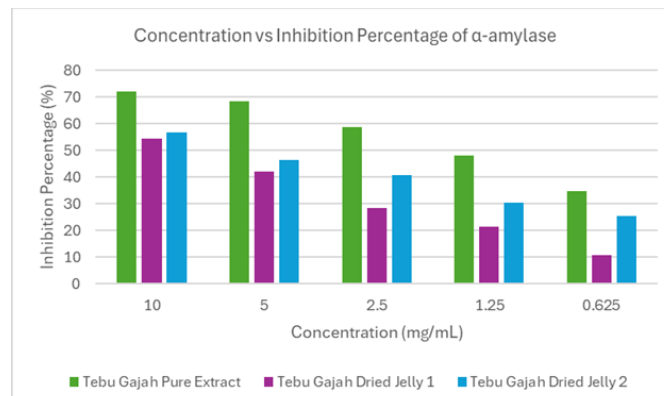


Figure 2: Concentration vs Inhibition Percentage

This study compared the α -amylase inhibitory property of Tebu Gajah dried jelly extracts at 0.625-10mg/mL of concentration. These findings (Figure 2) revealed a distinct dose-dependent inhibition with the higher the concentration, the more the inhibitory effect. The Pure Extract showed the greatest inhibition of 72.09% at the highest concentration of 10 mg/mL, followed by the Dried Jelly 2 (56.83) and 1 (54.29) at 10 mg/mL. This tendency indicates that bioactive molecules present in Tebu Gajah react with the enzyme and inhibit the hydrolysis of starch. The inhibitory capacity of Tebu Gajah is in the moderate category of plant-based α -amylase inhibitors as compared to literature reports. *Spondias mahagoni* is an example of plant extract with higher inhibition (approximately 77.5%), and others have much lower levels (Febryanti et al., 2025). Pharmaceutical inhibitors such as acarbose usually reach greater levels of inhibition (80-90%) (Chiasson et al., 1994), but the moderate effects of Tebu Gajah could be beneficial since there is a risk of side effects in the gastrointestinal system caused by stronger inhibitors. Probably the factor causing the inhibition is due to the phytochemicals which include phenolic compounds and flavonoids which may bind to enzyme active or allosteric sites and decrease catalytic activity. On the whole, the Tebu Gajah dried jelly extracts show concentration-dependent α -amylase inhibition, which justifies the potential of these products in natural functional foods to modulate the digestion of starch and control the postprandial glucose level.

Table 1: Correlation between concentration and inhibition percentage

Sample	Correlation Coefficient (r)	p-value
Pure Extract	0.852	0.0668
Tebu Gajah Dried Jelly 1	0.957	0.0106
Tebu Gajah Dried Jelly 2	0.951	0.0129

Table 1 presents the correlation analysis demonstrating the concentration-dependent inhibition activity of *Tebu Gajah* samples. The Pure Extract showed a strong positive correlation ($r = 0.852$) between concentration and inhibition activity, although it was not statistically significant ($p = 0.0668$), possibly due to the small sample size or variation in bioactive compound composition. In contrast, both processed samples showed very strong and statistically significant correlations: Dried Jelly 1 ($r = 0.957$, $p = 0.0106$) and Dried Jelly 2 ($r = 0.951$, $p = 0.0129$). These findings indicate that increasing extract concentration enhances the inhibitory activity, likely due to higher levels of phenolic and flavonoid compounds.

Overall, the correlation analysis confirms that concentration plays a significant role in determining the bioactivity of *Tebu Gajah*-based products.

Inhibition Strength (IC₅₀)

In order to measure the inhibitory strength of *Tebu Gajah* extracts further, half-maximal inhibitory concentration (IC₅₀) was calculated. IC₅₀ is the concentration of extract that can prevent 50% of the α -amylase activity and it is commonly employed to compare the efficacy of enzyme inhibitors. When the value of IC₅₀ is low, the inhibition is greater, which is an indication of greater bioactivity of the extract. In this experiment, the degree of inhibition of α -amylase by Pure *Tebu Gajah* extract and two dried jelly extracts at different concentrations was used to obtain the IC₅₀ values. These findings give a quantitative determination of the strength of the inhibition and can be used to directly compare the extracts between themselves and with the standard controls or those of literature-reported plant inhibitors and to be able to evaluate their potential as useful functional antidiabetic agents.

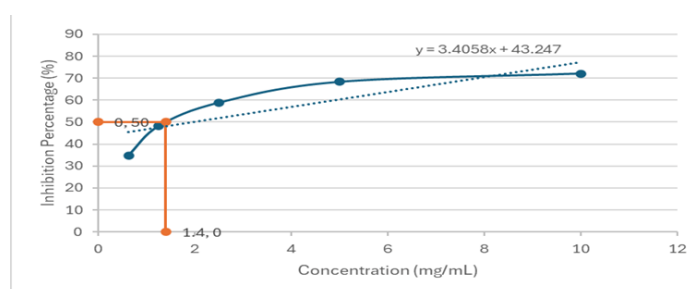


Figure 3: : IC₅₀ graph of *Tebu Gajah* Pure Extract

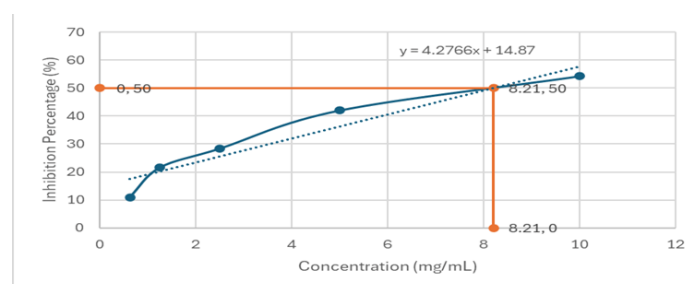


Figure 4: IC₅₀ graph of *Tebu Gajah* Dried Jelly 1

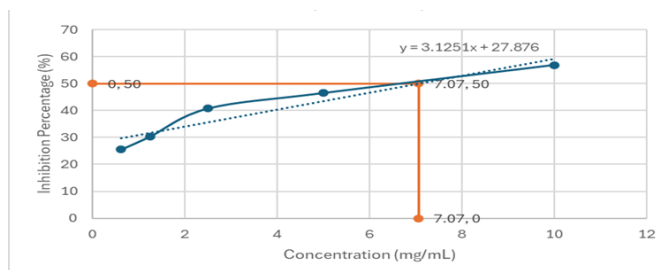


Figure 5: IC₅₀ graph of *Tebu Gajah* Dried Jelly 2

The strength of *Tebu Gajah* samples was determined with the help of the concentration of the sample which inhibits 50 percent of the enzyme activity as the IC₅₀ value. The lower the IC₅₀ the stronger the action of the inhibition. The Pure Extract was the most potent with the IC₅₀ value of 1.47 mg/mL (Figure 3), which implies that the extract contains a high level of active phytochemicals including phenolic acids and flavonoids that make it bioactive. Comparatively, Dried Jelly 2 and Dried Jelly 1 had a lower IC₅₀ value of 7.07mg/mL and 8.25mg/mL, respectively (Figures 4 and 5), which implies less inhibitory potential. This loss can be explained by the degradation or dilution of bioactive compounds during processing, such as heat, oxygen, dehydration, and the introduction of food substances such as sugars. But slightly more activity was observed in Dried Jelly 2 than in Dried Jelly 1 indicating that phytochemical stability can be affected by the processing conditions and formulation. On the whole, the findings show that minimum processing leaves more bioactive compounds and leads to a more potent biological activity. These results emphasize the need to maximize the processing procedures in order to preserve the health-promoting qualities of *Tebu Gajah*-based businesses.

Conclusions

In conclusion, this research conducted a comparison of the α-amylase inhibitory activity of *Tebu Gajah* (*Albizia myriophylla*) in pure extract and dried jelly preparations under iodine-starch assay. The findings revealed a distinct concentration-dependent inhibition of α-amylase in all the samples suggesting the existence of bioactive compounds that have the ability to control the digestion of starch. The Pure Extract showed the most significant inhibitory activity as shown by the increasing absorbance values, the percentage inhibition and the lowest IC₅₀ (1.47 mg/mL) value among the samples. This indicates that the pure extract has a greater amount of active phytochemicals like phenolic and flavonoid compounds. The dried jelly formulations still had α-amylase inhibitory activity, which was less effective than the pure extract. Such a decrease can be explained by processing conditions like heat exposure, dehydration, oxidation and dilution in formulation additives that may diminish the stability and concentration of bioactive compounds. Dried Jelly 2, however, showed a little more inhibition as compared to Dried Jelly 1 which showed that formulation and processing conditions can help to preserve phytochemicals. Correlation analysis has also revealed that there was a strong positive relationship between extract concentration and percentage of inhibition especially in the dried jelly samples thus proving that higher concentration boosts inhibitory activity. In general, these results indicate that *Tebu Gajah* has potential as a natural α-amylase inhibitor and has prospects as a functional food ingredient in the regulation of starch

digestion and postprandial glucose.

On the basis of these results, a follow-up research is suggested in order to justify the development and use of Tebu Gajah as a functional antidiabetic ingredient. Future research on this topic should include a thorough phytochemical profiling through the applications of analytical methods including Gas Chromatography-Mass Spectrometry (GC-MS), High-Performance Liquid Chromatography (HPLC) or Liquid Chromatography-Mass Spectrometry (LC-MS) to determine and quantify the identity of the specific bioactive compounds that result in the observed inhibitory effect. Determining the connection between these compounds and the inhibition of enzymes would improve the processes of extraction and processing and facilitate the standardization of formulations. Moreover, further research must involve the development of functional foods by optimizing formula of dried jelly, sensory analysis on consumer acceptability of the product and shelf-life research to establish the stability of bioactive compounds in storage. Their product formulation should also be standardized and additional biological testing, such as in vivo tests, should be conducted to confirm the antidiabetic nature of Tebu Gajah and facilitate its use in functional foods and nutraceutical products.

Acknowledgement

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RECONSTRUCTING INTERNATIONAL AUDIENCES' COGNITION OF CHINESE CULTURE: THE EFFECTS OF LI ZIQI'S INTANGIBLE CULTURAL HERITAGE SHORT VIDEOS ON STEREOTYPE DISMANTLING AND CURIOSITY ACTIVATION

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Abstract: *This qualitative study examines how Li Ziqi's intangible cultural heritage (ICH) short videos reshape international audiences' perceptions of Chinese culture. Drawing on semi-structured interviews with 15 participants from 10 countries and pre-post cognitive contrast data, the study identifies two major cognitive reconstruction effects. First, the videos dismantle monolithic stereotypes that associate China primarily with technological modernity. Second, they activate cross-cultural curiosity and stimulate active cultural exploration behaviors. In addition, bicultural participants demonstrate deeper interpretive engagement than monocultural audiences. The findings highlight the role of everyday-embedded heritage representation in reducing cultural distance and promoting intercultural understanding.*

Keywords: *Li Ziqi's ICH Videos; International Audiences; Bicultural Audiences; Cultural Cognition Reconstruction; Cross-Cultural Perception*

Introduction

Global audiences' understanding of Chinese culture is frequently shaped by fragmented, skewed media representations, leading to persistent cultural stereotypes. Prior research indicates that many overseas viewers associate China primarily with cutting-edge technologies (e.g., high-speed rail, mobile payment systems) and sprawling metropolises (e.g., Shanghai, Beijing), with limited awareness of the richness and vitality of traditional intangible cultural heritage. This one-dimensional cognitive bias not only impedes the holistic dissemination of Chinese culture but also undermines the potential for equitable, in-depth cross-cultural dialogue (Scollon & Scollon, 2013).

The rise of short-video platforms has fundamentally reshaped global cultural communication: Algorithm-driven recommendation systems (e.g., TikTok) enable rapid circulation of audiovisual content and enhance audience engagement, providing unique advantages for

cultural dissemination (Cao, 2025). Li Ziqi's ICH-themed videos leverage these platform advantages: As Whyke et al. (2022) note, video-sharing platforms like YouTube and TikTok use a universal audiovisual language that enhances intercultural communication, and Li's content effectively capitalizes on this medium. Unlike traditional cultural communication content that relies on grand narratives, Li's videos embed ICH practices into mundane daily scenarios: making osmanthus cakes in autumn, crafting handmade paper for Spring Festival couplets (traditional Chinese festive decorations with calligraphy of auspicious phrases), and weaving bamboo baskets for household storage. These depictions present a "lived-in" and perceptible portrait of Chinese traditional culture (Zhang & Wang, 2021). However, empirical research examining how digital heritage videos reshape international audiences' cultural cognition and stereotypes remains limited.

Building on data from a larger-scale study of cross-cultural ICH symbol interpretation, this paper centers on the cognitive shifts of international audiences before and after viewing Li Ziqi's ICH videos. It addresses two core research questions: (1) How do Li's ICH videos dismantle the entrenched cultural stereotypes of international audiences? (2) What mechanisms drive the activation of cross-cultural curiosity and subsequent active exploration behaviors among viewers? Drawing on cognitive contrast data from key participants (including Russian Olya, Bruneian Stanley, and bicultural respondent Amja), the study verifies the cognitive reconstruction value of ICH short videos and offers theoretical insights for targeted Chinese cultural content dissemination.

Literature Review

Cultural Stereotypes of China in International Media Discourse

Scholarship on international perceptions of Chinese culture has consistently documented the prevalence of one-dimensional stereotypes. Early studies by Zhang and Wang (2021) noted that Western media coverage of China tends to prioritize technological advancement and urban modernization, framing the country as a "tech powerhouse" while sidelining its traditional cultural heritage. This skewed framing has led many low-cultural-exposure audiences to equate Chinese culture with modern infrastructure and digital innovation, with little awareness of traditional practices such as bamboo weaving, indigo dyeing, or ancient papermaking (Ge et al., 2024).

For instance, Zhang and Wang (2021) found that over 60% of low-cultural-exposure Western audiences associate China primarily with high-speed rail and e-commerce, with no awareness of traditional ICH practices. However, recent research highlights the critical role of digital platforms in mitigating such stereotypes: Ge et al. (2024) demonstrate that video-streamed representations of intangible cultural heritage (ICH) can foster positive intercultural attitudes and help mitigate stereotypes. As Whyke et al. (2022) observe, video-sharing platforms employ a universal audiovisual language that resonates with transnational audiences, thereby helping to contextualize unfamiliar cultural symbols. Such stereotypes, rooted in limited and biased media exposure, create barriers to a holistic understanding of China's cultural diversity (Hofstede Insights, 2023; Hofstede, 2011).

Digital Cultural Content and Cross-Cultural Cognitive Change

Digital media's role in reshaping cross-cultural cognition has garnered growing academic attention (Li, 2022). Braun and Clarke (2019) argued that multimodal digital content—combining visual, auditory, and narrative elements—can bypass linguistic barriers to foster deeper cultural engagement, particularly when content is grounded in relatable daily experiences. In the context of heritage communication, existing literature has proposed that cultural content tied to audiences' daily lives is more likely to arouse curiosity and drive further active learning—particularly when integrated with sensory and narrative cues (Braun & Clarke, 2019).

Whyke et al. (2022) further demonstrated that Li Ziqi's ICH videos, which embed traditional crafts into domestic routines, have enhanced global audiences' awareness of Chinese heritage, though the study did not explore the specific mechanisms of stereotype dismantling or long-term cognitive change. Scholarly work on multimodal cultural discourse has complemented this by identifying how sensory and narrative cues in short videos can reshape audience cognitive frameworks by connecting unfamiliar cultural elements to universal human experiences (e.g., family care, seasonal labor). Additionally, Castillo-Montoya (2016) emphasized that targeted stimulus materials (such as key video frames) can help audiences articulate cognitive shifts more clearly, which provides methodological support for tracking cultural cognition changes in this study.

Bicultural Audiences as Mediators of Cultural Cognition

Bicultural individuals, who possess dual cultural identities and flexible cognitive schemas, have long been identified as critical intermediaries in cross-cultural communication (Berry, 2017). Grounded in Berry's acculturation theory, bicultural people exhibit the unique capacity to integrate two distinct cultural systems and switch between cognitive perspectives, enabling them to interpret unfamiliar cultural content through multiple lenses. Empirically, Li (2022) notes that Li Ziqi's videos facilitate global audiences' active construction of cultural meaning, which supports the idea that viewers with bicultural frameworks are particularly adept at drawing parallels between traditional Chinese practices and their own heritage.

This capability allows them to bridge interpretive gaps between high-context and low-context cultural groups, as they can contextualize unfamiliar cultural symbols within both their native and host cultural frameworks.

However, research on how bicultural audiences' cognitive depth differs from that of monocultural audiences in the context of Chinese cultural cognition remains underdeveloped, leaving a gap in understanding the heterogeneity of cross-cultural cognitive responses to digital heritage content (Malterud et al., 2016). Creswell and Poth (2018) noted that phenomenological qualitative designs are particularly suited to exploring such differentiated cognitive experiences, as they prioritize the subjective meaning-making processes of individual participants from diverse cultural backgrounds.

Theoretical Dialogue: Complementarity and Boundaries of Core Frameworks

To address the fragmented application of theories in prior research, this section clarifies the complementarity and interpretive boundaries of three core theoretical frameworks. Hall's (1976/2018) high-low context theory explains the process of cultural cognition formation and initial interpretation—low-context audiences rely on explicit, decontextualized media information to form stereotypes, while high-context audiences are attuned to implicit cultural cues. In contrast, Hofstede's (2011) cultural dimension theory (updated via Hofstede Insights, 2023) illuminates the value roots of cognitive differences: collectivist cultural groups prioritize relational and communal cultural elements (e.g., intergenerational craft inheritance), while individualist groups focus on technical or utilitarian aspects of heritage. Berry's (2017) bicultural identity theory fills the gap in explaining cognitive depth variations, as bicultural audiences' dual schema enables cross-contextual comparison that monocultural audiences cannot replicate. Together, these frameworks form a “cognition formation-interpretation-depth differentiation” chain, avoiding the one-sided theoretical application common in existing scholarship.

Methodology ***Research Design***

This study adopts a phenomenological qualitative design with a pre-post cognitive contrast framework, focusing on the subjective cognitive experiences of international audiences before and after viewing Li Ziqi's ICH videos. The design prioritizes in-depth exploration of individual cognitive shifts, aligning with Creswell and Poth's (2018) emphasis on contextualized understanding of human experiences in qualitative inquiry. The research integrates pre-viewing cultural cognition pre-tests, semi-structured interviews with cognitive change tracking, and thematic coding to systematically capture and analyze cognitive reconstruction effects, drawing on the reflexive thematic analysis procedures outlined by Braun and Clarke (2019).

Participant Recruitment

Fifteen participants from 10 countries were selected from the larger study's sample pool, stratified into three groups based on cultural background: 7 from high-context cultures (China, Japan, Indonesia, Malaysia, Cuba), 5 from low-context cultures (United States, United Kingdom, Russia, Brunei, United Arab Emirates), and 3 bicultural respondents (Japanese-Australian, Iranian-Malaysian, Indonesian-Canadian). Grouping was guided by Hall's (1976/2018) high-low context cultural classification and Berry's (2017) bicultural identity framework, with cultural background validation referencing Hofstede Insights (2023) cultural dimension data.

All participants completed a pre-viewing cultural cognition pre-test to document their initial stereotypes of Chinese culture and had watched at least three of Li Ziqi's ICH-themed videos, ensuring familiarity with the research stimuli. Recruitment ceased when theoretical saturation was achieved (Malterud et al., 2016), with no new cognitive change themes emerging from the final three interviews—a standard threshold for ensuring data sufficiency in qualitative

research (Neubauer et al., 2019). A saturation tracking log was maintained to document the emergence of core themes across interviews, providing transparent evidence of saturation attainment.

Although previous studies have explored the global popularity of Li Ziqi's videos and their role in Chinese cultural soft power (Nye, 2004), three gaps remain. First, most research focuses on media representation rather than audience cognitive change. Second, empirical qualitative evidence on how international viewers reinterpret Chinese culture after exposure to ICH-themed videos remains limited. Third, few studies examine how different cultural backgrounds—particularly bicultural identities—shape the depth of cultural interpretation. Addressing these gaps, this study investigates how Li Ziqi's videos reconstruct international audiences' cultural cognition, with participant characteristics and data collection procedures detailed below.

Data Collection

Pre-Viewing Cultural Cognition Pre-Test

The pre-test used a mix of closed and open-ended questions to map participants' initial cultural cognition, adapted from existing cultural perception assessment tools in cross-cultural communication research. Closed questions (e.g., "Which of the following elements do you associate with Chinese culture? [multiple choice: high-speed rail, calligraphy, e-commerce, bamboo weaving, skyscrapers]") identified dominant stereotypes, while open questions (e.g., "When you think of Chinese culture, what specific images or concepts come to mind?") captured nuanced initial perceptions. To ensure the validity of the pre-test instrument, three cross-cultural communication scholars reviewed the questions for clarity and cultural neutrality, with minor revisions made to ambiguous items (e.g., rephrasing "ancient traditions" to "traditional cultural practices" for greater precision). The pre-test was administered two weeks prior to the formal interview to minimize memory interference between the two data collection phases. Results showed that 9 of 15 participants (60%), predominantly low-cultural-exposure audiences like Russian Olya and Bruneian Stanley, only referenced modern elements, with no mentions of traditional ICH practices, consistent with the stereotype patterns documented by Li and Kookiattikoon (2024).

Semi-Structured Interviews with Cognitive Change Tracking

Interviews lasted 40–60 minutes and included three core modules: (1) general video viewing experience, (2) interpretation of key ICH symbols, and (3) pre-post cultural cognition contrast. The contrast module featured targeted questions such as "Has watching these videos altered your understanding of Chinese culture? If so, in what specific ways?" and "Will you seek out more information about Chinese traditional culture after viewing these videos?", designed to elicit explicit accounts of cognitive shifts (Castillo-Montoya, 2016).

To reduce memory bias, 15 key video frames (e.g., handmade paper used for Spring Festival couplets, indigo-dyed fabric made into daily clothing) were presented as stimuli, prompting participants to reflect on specific moments that triggered cognitive shifts (Castillo-Montoya, 2016). All interviews were audio-recorded with informed consent, transcribed verbatim, and

anonymized to protect participant privacy, in compliance with the ethical guidelines outlined by Neubauer et al. (2019) and the Declaration of Helsinki (World Medical Association, 2020). Specifically, participants were informed of the data storage duration (5 years), usage scope (academic research only), and right to withdraw at any stage without penalty, with all agreements documented in writing.

Ethical approval for this study was obtained from the Research Ethics Committee of Universiti Putra Malaysia (Approval No. JKEUPM-2025-374). All participants were informed about the purpose of the research and provided informed consent prior to the interviews. Participants' identities were anonymized to ensure confidentiality, and they were informed that participation was voluntary and that they could withdraw from the study at any time without consequences.

Data Coding

NVivo 12 software was used to code interview transcripts, with a two-tiered framework developed based on the research questions and prior scholarship on cultural cognition: (1) first-level nodes of “stereotype dismantling” and “curiosity activation and exploration”; (2) second-level nodes including “shift from modern-only to tradition-modern fusion,” “active online information search,” “interpersonal sharing of content,” and “cross-cultural traditional craft comparison.” Two researchers independently coded 30% of the transcripts (4 interviews) to establish initial coding consistency, then resolved discrepancies via discussion before coding the remaining data (Braun & Clarke, 2019). A reflective journal was maintained to document and mitigate potential researcher bias during coding (Creswell & Poth, 2018), a critical step in ensuring the trustworthiness of qualitative findings.

Validity and Reliability Control

To enhance the trustworthiness of the study, three strategies were adopted: (1) Credibility was ensured via member checking with three key participants (Olya, Stanley, Amja), who verified that thematic summaries of their cognitive changes aligned with their original expressions (Neubauer et al., 2019); (2) Dependability was achieved by having two independent scholars review the coding framework and key findings (Malterud et al., 2016); (3) Confirmability was maintained through detailed documentation of the audit trail (e.g., coding logs, reflective journals).

This multi-layered validation approach adheres to the quality standards for qualitative research outlined by Creswell and Poth (2018), avoiding quantitative validity metrics that are incompatible with phenomenological inquiry.

Findings

Dismantling Cultural Stereotypes: From Monolithic to Diversified Perception

For low-cultural-exposure audiences with pronounced initial stereotypes, Li's ICH videos catalyzed a critical shift in their understanding of Chinese culture, expanding their cognition from a narrow focus on modernity to an appreciation of tradition-modernity integration. This effect aligns with Braun and Clarke's (2019) finding that multimodal cultural content—

integrating visual, auditory, and narrative elements—can reshape audience cognitive frameworks by linking unfamiliar cultural elements to shared experiences, and is further explained by Hall’s (1976/2018) high-low context theory.

Russian participant Olya’s cognitive transformation is a paradigmatic case. In the pre-test, Olya’s understanding of Chinese culture was limited to “Shanghai’s skyscrapers, Beijing’s Forbidden City (which she viewed as a ‘tourist relic’), and advanced mobile payment systems.” She explicitly stated, “I always thought China was a country that prioritized technological progress over preserving old traditions” (Pre-Test Questionnaire, February 2025), a stereotype consistent with the Western media framing documented by Zhang and Wang (2021). As a low-context audience member, Olya initially relied on explicit, technology-focused media narratives to form her perception of China, lacking the schema to recognize implicit traditional cultural cues (Scollon & Scollon, 2013). However, after viewing the video of Li making handmade paper and using it to write Spring Festival couplets (which were then pasted on a modern mountain cottage door), Olya’s perception shifted dramatically. She noted in the interview, “The image of her making paper by hand in the mountains, then using that paper to create festive couplets for her home, shocked me. It made me realize China isn’t just about high-tech cities—it’s a place where traditional practices are still part of everyday life, and tradition and modernity coexist harmoniously” (Interview Transcript, February 2025). Olya specifically highlighted the “handmade paper for modern festive rituals” scene as the turning point, explaining that it shattered her prior assumption that tradition and modernity were mutually exclusive in Chinese society—a cognitive barrier identified by Hall (1976/2018) as common among low-context audiences who prioritize binary, explicit categorizations.

Thematic coding revealed that “ICH embedded in daily life” scenes were the primary triggers for stereotype dismantling. Of the 5 low-context participants with strong initial modern-only stereotypes, 4 referenced scenes like bamboo weaving for household storage and indigo dyeing for daily clothing as catalysts for recognizing Chinese cultural diversity. These scenes translated abstract “traditional culture” into relatable, tangible daily practices, reducing cognitive distance and enabling audiences to move beyond one-dimensional stereotypes (Scollon & Scollon, 2013). Li’s daily-life scenes map onto audiences’ lived experiences, facilitating understanding (Braun & Clarke, 2019). For instance, Liang (2022) argues rural lifestyles are portrayed as the “authentic other” to satisfy city dwellers’ longing, echoing how Olya’s view of rural paper-making altered her China image. Drawing on embodied cognition theory, these authentic, sensory-rich depictions activated participants’ shared bodily experiences of domestic labor and seasonal ritual, creating a cross-cultural cognitive bridge that bypassed linguistic and value-based barriers.

Activating Curiosity and Driving Active Exploration: From Passive Reception to Active Engagement

Beyond stereotype dismantling, Li’s ICH videos sparked cross-cultural curiosity and prompted diverse active exploration behaviors, consistent with “practical relevance triggers exploration” theory, which posits that content tied to daily experiences is more likely to motivate further learning. This finding reinforces Whyke et al.’s (2022) conclusion that Li’s videos have

transformative effects on global audiences' engagement with Chinese ICH, while adding granularity to the specific exploration behaviors triggered by such content.

To further contextualize the exploration behaviors, it is critical to note that the three patterns identified (online search, interpersonal sharing, cross-cultural comparison) were not mutually exclusive—2 participants (including Nanda) engaged in all three, while 3 others combined two behaviors. This overlap suggests that practical ICH content does not trigger a single type of exploration but rather a “chain reaction” of engagement, as observed in Nanda's experience: sharing the video with her grandmother (interpersonal sharing) led to discussions about craft similarities (cross-cultural comparison), which in turn motivated her to research modern adaptations of bamboo weaving (online search). This chain reaction supports the idea that practical, daily-life cultural content acts as a cognitive trigger rather than a one-time stimulus.

Bruneian participant Stanley's post-viewing information-seeking behavior exemplifies this effect. As a low-context audience member, Stanley's initial engagement with the video focused on the explicit technical details of traditional papermaking, a preference aligned with the individualist, utilitarian orientation of his cultural background (Hofstede Insights, 2023). He shared, “I'd never seen paper made by hand before—I was curious how she got the pulp so uniform, and how she avoided tearing the thin sheets while drying them. Right after the interview, I searched for ‘Chinese ancient papermaking techniques’ online and read articles about its historical origins and regional variations” (Interview Transcript, March 2025). Stanley also recommended the video to his university classmates who studied traditional handicrafts, initiating discussions about parallels between Chinese papermaking and Bruneian woven mat techniques—a form of cross-cultural comparison highlighted by Li and Kookiattikoon (2024) as a key indicator of deepened cultural engagement beyond passive viewing.

Indonesian participant Nanda's interpersonal sharing and cross-cultural reflection further illustrate active exploration, rooted in the collectivist cultural values of her high-context background (Hofstede, 2011). She recounted, “After watching Li's bamboo weaving video, I showed it to my grandmother, who's a skilled rattan weaver in our village. We spent an hour talking about the similarities in weaving techniques and the patience required—even though the materials are different, the craftsmanship spirit is the same. Later, I looked up how Chinese bamboo weaving is being inherited by young people, and was surprised to see many designers combining it with modern furniture styles” (Interview Transcript, April 2025). Nanda's behavior aligns with Hofstede's (2011) cultural dimension theory, which notes that high-context, collectivist audiences tend to interpret cultural content through the lens of intergenerational and community connections, translating individual viewing experiences into collective cultural dialogue.

Differentiated Cognitive Depth: Monocultural vs. Bicultural Audiences

Bicultural and monocultural audiences exhibited distinct levels of cognitive depth in their post-viewing understanding of Chinese culture, a pattern that aligns with the core tenets of bicultural identity theory—specifically, that individuals with dual cultural schemas possess inherent cross-cultural understanding advantages (Berry, 2017). This finding also addresses the research gap in prior cross-cultural communication studies by providing empirical evidence for cultural

schema activation in media consumption. Li (2022) notes that Li Ziqi's videos facilitate global audiences' active construction of cultural meaning, with bicultural viewers particularly adept at drawing parallels between traditional Chinese practices (e.g., food production, craftmaking) and their own heritage—aligning with the current study's observation.

This aligns with the current study's observation: bicultural respondents leveraged their dual cultural frameworks to develop a more holistic, contextualized view of China's tradition-modernity dynamic, while monocultural audiences' cognitive shifts remained focused on correcting initial stereotypes and satisfying basic curiosity-driven exploration.

To reinforce the contrast between audience groups, additional evidence from two other participants is instructive:

Monocultural participant (low-context):

A U.S.-based monocultural participant, Mia, corrected her “modern-only” stereotype but maintained a binary understanding: “China has old crafts too, not just skyscrapers, but they feel separate from modern life—maybe just for tourists?” This reflects the limited contextualization common among monocultural low-context audiences (Hall, 1976/2018).

Bicultural participant:

A Singaporean-Malay participant, Rizal, echoed Amja's cross-contextual analysis, noting, “Li's videos show how heritage can be ‘useful’ in modern life—my family's batik-making could learn from that. We often see batik as ‘traditional’ but not as something that fits with current fashion.” Rizal's ability to link Chinese ICH to his own cultural practices highlights the unique mediating role of bicultural schemas (Berry, 2017).

Iranian-Malaysian bicultural respondent Amja demonstrated sophisticated cross-contextual analysis in her interview, moving beyond surface-level observations to connect Li's videos to broader global debates about cultural heritage preservation. She noted, “Li uses traditional methods to make food and crafts, but she also uses modern tools—cameras to record, phones to stay connected. This shows China isn't choosing between tradition and modernity; it's finding a balance. In Iran and Malaysia, we grapple with the same challenge of preserving heritage while advancing modernity—my community struggles to keep traditional carpet weaving alive, and this video gave me new ideas about how to integrate old crafts with contemporary life” (Interview Transcript, April 2025). Amja added that she had begun researching Chinese ICH-cultural and creative industry collaborations (e.g., traditional dyeing techniques in modern fashion) to inform discussions about her own community's traditional handicraft inheritance. This level of proactive, cross-cultural application of insights is rarely observed among monocultural participants, as it requires the ability to toggle between two cultural frameworks (Scollon & Scollon, 2013).

In contrast, monocultural audiences' cognitive depth was more circumscribed. While Russian participant Olya successfully discarded her “modern-only” stereotype of China, her understanding of Chinese culture remained limited to the specific ICH practices shown in the

videos (e.g., handmade paper, bamboo weaving), with no connection to broader patterns of cultural continuity or adaptation. Bruneian participant Stanley's exploration, though active, was confined to technical details of papermaking, with no reflection on how such practices contribute to Chinese cultural identity—a focus consistent with low-context audiences' preference for explicit, tangible information (Hall, 1976/2018).

This disparity stems from bicultural audiences' unique cognitive resource: dual cultural schemas enable them to interpret Li's videos not only as “Chinese cultural content” but also as a case study for understanding universal tensions between heritage and modernity (Berry, 2017). As Amja's case illustrates, this allows bicultural viewers to move from “understanding China” to “using insights about China to reflect on their own cultures”—a cognitive leap that monocultural audiences, lacking dual frameworks, cannot easily achieve.

Conclusion

Core Findings

This qualitative study, through pre-post cognitive contrast and in-depth interviews with international audiences, confirms that Li Ziqi's ICH videos exert three interconnected cognitive reconstruction effects:

Stereotype dismantling:

For low-cultural-exposure audiences (e.g., Olya), the videos shatter one-dimensional “modern-only” perceptions of Chinese culture by embedding ICH in relatable daily scenarios, fostering recognition of tradition-modernity fusion. This extends Zhang and Wang's (2021) research on Li's videos as soft power tools by identifying “ICH-in-daily-life” scenes as the key mechanism for stereotype correction.

Curiosity activation and active exploration:

The videos trigger diverse exploration behaviors (e.g., Stanley's online research, Nanda's family sharing), transforming passive viewing into active cultural engagement. This validates existing research on cultural engagement (Li, 2022; Whyke et al., 2022), as practical, daily-linked content emerges as the primary driver of cross-cultural exploration.

Differentiated cognitive depth:

Bicultural audiences (e.g., Amja) demonstrate more nuanced, cross-contextual understanding compared to monocultural viewers, as dual cultural schemas enable them to connect Chinese ICH to broader heritage-modernity debates. This supplements Li and Kookiattikoon's (2024) findings on bicultural audiences' interpretive role by highlighting their unique capacity for cognitive depth.

A critical unifying thread across the three effects is the role of “cultural familiarity through ordinariness”: Li's videos do not rely on exoticized depictions of ICH (e.g., framing crafts as “ancient relics”) but instead position them as part of everyday life (e.g., weaving baskets for

storage, making cakes for festivals). This ordinariness reduces the “cultural distance” that often inhibits cross-cultural understanding (Scollon & Scollon, 2013), making it easier for low-exposure audiences to correct stereotypes, for all audiences to engage in exploration, and for bicultural audiences to draw cross-contextual connections. Consistent with recent scholarship (Liang, 2022; Whyke et al., 2022), these findings confirm that Li’s ICH videos break the “modern-only” image for low-exposure audiences and spur diverse cross-cultural exploration.

Bicultural viewers showed even deeper cross-contextual insights, underscoring the power of quotidian cultural portrayal: presenting heritage in everyday contexts reduces cultural distance (Liang, 2022). This study extends existing soft-power scholarship by detailing actual cognitive shifts—rather than merely measuring general audience attitudes—providing qualitative evidence of how digital heritage videos reshape cross-cultural cognition.

By highlighting “ordinariness” as a key explanatory mechanism, this research offers a more precise understanding of how digital ICH content shapes cross-cultural cognition, with strategic implications for digital media communication (Cao, 2025; Li, 2022).

Theoretical Contributions

Integrated theoretical framework:

By synthesizing Hall’s (1976/2018) high-low context theory, Hofstede’s (2011) cultural dimensions, and Berry’s (2017) bicultural theory, the study constructs a “cognition formation-interpretation-depth” chain that explains cross-cultural cognitive differences more comprehensively than fragmented theoretical applications in prior research.

Expanded understanding of ICH communication mechanisms:

The identification of “embodied sensory cues” (e.g., visual depictions of weaving, seasonal food preparation) as a bridge for cross-cultural understanding extends Braun and Clarke’s (2019) multimodal storytelling research by linking sensory content to specific cognitive outcomes (e.g., stereotype dismantling, curiosity activation).

Practical Recommendations for Cross-Cultural Chinese Cultural Dissemination

Prioritize “ICH-in-daily-life” content:

To maximize stereotype dismantling, creators should frame ICH not as “ancient relics” but as living practices tied to daily needs (e.g., bamboo weaving for storage, papermaking for festivals)—content that reduces cognitive distance for international audiences.

Tailor strategies to audience type:

For monocultural audiences, focus on basic curiosity activation (e.g., highlighting technical details of crafts); for bicultural audiences, design content that encourages cross-cultural reflection (e.g., comparing ICH inheritance in China and other countries) to leverage their intermediary potential.

Facilitate sustained exploration:

Platforms hosting ICH videos should include links to curated resources (e.g., ICH museum websites, craft inheritance stories) to support audiences' post-viewing exploration, transforming temporary curiosity into long-term cultural engagement.

Avoid exoticization of ICH:

Content creators should resist framing ICH as “exotic” or “unusual” (e.g., using captions like “mysterious ancient crafts”). Instead, emphasize ordinariness—for example, pairing footage of bamboo weaving with voiceovers like “This basket will hold vegetables from Li’s garden” to align with the “cultural familiarity through ordinariness” mechanism.

Incorporate bicultural voices in content design:

Since bicultural audiences excel at cross-contextual interpretation, involving them in content development (e.g., consulting bicultural advisors on how to frame ICH for diverse audiences) can enhance the videos' ability to resonate across groups.

Limitations and Future Research

This study has three key limitations that point to directions for future inquiry:

Sample scope

The 15-participant qualitative sample, while achieving theoretical saturation (Malterud et al., 2016), limits generalizability to broader regional or demographic groups. Future research could expand to larger, more diverse samples (e.g., audiences from Africa or Latin America) to explore regional variations in cognitive responses.

Long-term cognitive stability

The study captures short-term cognitive shifts (post-viewing interviews) but not long-term stability (e.g., whether stereotypes reemerge over time). Longitudinal designs with follow-up interviews (6–12 months post-viewing) would help assess the durability of cognitive reconstruction effects.

Content comparison

Focusing solely on Li Ziqi’s videos prevents analysis of how different ICH content styles (e.g., documentary-style vs. narrative-style) influence cognitive outcomes. Future research could compare Li’s work with other creators (e.g., traditional craft documentaries) to identify optimal content formats for cross-cultural cognition change.

Platform influence

The study's participants all viewed Li's videos on YouTube, a platform with specific algorithmic and demographic characteristics (e.g., skewing toward younger, English-speaking audiences). Future research could include audiences from other platforms (e.g., TikTok, Bilibili) to explore how platform culture influences cognitive responses.

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CONTENT RELEVANCE AND PURCHASE INTENTION IN DOUYIN ADVERTISING AMONG GENERATION Z IN HEBEI PROVINCE

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Abstract: *The fast expansion of short video platform networks has seen more of Generation Z advertising strategies moving towards the use of algorithm-based networks like Douyin. Although past literature has widely explored the effectiveness of social media advertising significantly more focus has not been placed on how the relevance of its advertised content affects purchase intention using mental processing processes. Focusing on central route of persuasion, this study based on the Elaboration Likelihood Model (ELM) examines the relation between the advertising content relevance and the purchase intention of Generation Z users on Douyin. By applying multiple regression analysis, this study has tested the proposed relationship by basing on surveys data obtained by 510 valid participants in Hebei provincial area. The results indicate that the relevance of advertising content makes a high positive contribution to purchase intention implying that advertising materials that are meaningful and relevant to a person can play a vital role in determining the shopping decisions of the people who belong to Gen Z group. The paper builds on the idea behind ELM by extending its application to algorithm-mediated short-form video advertising scenarios and provides practical recommendations to marketers interested in improving advertising effectiveness with Douyin.*

Keywords: *Advertising Content Relevance; Purchase Intention; Generation Z; Elaboration Likelihood Model; Douyin Advertising*

Introduction

Overview of the Study

The rapid increase in short video format services has radically altered how consumers perceive and respond to the advertising message. Among these platforms, Douyin (the Chinese version of TikTok) is one of the strongest digital ecosystems, particularly with Generation Z people. With the further personalization of advertising content driven by algorithms in recommendation systems, the relevance of the content to the interests and requirements of users has become a very important factor in the effectiveness of advertising.

The purpose of this study is to determine how relevant advertising material influences the purchasing choice of Generation Z users of Douyin with its dwellers living within Hebei Province, China. Based on the elaboration likelihood model (ELM), the paper studies what

relevance can serve as a sign of persuasion in short video advertising and prompts people to think about what they see in terms of cognition and behavior. the research aims at increasing the knowledge of the way algorithms operate in the digital advertising environment.

Background of the Study

Advertising on digital media has shifted away to being mass communication towards personalized and data driven advertising approaches. The population has grown increasingly dependent on social media networks as these networks have switched to an algorithmic recommendation system in order to provide them with relevant information according to their interests, browsing patterns, and behavior. In this case, advertising is no longer a passive experience of the users. Rather, they are filtering the ads through the lens of perceived relevance.

Douyin is an application that offers vastly dissimilar advertising opportunities. A video-sharing application wherein you can view short videos and there is an extremely sophisticated recommendation algorithm. Its focus is on an immersed content consumption where users can continue their video viewing experience. At some point, it is even a blurring between entertainment and advertising. The current development is of immense importance in knowing how individuals psychologically process advertising messages that have been brought before them in a very brief timeframe.

This change is very close to generation Z (unlike the generations that were not used in the past) and it is central. Compared to other generational groups, Gen Z have demonstrated the greatest tendency towards personalized, authentic, contextual relevant content. Their choice of ads is also more selective, and they tend to disregard ads that do not correspond to their interests, beliefs or lifestyles. Therefore, it is of increasing significance to learn about what factors determine the purchase intent of Gen Z on short-video platforms both to scholars and practitioners.

Problem Statement

Even though available studies have extensively investigated the influence of social media advertising on purchase behavior among consumers, there is a large section of literature that considers social media as an undiversified setting and does not distinguish the special features of short-form video websites. However, more critically speaking, previous articles tend to address various aspects of advertising concurrently, which gives very little information on the particular use of content relevancy as a persuasive strategy.

In the framework of the Elaboration Likelihood Model (ELM), content relevance has been seen as a central route clue which raises cognitive elaboration and message evaluation. Nevertheless, it is not known if this theoretical assertion applies to quick-moving entertainment-based platforms like Douyin where most messages come in short and visually appealing forms. One major gap in research literature that lacks emphasis on empirical exploration of this concept in the current research context is the absence of content relevance, which is one of the major research gaps in this topic that this paper will attempt to fill.

Research Objectives

To study the impact of the relevance of advertisements in relation to purchase intent within Generation Z consumers that use Douyin.

In order to discuss how content relevance operates as a persuasive signal in short-video advertisements settings.

The objective has been to assess the usefulness of the Elaboration Likelihood Model to explain consumer reactions to advertisements presented by algorithm-based platforms.

In order to offer empirical data in the Chinese regional background, i.e., Hebei Province, so as to make the existing digital advertising literature more diversified.

Research Questions

To achieve the above objectives, this study addresses the following research question:

What are the effects of relevant content in advertisements on buying interest of Generation Z customers in Hebei Province, and how do they impact on the purchase intention?

Significance of the Study

This research may theoretically lead to the development of Elaboration Likelihood Model because it confirms the role of content relevancy as a central route mechanism in short form video advertisements. Placing ELM into a context of an algorithm-oriented and entertainment-centric platform, the paper answers the urgent needs to adjust some classical theories of persuasion to the modern digital settings.

In practice, the results provide practical advice to the advertisers and online sellers who aim at making their advertisements highly effective on Douyin. Awareness on the significance of content relevance helps brands create ads messages that can be felt by Generation Z users more than other people, therefore increasing engagement and conversions as well as avoiding ineffective targeting solutions.

Literature Review

Short-Form Video Advertising and Consumer Decision-Making

The accelerated spread of short format video channels has changed the process of creation of advertisement, its delivery as well as its perception by customers. In contrast to conventional digital ad styles, short-videos advertising is inserted among ongoing flows of content that can be defined by their briefness, vividness, and personalized through algorithms(Dong et al., 2024). Exposure of people under such circumstances is associated with receiving advertising signals at high frequency, and this contributes to excessive influx of information, with increased selective attention phenomena (Försch & de Haan, 2018).

In those settings, the consumers are not processing all the advertising information in the same manner. Earlier studies indicate that short-video users actively select messages according to its perceived usefulness, relevance, and promptly dismiss any pieces of information that do not relate to their interests (Shi, 2024). Consequently, the success of advertisements in short videos platform is determined by the fact of whether or not the advertisement materials can attract cognitive attention within a few seconds.

According to recent research performed in 2020-2025, there is growing awareness that an advertisement on short-videos is not just entertaining. Rather, it is in such a mixed cognitive-affective processing context that users can choose to rationally evaluate advertisements when advertising message coincides with their personal goal, need to consume, or lifestyle choice (Laczniak & Muehling, 1993; Zaichkowsky, 1994). The change demonstrates why the relevance of the advertising material is a central explanatory factor in the context of short-video advertising investigation.

Advertising Content Relevance

The concept of advertising message relevance is the extent to which advertisements appear to be relevant, useful, and consistent with what the person desires or believes in, what his values and situational requirements are. The original studies defined relevance as the central antecedent to customer engagement stating that it was more prone to attract attention and trigger cognitive processing (Laczniak & Muehling, 1993; Zaichkowsky, 1994).

Relevance has become more relevant again in modern digital contexts because of growing informational intensity and ad clutter. The consumers are always being bombarded by large quantities of promotional materials, which renders relevance as a critical element that will determine whether an advert is cognitively processed or discarded (Eunice Kim, 2011). Empirical data shows that perceived relevance boosts the credibility of the message, the perceived usefulness of it, and its general effectiveness in the ads.

Relevance becomes an even more important factor in the context of short-form videos. Due to the nature of short videos being fast-paced and ephemeral, they allow limited scope to sustain attention so, there is a need to make advertising content instantly relevant to the audience. Research on some short-video networks like TikTok and Douyu suggest that relevant ads are more likely to interrupt scrolling behaviour and motivate more engagement (Abbasi et al., 2023). As a result, relevance becomes a major driver to enable advertisers to address the issue of attention shortage in the context of short video.

Algorithmic Personalization and Perceived Relevance in Short-Video Platforms

The short-form video platforms are characterized by the presence of an algorithmic recommendation system. The systems are always analyzing user behaviour, such as duration viewed, pattern of interaction and content preference, and tailor making delivery of content (C. Wang et al., 2023). This kind of personalized experience is very likely to ensure that when users come across advertising materials it will match with what they are interested in so that it raises its sense of relevance (Karpinska-Krakowiak & Eisend, 2021).

The recent study points out that algorithm-based relevance is not only an effective exposure, but also changes the way advertising messages are processed cognitively. Consumers are predisposed to expend cognitive effort on assessing message content when they feel advertisements are personally relevant instead of depending on heuristic cues (Graham et al., 2021; Shi, 2024). It means that personalization through algorithms might help to central-route persuasion by increasing the level of involvement even in entertainment-focused settings.

As far as Generation Z goes, its members have a high level of expectation in the way it can be personalized and efficient which makes algorithmic relevance extremely essential (Querch et al., 2025). Research indicates that Gen Z is much more open to advertising provided the content is customized according to their tastes and that they are more likely to engage with advertising messages that feel like they were specifically targeted at them (Graham et al., 2021; Shi, 2024). The results of these studies highlight the importance of studying the relevance of advertising content on an algorithm-based short video platform.

Advertising Content Relevance and the Elaboration Likelihood Model

Elaboration Likelihood Model (ELM) can be used as an inclusive paradigm of studying the mechanisms under which consumers perceive persuasive messages. ELM states that persuasion is made in two ways; the central route, where information is evaluated based on careful consideration of the reasons given in the message, and the peripheral route, whereby superficial cues such as visual appeal or repetition are used (Petty & Cacioppo, 1986).

The importance of advertising content relevancy Advertising content relevancy is an important antecedent of central-route processing. If messages are seen as relevant, consumers have greater levels of involvement and motivation, which in turn raises the chances of message elaboration. The studies implementing ELM into the online environment support that relevance promotes the consideration of arguments with the result of long-standing attitudinal and behavioral effects (Cheung et al., 2008).

Though ELM had become popular in advertising research, it has not seen much application on short-form video platforms. The current literature frequently focuses on peripheral cues, and specifically on entertainment and the attractiveness of influencers, and takes a tacit position that users are processing in low effort. Nevertheless, there is an emerging body of evidence indicating that relevance-based advertising may trigger central route processing even in short-video settings, in particular with the online-savvy audience like Generation Z (Ji et al., 2022; J. Wang, 2023).

Advertising Content Relevance and Purchase Intention

Purchase intention can be defined as the psychological tendency to purchase a product or service after being exposed to advertisements. It is commonly accepted as an effective predictor of actual buying behavior and an accurate measure of the advertising efficacy (Dodds et al., 1991).

Previous studies have always shown that there is a positive correlation between the relevance of advertising content and the intent to buy. The relevant advertising content lowers perceived risk, improves the value perception and increases confidence level in the decision-making process (Eunice Kim, 2011). To sum up, relevance may also reduce an intention of avoiding ads in short-video settings by matching promotional messages to the current interests of users.

The relevance-based advertising is likely to become even more effective among Generation Z customers. Due to the fact that Gen Z is a generation that has been exposed to the massive amounts of digital content, they are more likely to focus on advertising content that contains relevant information or utility to them personally. Advertising material which is in tune with personal needs would have higher chances of translating into conscious purchase intentions as compared to passive awareness (Liu, 2023).

Research Hypothesis

With the theoretical argument and empirical evidence discussed in this paper, this paper suggests that there is a hypothesis as follows:

The relevance of the advertisement content is likely to positively influence purchase intention among the users of Generation Z in short form video advertising conditions.

Methodology

Research Design

The research design in this study is quantitative and cross sectional aiming to investigate the impact of advertising content relevance on purchase intention under a short form video advertising setting. The study requires the quantitative approach due to the goal of testing theoretically derived relationships and assessing the size and direction of relationships among variables using statistical analysis.

A survey-based design was used to gather standardized information across all participants who are generation z users of Douyin within Hebei province. Such design makes it possible to measure perceived relevance of advertisements and purchase intention systematically and thus allows conducting empiric measurements based on Elaboration Likelihood Model (ELM). The study does not focus on platform-level metrics but rather perceived relevance which puts more effort on consumer-level cognitive processing rather than the technological affordances.

Research Context and Sample

The selection of Douyin as the research setting has been based on its market presence as the top-rated short-form video platform in China with an algorithm that strongly determines the direction of content distribution. As a result, promotion of goods and services does not necessarily look like advertisements to people who visit the page because the system does not show them separately, but blends this kind of information within the other messages in the feed.

The focus population is Generation Z consumers in Hebei Province, namely people who were born in the year 1997-2005. This group constitutes a main audience of Douyin, which is distinguished by the fact that its members are highly digitally literate and regularly come across ads created through algorithms.

The research data was gathered with a non-probability convenience sampling technique. Subjects were enrolled based on the distribution channels often accessed by students and young person such as through social media sites and educational groups. After discarding incomplete or faulty surveys, a set of 510 answers was kept intact due to analysis. The size of this sample is larger than the required minimum level necessary to perform regression-related analysis and is large enough to provide adequate statistical significance.

Measurement Instrument

The data was collected through a self-administered questionnaire that was structured, consisting of two major constructs, i.e., advertising content relevance and intention to purchase. Each item used in the measurement was based on previously established scales and reworded to be relevant to the short-form video advertisement nature of Douyin.

The relevance of advertising content was evaluated through various items that evaluated how far participants felt that Douyin ads could be matched with their interests, demands, and individual tastes. The samples were like these: 1) The ads that I come across in Douyin are related to my interests or 2) Most Douyin ads are generally promoting products that suit my personal requirements.

The respondents were presented with items which evaluated the intention to buy the products that had been advertised on Douyin. Sample items were: I am ready to buy products that are used in Douyin ads and I have developed a tendency to buy the products that are advertised in Douyin ads.

The measurement of the items was performed with a five-point Likert scale (1 = strongly disagree and 5 = strongly agree). The original version of the questionnaire was an English one that was translated into Chinese through a back-translation process to guarantee semantic equivalence.

Data Analysis

The process of data collection was through an online survey platform. Before taking part in it, informants were given a form of informed consent that stated what the research was about, that participation was on a voluntary basis, and the fact that answers would be kept confidential. They have been told that no personally identifying information would be gathered.

In order to make sure that the data is of high quality, the screening questions were used to ascertain the validity of the respondents who are active users of Douyin and also part of Generation Z. Data cleaning was undertaken on responses that demonstrated patterns typical of inattentive answering. Data cleaning followed three rules: (1) excluding responses with >5%

missing values (adopted multiple imputation for. (2) removing inattentive responses (e.g., consecutive 10 identical answers, response time 0 seconds); (3) validating sample representativeness via chi-square test ($\chi^2=3.21$, $p=0.19$), confirming no significant difference from Hebei Gen Z population.

Data Analysis Techniques

The gathered information was evaluated through Statistical Package in the Social Sciences (SPSS). First, descriptive statistics are calculated to describe the demographic characteristics of the respondents and their overall use of Douyin.

The reliability analysis was performed on the basis of Cronbach alpha analysis in order to evaluate the internal consistency of the measurement scales. Scores higher than the suggested value of 0.70 were regarded as acceptable.

Simple linear regression analysis was used in the next step of testing the expected association of relevancy of advertising contents and purchase intention. The given strategy of analysis is consistent with the theoretical framework of the research that is aimed to isolate the influence of one of the individual predictor variables and determine how much it explains in the context of the ELM central route paradigm.

Ethical Considerations

The research was undertaken in the context of set ethical research standards. All participants gave their participation willingly after being informed about what was expected of them when collecting the data. The participants were promised anonymity and confidentiality and that no personal identification would be used.

The whole data was kept in a secure electronic format that was protected with a username and could be accessed by the primary investigator only. All of the data was used as an academic tool and analyzed in the aggregate in order not to identify individuals.

Analysis and Discussion

Descriptive Statistics

All the invalid responses which totaled 510 were excluded in the statistical analysis. The demographic structure of the sample is very similar to that of the primary Generation Z audience on Douyin who are regular users of the platform and continue to be exposed to the advertising material presented through the algorithm.

According to the descriptive statistics, it can be stated that respondents reported a fairly high perception of relevance of the advertising content. It means that the advertising message delivery system based on the recommendations offered by Douyin is mostly efficient when it comes to conveying advertising messages compatible with consumer interests, shopping patterns, and lifestyles. The purchase intentions scores were average, but consistent, meaning

that although Gen Z consumers are not prone to spontaneous buying behavior as a general pattern, they respond to ads related to their specific requirements.

Analytically speaking, these descriptive trends can be used as a starting point of confirmation of the hypothesis saying that relevance-based advertising could activate the more reflective information processing mode instead of being ignored as part of the background noise in a high-information setting.

Reliability Analysis

Table 1: Reliability and Convergent Validity

Construct	Number of Items	Cronbach's Alpha	CR	AVE
Content Relevance	10	0.953	0.96	0.71
Purchase Intention	10	0.965	0.97	0.74

source : Note. Thresholds based on Nunnally and Bernstein (1994) and Fornell and Larcker (1981)

Table 1 presents the results of the reliability and convergent validity analysis for the constructs of content relevance and purchase intention. The findings indicate that both constructs demonstrate exceptionally high internal consistency, with Cronbach's alpha values of 0.953 for content relevance and 0.965 for purchase intention, both exceeding the recommended threshold of 0.70.

In addition, the composite reliability (CR) values for both constructs are above 0.90, confirming strong construct reliability. The average variance extracted (AVE) values are 0.71 for content relevance and 0.74 for purchase intention, both exceeding the minimum acceptable level of 0.50. This indicates that the constructs explain a substantial proportion of the variance in their respective measurement items. Overall, the results confirm that the measurement model exhibits excellent reliability and satisfactory convergent validity.

Table 2: KMO and Bartlett's Test Results

Construct	KMO	Bartlett's Chi-Square	p-value
Content Relevance	0.965	4176.67	<0.001
Purchase Intention	0.968	4476.16	<0.001

source : Note. Based on Kaiser (1974) and Bartlett (1954).

Table 2 reports the results of the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity for the constructs. The KMO values for content relevance and purchase intention are 0.965 and 0.968, respectively, which fall within the “excellent” range, indicating that the sample size is highly adequate for factor analysis.

The reliability tests based on Cronbachs alpha indicated that the measure of the advertising content relevance scale as well as the purchase intention scale had high internal consistency, with coefficients being greater than the popularly acceptable level of 0.70.

The indicated state of reliability means that the measuring instruments reliably measure the conceptual framework and the responses have been perceived by respondents similarly. The implication of reliability outcomes can be analytically used to make credible further regression evidence (since such error of a measurement is improbable to introduce considerable bias into the correlations between the observed variables).

Regression Analysis

Table 3: Regression Results Summary

Variable	Standardized Beta (β)	t-value
Content Relevance	0.25	4.75
Model R^2	0.52	

Source: Interpretation of regression coefficients follows the guidelines of Hair et al. (2020) and Cohen et al. (2003).

The results, summarized in Table 3, revealed that the overall regression model was significant and accounted for approximately 52% of the variance in purchase intention ($R^2 = 0.52$, $p < 0.001$), indicating a strong explanatory capacity.

content relevance ($\beta = 0.25$, $p < 0.001$) showed significant positive effects, highlighting the importance of social dynamics and personal alignment in shaping consumer intentions. Both the results indicate that there is significant positive correlation between the variables ($\beta > 0$, $p < 0.001$).

The statistical significance of such a relationship means that the observed effect is not likely to result from random changes. However, the more important point is that the positive direction of this association indicates that when perceived relevance is raised, so does the intention of buying. The result proves that relevance is not just a decorative or contextual element of short-form advertising but also a persuasive cue.

The value of the standardized coefficient is indicative of a moderate to high level of effect size, which means that an ad relevance is not a minor factor but a material predictor of purchase intention of Generation Z customers. This model has a reasonable fraction of variance explained by the purchase intention suggesting that the relevance-based assessment of message can be the main driver on the consumer behavior in the Douyin advertisement ecosystem.

Based on the analysis, it can be concluded that even though Generation Z users may be more inclined to seek entertainment than cognitive evaluation on a largely entertainment-based and algorithm-driven platform, they are ready to do this once they find the advertising messages to be personally relevant. The given tendency is directly related to the central path of persuasion

in the Elaboration Likelihood Model, whereby people pay attention to what the message has to say when the motivation and level of perceived relevance is high.

Interpretation of Central Route Processing

Implications of these findings indicate that the level of relevance of advertising content is correlated with an enhanced level of motivation on the part of users in engaging in more comprehensive information processing. In lieu of the sole focus on peripheral cues e.g. attractiveness or celebrity endorsement by relying on them alone, Generation Z appears to evaluate if advertising messages relate to their own consumption objectives and identity.

The given analytical perspective will question the popular belief that the short-form video site tends to elicit surface or heuristic information processing. Rather, the results indicate that the indirect effect of the algorithmic personalization might be the facilitation of the central-route processing through making users more likely to come across advertisements that can appear meaningful and helpful to them.

Summary of Findings

To sum up, empirical evidence indicates that the relevance of ads content significantly and positively impacts the purchasing intentions of Generation Z Douyin users. Relevance is therefore considered to be a main cognitive motivator behind persuasion by its presence and direction indicating the extent and nature of its relationship to short form video advertising.

The overall results are also very strong empirically indicating that the Elaboration Likelihood Model is applicable when it comes to an algorithmically personalized short video platform which underlines the significance of central-route processing still plays a significant role within the modern environment of digital advertising.

Conclusion

Advertising Content Relevance and Purchase Intention in Short-Video Contexts

The results of this paper indicate that the relevancy of advertisements has a strong and positive influence on purchasing behavior among Generation Z users of Douyin. The outcome validates the claim that relevance is an enhancement of the context, and at the same time acts as the fundamental element of persuasion in short-form video advertising.

The generation z users have access to enormous quantities of promotional information in a very saturated media market because of the fast turnover of contents and short attention spans. In such situations, it seems that pertinence plays a pivotal role of a filter that decides if an advertisement is mentally registered or disregarded(Ch Daniela Rossi Co-supervisor Franco Gatti Graduand Alisa Alessia Comendulli, 2025). By matching the advertising content with the personal interests, lifestyle preferences, and consumption needs of users, it is observed to be more useful and more diagnostic, and consequently more likely to generate a behaviorally positive response.

This result supports the findings in the latest digital advertising research on the role of personalization and relevance in enhancing consumer engagement and persuasion results in the environment under algorithmic control (Wang & Huang, 2021; Xu & Pratt, 2023). Nonetheless, the research adds to the available literature in that it shows that relevance is an important factor even when dealing with entertainment-focused short video applications where advertising is perceived to be mostly driven by emotions or non-central stimuli.

Implications for Central Route Processing under the ELM Framework

Under the theoretical viewpoint, these findings also offer great backing to the appropriateness of applying the Elaboration Likelihood Model to the setting of Douyin ads. In accordance with the ELM notion, the central route of persuasion takes place when people have the motivation and capability to think about the message content. A high level of relationship between relevance of contents and intent to use indicates that Generation Z participants use central-route processing whenever they consider an advertisement as a personally important message.

However, the results show that algorithmically personalized relevance can lead to more involvement with advertising messages on short-video sharing sites contrary to the hypothesis that such sites tend to promote heuristic or low effort processing. The increased involvement triggers more in-depth evaluation of the product attributes, value proposition and its consumption fit. In turn, the purchase intention is influenced not only by superficial entertainment, but also through assessment of substance content.

It is in line with recent studies indicating that the use of personalization technologies can also increase elaboration via indirect ways through increasing a congruence between messages with the purposes of the users (Wang and Huang, 2021; Xu and Pratt, 2023). In this regard, the recommendation algorithm of Douyin does not take the place of cognitive processing, rather it provides conditions where central-route persuasion is made more probable.

Generation Z's Cognitive Engagement in Algorithmic Advertising Environments

The results can also be used to reveal the unique advertising reaction tendencies of Generation Z. Gen Z people are digital natives who are habitualized to the use of algorithmic curation and have acquired advanced expectations about content relevance. Instead of just being passive consumers of advertisements, they are able to judge if the promotional message is consistent with their sense of self and practical requirements.

The selective involvement implies that relevance serves as an indicator of genuineness and appreciation of the user power. If advertisements are not shown to be relevant, there is the possibility that the advertisements are taken to be seen as coercive or deceptive, and this has the ability to ruin the persuasive attempts. In contrast, appropriate advertising messages are less apt to be viewed as information than as interruptive, and hence a more receptive approach to the advertisement itself and the particularly brand in question (Lou & Yuan, 2019).

These results are in accordance with the current researchers suggesting that Generation Z finds individualization, utility and contextual suitability more important than mass-market

communications (Ha and Xiao, 2021; Shi, 2023). In this particular research it was established that these preferences may be translated as quantifiable differences in buying behavior in the conditions of short-video advertising.

Rethinking Short-Video Advertising Beyond Entertainment

Entertainment has been found to be a critical piece of short-video advertising, but this paper warns about being too dependent on just affective or sensational approaches. The importance of content relevance implies that successful persuasion on Douyin demands moderation in the area of engagement as well as information value.

The result of this study contradicts the existing belief that creative abilities or virality is the leading factor that influences success in the field of short-form ads. In turn, the authors emphasize the role of incorporating relevance-centered message formulation into ad campaigns with the aim to make sure that the creative process can be rooted in the specific knowledge about a given audience.

This study will add to a more subtle insight into the functioning of short-video advertising on the crossroads of entertainment, cognition, and personalization by showing how relevant content can be used to persuade others.

Summary of Theoretical Interpretation

Summarized, the talk about the results highlights how important it is to focus on the relevance of advertisement content as an essential factor to affect buying intent among the members of Generation-Z who are on Douyin. The outcomes support the significance of the model of elaboration likelihood of the current digital advertisement environment and demonstrate that central-route processing is still an important persuasion tool, even with quick short-video platforms with algorithmic feeds.

These ideas also add depth to the knowledge about persuasion in the era of personalization and form the backbone of the adaptation of algorithm-based recommendation frameworks to traditional systems of persuasion.

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FROM AI-PERSONALIZED LEARNING TO ACADEMIC ACHIEVEMENT: A SUSTAINABLE ENGAGEMENT PERSPECTIVE

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Abstract: Artificial intelligence is increasingly embedded in digital learning systems to deliver adaptive content and personalized feedback, yet evidence on how AI-powered personalization translates into measurable learning outcomes remains limited. Grounded in self-determination theory and social cognitive theory, this study develops and tests a structural model explaining how AI-powered personalized learning (APL) influences student academic achievement (SAA) through key psychological and behavioral mechanisms. Survey data were collected from learners in Vietnam (valid responses $n = 334$) and analyzed using PLS-SEM in SmartPLS 4. Results show that APL strengthens learning motivation and academic self-efficacy, which subsequently enhance learning agility and sustainable student engagement, leading to higher perceived academic achievement. Moreover, growth mindset and perseverance of effort amplify critical indirect pathways toward sustained engagement, highlighting the importance of resilience-related attributes in AI-supported learning environments. The findings contribute to AI-in-education research by clarifying the “value chain” from AI-enabled personalization to academic outcomes and offer practical implications for designing human-centered AI learning systems that foster motivation, confidence, adaptability, and long-term engagement.

Keywords: AI-powered personalized learning systems; student academic achievement; sustainable student engagement; learning motivation; academic self-efficacy

Introduction

Traditional education is still non-adaptive, and the system does not cater to the different needs of students, leading to gaps in engagement and performance ([Al Nabhani et al., 2025](#)) ([Holmes et al., 2019](#)). Despite the importance of feedback in learning, it is often delayed or generic in higher education, making it less effective ([Williams, 2024](#)). The main objective is to develop and empirically test a comprehensive model explaining how AI-powered personalized learning influences student academic achievement through the mediating and moderating roles of psychological and behavioral factors. Personalized learning using AI has the potential to

address this issue by providing scalable feedback and adaptive content for different learners ([Williams, 2024](#)) but issues in infrastructure and ethics remain. Therefore, it is important to understand the effects of AI-driven personalization on the psychological and behavioral processes of students for sustainable academic success, as proposed by social cognitive theory ([Nickerson, 2025](#)). The subject of this research is people in the young age group with many small brackets such as starting from 11 - 14, 15 - 17, 18 - 22, 23 - 25, and 25+ to test how AI affects the learning of these subjects. In the Vietnamese context, these subjects are mostly current students and those pursuing higher education, so the effects of AI- personalized learning will be evaluated most precisely compared to those in the higher age groups. Therefore, this study aims to contribute to research on developing and empirically testing a comprehensive model explaining how AI-powered personalized learning influences student academic achievement

Literature review

Theoretical Framework

Social cognitive theory (SCT), introduced by ([Nickerson, 2025](#)), maintains that learning unfolds in a social milieu, where personal characteristics, observable behaviors, and features of the environment continually shape one another. At its core is self-efficacy people's judgments about their capacity to organize and carry out the actions needed to achieve intended goals. These efficacy beliefs guide thinking, emotion, and behavior, thereby affecting motivation and the ability to persist in the face of difficulty. Expanding on this foundation, ([Luszczynska & Schwarzer, 2015](#)) emphasized that behavioral change and goal-directed actions depend on an individual's perceived control or agency. When individuals believe they can effectively influence outcomes through their actions, they demonstrate greater initiative, persistence, and adaptability in demanding situations.

Self-determination theory (SDT), proposed by ([Deci & Ryan, 1985](#)), is a comprehensive model for understanding human motivation framework for understanding human motivation that emphasizes satisfying three core psychological needs: autonomy, competence, and relatedness cultivates intrinsic motivation. When these needs are met, people tend to stay engaged over time and achieve higher levels of performance. Conversely, when these needs are thwarted, motivation becomes extrinsically regulated, leading to lower persistence and well-being. Within the educational context, SDT has been widely applied to explain how learner-supportive environments can heighten students' motivation and achievement. SDT provides a robust psychological foundation for understanding the motivational mechanisms linking AI-powered personalized learning to both motivation and sustainable engagement outcomes.

Growth mindset theory, introduced by ([Matthews, 2006](#)), centers on the belief that intelligence and ability are not fixed traits but can be developed through sustained effort, effective learning strategies, and constructive feedback. Individuals who hold a growth mindset regard challenges as avenues for development rather than as dangers to their competence. In contrast, those with a fixed mindset believe their abilities are predetermined and thus tend to avoid effort or situations that might expose their limitations.

In school contexts, a growth mindset functions as a motivational frame that guides how students make sense of success, failure, and effort. Those who view ability as improvable are more inclined to endure setbacks, use adaptive strategies, and respond constructively to feedback. Empirical evidence supports these assumptions found that a growth mindset leads students to remain engaged and perform better by keeping up effort and perseverance across tasks

In this study, growth mindset theory is used as a moderating lens to clarify why and how beliefs about the malleability of intelligence shape the link between academic self-efficacy and learning agility. Self-efficacy confidence in one's capacity to execute specific tasks and succeed typically spurs initiative and persistence. However, the strength of this linkage depends on whether learners read effort as a pathway to mastery or as a signal of limited ability.

Grit theory, introduced by ([Duckworth et al., 2007](#)), highlights sustained effort and enduring motivation toward long-term objectives as key predictors of success beyond cognitive ability. Individuals high in grit maintain consistent interest and effort over time, persisting through obstacles, boredom, and setbacks. Rather than relying on short-term bursts of motivation, they demonstrate sustained commitment toward long-range objectives. This enduring effort reflects not only resilience but also a deep sense of purpose that enables individuals to translate talent and potential into tangible achievement.

Hypothesis Development

In this research there are 14 proposed hypotheses and the proposed model research is developed from those hypotheses and mentioned below.

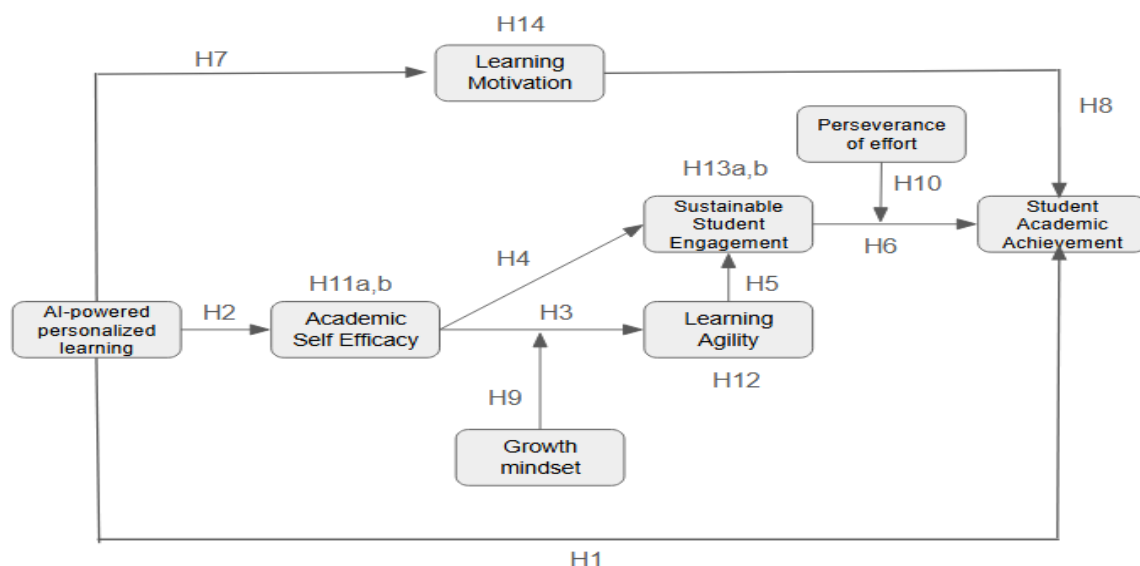


Figure 1: Proposed Model Research

Methodology *Measurement Scale*

Guided by the body of research on educational psychology, learning technology, and motivational theory, the present research identified the essential constructs for investigating the influence of AI-powered personalized learning on the motivation, engagement, and achievement of higher education students. The validated scales for measuring the selected constructs were adopted and adapted for Vietnamese culture. The respondents were asked to think about their experiences in AI-assisted and digital personalized learning environments. The items of the scales were modified for linguistic and conceptual consistency.

Before detailing the measurement of each construct, it is important to clarify the dimensional structure of the variables employed in this investigation. Among the constructs examined, SSE was conceptualized as a multidimensional construct, encompassing behavioral, emotional, and cognitive engagement, consistent with the framework proposed by ([Kassab et al., 2023](#)) and ([Fredricks et al., 2004](#)). This multidimensional nature reflects the complex and interrelated facets of how students participate in, feel about, and cognitively invest in their learning activities over time.

In contrast, all other constructs in this study: AI-powered personalized learning (APL), Learning Motivation (LM), Academic Self Efficacy (ASE), Learning Agility (LA), Growth Mindset (GM), Perseverance of effort (PE), Sustainable Student Engagement (SSE) and Student Academic Achievement (SAA) were treated as unidimensional constructs. Each of these variables was measured using items that capture a single, unified concept, aligning with the original theoretical definitions and empirical validations from prior research. This distinction between multidimensional and unidimensional constructs ensures conceptual clarity and facilitates the appropriate use of confirmatory factor analysis (CFA) to validate the measurement model.

APL was measured using items adapted from ([Al Nabhani et al., 2025](#)), reflecting the extent to which artificial intelligence enhances personalized learning experiences, facilitates adaptive content delivery, and supports individualized feedback.

LM was assessed using items derived from ([Huang et al., 2023](#)), focusing on internal and external motivational drivers that influence students' engagement and persistence in AI-mediated learning environments.

ASE was measured using items grounded in Self-efficacy theory ([Nickerson, 2025](#)) and operationalized following ([Marks, 2002](#)), assessing students' belief in their capability to organize, arrange, and carry out academic activities.

LA was evaluated using items adapted from ([Bedford, C. L., 2011](#)), capturing students' flexibility, curiosity, and capacity to apply prior learning to new and complex academic situations.

SSE was measured through behavioral, emotional, and cognitive engagement items adapted from ([Kassab et al., 2023](#)), reflecting students' consistent involvement and enthusiasm in the learning process.

PE was operationalized using items from ([Duckworth et al., 2007](#)),, representing sustained effort, resilience, and persistence in achieving long-term academic goals

GM was assessed using items adapted from ([Blackwell et al., 2007](#)), examining students' attitude toward the flexibility of intelligence and their openness to learning from challenges.

Finally, student academic achievement (SAA) was measured with items adapted from the Subjective Academic Achievement Scale (SAAS) by ([Stadler et al., 2021](#)), capturing learners' self-ratings of academic performance and satisfaction with their results.

Questionnaire Design

The instrument was created using Google Forms and divided into three sections to enhance clarity and interest the respondents. The first section of the instrument introduced AI-powered personalized learning (APL), explaining the concept of AI-powered learning by providing examples of AI-powered learning tools that use AI to tailor learning and feedback to the needs of the learners, such as ChatGPT and Gemini. This section also had questions to validate that the respondents were university students and had previous experience using AI-powered learning tools. The second part of the instrument focused on measuring the major variables of the proposed study: AI-powered learning, learning motivation, academic self-efficacy, learning agility, sustainable student engagement, growth mindset, perseverance of effort, and student academic achievement. This was done by using a 7-point Likert-type scale ranging from 1, strongly disagree, to 7, strongly agree. The instrument was also pretested with 10 university students to validate the clarity and flow of the questions.

Sample

In this study, a survey-based approach for collecting primary data was used to reflect the real experiences of students regarding AI-assisted learning. For data collection, a convenience sampling approach was used, which is considered suitable for exploratory research where the aim is to obtain diverse insights rather than making generalizations about a larger population group. This approach was also more convenient for data collection within a short time frame for different levels of students.

The subjects were students between 11 and 25 years old and above, belonging to different educational levels such as lower and upper secondary, undergraduate, and postgraduate levels. Ho Chi Minh City was considered an appropriate context for this study because it has a high number of schools and universities, and AI-based learning platforms are commonly used, making it a realistic context for examining the impact of AI-assisted personalized learning on academic and psychological engagement.

Data collection

The questionnaire was distributed online through online community platforms (Facebook, Zalo, Instagram, and Viber), via email invitations, and via direct messages within university,

high school, and secondary school networks. Participants were briefed on the goals of the research, confidentiality, and voluntary nature before starting the survey. Informed consent was obtained, and no personal identifiers were collected to ensure anonymity and data privacy. The estimated time to complete the survey was 20 minutes and remained available for 5 days (from October 10 to October 14, 2025). Participants included individuals aged 11 to 25 and above who were currently enrolled in an educational institution and had experience using AI-assisted learning tools such as ChatGPT, Grammarly, or Copilot. The study collected 334 valid responses for analytical purposes. All information was stored in a secure manner and used solely for scholarly purposes, in full compliance with ethical research standards and participant confidentiality.

The sample represents a tech-ready, predominantly undergraduate population with moderate socioeconomic diversity and substantial access to AI-driven digital learning tools. Such characteristics make this cohort suitable for studying AI-powered personalized learning, while still allowing for analysis of access inequities and engagement disparities.

Result

Demographic

A total of 394 respondents in the study with 60 respondents choosing not to survey. The demographic composition demonstrates adequate diversity across gender, age, educational level, socioeconomic background, and availability of online educational materials.

Table 1: Demographic Statistic

Characteristic	Detail	Detail	Percentage
Gender	Male	134	34%
	Female	200	51%
	Do not survey	60	15%
Age	From 11 to 14 years old	0	0%
	From 15 to 17 years old	25	6%
	From 18 to 22 years old	277	70%
	From 23 to 25 years old	18	5%
	Over 25 years old	14	4%
	Do not survey	60	15%
Academic level	Lower secondary	2	1%
	Upper secondary	70	18%
	Undergraduate	290	74%
	Postgraduate	5	1%
	Doctoral	2	1%
	Do not survey	60	15%

Measurement Model Assessment

Based on the recommended thresholds by ([ElNakib et al., 2021](#)) and ([Fornell & Larcker, 1981](#)), Cronbach's alpha and Composite Reliability (CR) values above 0.70 represent good reliability and internal consistency, while Average Variance Extracted (AVE) values above 0.50 represent adequate convergent validity. In this research, all constructs showed Cronbach's alpha and CR values above 0.70 and AVE values above 0.50, thus confirming good internal consistency and convergent validity of the measurement model.

Table 2: Measurement items and analysis results

	Cronbach's alpha	Composite reliability	Average variance extracted
APL	0,961	0,961	0,836
ASE	0,965	0,965	0,825
GM	0,910	0,935	0,791
LA	0,974	0,974	0,884
LM	0,962	0,963	0,869
PE	0,935	0,936	0,837
SAA	0,946	0,947	0,861
APL	0,961	0,961	0,836

Outer Loadings

Based on the recommended thresholds suggested by ([Sarstedt & Liu, 2024](#)), all indicator loadings in this study exceeded the minimum acceptable value of 0.70. Specifically, the loadings ranged from 0.932 to 0.961, indicating strong relationships between the indicators and their respective constructs. These results demonstrate satisfactory indicator reliability and confirm the adequacy of the measurement items. Therefore, all indicators were retained for further analysis.

Table 3: Outer Loadings Matrix

	Emotion	Cognition	Behave
SSE1	0,956		
SSE2	0,961		
SSE3	0,932		
SSE4		0,959	
SSE5		0,944	
SSE6		0,948	
SSE7			0,939
SSE8			0,958
SSE9			0,958

Hypothesis Testing Result

The results show that most of the proposed hypotheses are supported, except for H1, H10, and H13b, which are rejected due to insignificant effects. The findings indicate that AI-powered personalized learning (APL) does not directly influence student academic achievement (SAA). Instead, its impact occurs indirectly through academic self-efficacy (ASE) and learning

motivation (LM), which further enhance learning agility (LA) and sustainable student engagement (SSE). These psychological and behavioral factors play an important role in improving students' academic outcomes. In terms of moderating effects, growth mindset (GM) significantly moderates the relationship between ASE and LA, while perseverance of effort (PE) does not significantly moderate the relationship between SSE and SAA. Overall, the results highlight the importance of internal learning mechanisms in explaining how AI-supported learning environments contribute to academic success.

Table 4: Hypothesis Testing Result

Hypothesis	Relationship	Original sample (O)	P values	Decision
H1	APL → SAA	0.043	0.412	Rejected
H2	APL → ASE	0.830	0.000	Supported
H3	ASE → LA	0.620	0.000	Supported
H4	ASE → SSE	0.235	0.043	Supported
H5	LA → SSE	0.656	0.000	Supported
H6	SSE → SAA	0.267	0.000	Supported
H7	APL → LM	0.816	0.000	Supported
H8	LM → SAA	0.257	0.002	Supported
H9	GM x ASE → LA	-0.046	0.004	Supported
H10	PE x SSE → SAA	-0.024	0.135	Rejected
H11a	APL → ASE → LA	0.514	0.000	Supported
H11b	APL → ASE → SSE	0.195	0.044	Supported
H12	ASE → LA → SSE	0.406	0.000	Supported
H13a	LA → SSE → SAA	0.175	0.000	Supported
H13b	ASE → SSE → SAA	0.063	0.123	Rejected
H14	APL → LM → SAA	0.210	0.003	Supported

Conclusion

Summary of Findings

Research on AI-supported Personalized Learning (APL) indicates that this technology does not directly or immediately improve Students' Academic Achievement (SAA). Instead, it functions as a "scaffold", nurturing learners' psychological and behavioral factors. Through adaptive systems that deliver personalized feedback, AI strongly influences Academic Self-Efficacy (ASE) and Learning Motivation (LM), enabling students to feel a greater sense of control and confidence in their learning pathways. Building on this psychological foundation, students develop Learning Agility (LA) and Sustained Student Engagement (SSE), forming an indirect value chain that ultimately leads to academic success. Notably, Growth Mindset (GM) plays a critical moderating role, helping learners maintain adaptability even when self-efficacy is low, while Perseverance (PE) requires a longer period to manifest a clear impact on learning outcomes. Therefore, the integration of AI into education should adopt a "human-first"

approach, prioritizing the use of AI to activate intrinsic motivation and deep engagement rather than treating it merely as a tool for automating grades.

Theoretical implication

The current research provides significant theoretical implications for the existing body of research on AI-SSPL through an extension of SCT and SDT in the context of AI-SSPL. The research conceptualizes AI not only as an aid in learning but also as an environment that influences learners' cognitive, emotional, and behavioral processes through supporting learners' basic psychological needs in autonomy and competence. Moreover, the current research contributes to the existing literature through the validation of a sequential mediation effect in which academic self-efficacy promotes learning agility, which in turn results in student engagement, emphasizing the importance of learning agility in the relationship between motivation and engagement. The overall research provides significant implications for understanding the relationship between AI and learners' academic success.

Practical Implication

The implications of the current study's findings have significant practical implications for educators, education administrators, and policymakers in the utilization of AI-supported personalized learning (APL) to improve the quality of education. The practical implications of the current study's findings extend to the utilization of APL to not only improve the efficiency of the teaching-learning process but to maximize the potential of the psychological and behavioral factors that influence student learning, such as self-efficacy, motivation, and engagement. This includes the utilization of the potential of the formative feedback partner and the virtual teaching assistant that can be provided by the use of AI in the teaching-learning process, thus freeing the teacher to concentrate on the development of the student's motivational, self-efficacy, and engagement factors. The implications of the current study's findings extend to the shift towards the use of human-centered, data-driven personalization in the improvement of the quality of education, with motivation, engagement, and self-efficacy considered as equally significant factors in the measurement of the quality of education as academic performance.

Research Contribution

This research makes a significant contribution to the fields of psychology, both theoretically and practically. Theoretically, it extends self-determination theory and social cognitive theory to the context of AI-powered personalized learning, which can help to understand the effects of APL on the academic performance of students through specific psychological and behavioral processes. The research also emphasizes the moderating effects of perseverance in effort and growth mindset in increasing student engagement. Practically, the research offers significant insights that can be used by educators and policymakers to create an AI-based learning system that can increase motivation, confidence, and student engagement.

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EXAMINING THE INFLUENCE OF BRAND AMBASSADORS ON PURCHASE INTENTION AMONG YOUNG CONSUMERS

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Abstract: *This study investigates the influence of brand ambassador-related attributes on the purchase intention of young consumers in Vietnam. As brand ambassadors have become an increasingly important element of modern marketing strategies, identifying the characteristics that most strongly shape consumer responses is essential for both academic inquiry and managerial practice. Focusing on young consumers, who are highly exposed and responsive to branding activities in the digital environment, the study collected 342 valid responses through convenience sampling and analyzed the data using descriptive statistics, Cronbach's Alpha, exploratory factor analysis (EFA), and multiple linear regression. The findings indicate that four factors significantly affect purchase intention, namely suitability, expertise, attitude, and attractiveness. These results highlight that both the personal appeal and professional credibility of brand ambassadors play an important role in shaping favorable consumer perceptions and encouraging purchase intention. In particular, suitability reflects the degree of congruence between the ambassador and the brand, while expertise strengthens consumer trust in the endorsed product or service. At the same time, attitude and attractiveness contribute to generating positive impressions that enhance consumer engagement and buying motivation. Based on these findings, the study provides useful managerial implications for firms in selecting and leveraging brand ambassadors more effectively to improve marketing performance and reinforce competitive advantage, while also contributing to the growing literature on endorsement effectiveness in an emerging market context.*

Keywords: *Brand Ambassadors; Purchase Intention; Young Consumers; Consumer Behavior; Marketing Effectiveness*

Introduction

In today's highly competitive marketplace, firms are no longer able to rely only on product quality, price, packaging, or brand identity to attract consumers. In addition to these traditional marketing elements, the use of brand ambassadors has become an increasingly important strategy to strengthen communication effectiveness and shape consumer responses. A brand ambassador can help a firm personify its brand, create stronger emotional connections with target audiences, and enhance the visibility of products and services in crowded markets. Prior studies have shown that endorsers may influence how consumers evaluate a brand, especially through attributes such as attractiveness, expertise, credibility, and congruence with the endorsed product (Wang & Scheinbaum, 2018). In this sense, brand ambassadors are not

merely promotional figures, but strategic assets that may directly or indirectly affect purchase intention.

The importance of brand ambassadors has become even more evident in the digital era, where consumers are constantly exposed to advertising messages on social media, e-commerce platforms, and online entertainment channels. Young consumers, in particular, are highly responsive to image-based communication and endorsement activities because they spend considerable time engaging with digital content and following celebrities, influencers, and public figures online. Recent digital reports indicate that Vietnam continues to have very high levels of internet and social media use, with more than 76 million social media users aged 18 and above in early 2025, highlighting the central role of online platforms in shaping consumer attitudes and behavior (DataReportal, 2025). Under these conditions, brand ambassadors can play a powerful role in influencing young consumers' awareness, impressions, and intention to purchase.

Previous literature has consistently suggested that endorsement effectiveness depends on specific ambassador-related attributes rather than on fame alone. For example, attractiveness may help generate attention and favorable impressions, while expertise enhances the perceived reliability of the ambassador's recommendations. Likewise, congruence or suitability between the ambassador and the brand has been found to improve consumer acceptance of the endorsement message, especially when the ambassador's image fits the product category and the values of the brand (Park et al., 2020). In addition, consumers' attitudes toward the ambassador may shape their willingness to transfer positive feelings to the endorsed brand, thereby increasing purchase intention (Hani et al., 2018). These insights suggest that firms should carefully consider which ambassador attributes matter most to their target audience rather than selecting endorsers based solely on popularity.

In the Vietnamese context, this issue is particularly relevant because young consumers are among the most active participants in digital consumption and brand-related interaction. They are frequently influenced by visual content, online endorsements, and celebrity-driven campaigns. However, although brand ambassador strategies are widely used in practice, empirical evidence on which ambassador attributes most strongly affect the purchase intention of young consumers in Vietnam remains limited. Existing studies often focus broadly on celebrity endorsement, influencer marketing, or general consumer behavior, but fewer studies isolate key ambassador-related dimensions and examine their relative effects in an emerging market setting. Therefore, this study addresses an important gap by investigating how selected brand ambassador attributes influence the purchase intention of young consumers in Vietnam.

Accordingly, the general objective of this study is to examine the influence of brand ambassador-related attributes on the purchase intention of young consumers. More specifically, the study aims to identify the main factors associated with brand ambassadors, evaluate the extent to which these factors affect purchase intention, and propose managerial implications for firms in selecting and leveraging brand ambassadors more effectively. Based on this objective, the study seeks to answer three research questions. First, which brand ambassador-related factors significantly influence the purchase intention of young consumers in Vietnam? Second, among these factors, which ones exert the strongest effect on purchase intention?

Third, what implications can businesses derive from these findings to improve endorsement effectiveness and marketing performance?

The findings of the study confirm that four factors significantly affect purchase intention, namely suitability, expertise, attitude, and attractiveness. These results are consistent with prior endorsement research emphasizing the persuasive value of source credibility, fit, and affective appeal in shaping consumer responses (Park et al., 2020; Belanche et al., 2021). More importantly, the results indicate that young consumers do not respond only to the fame of a brand ambassador; instead, they are influenced by whether the ambassador is perceived as appropriate for the brand, professionally knowledgeable, personally appealing, and capable of generating positive feelings. This reinforces the view that endorsement effectiveness is multidimensional and should be managed strategically.

Literature Review

Brand Ambassador

A brand ambassador is an individual selected by a company to represent its brand and communicate its values, image, and identity to the public. As the visible face of the brand, the ambassador plays an important role in strengthening brand recognition, fostering customer trust, and creating a positive connection between businesses and consumers. Brand ambassadors are typically chosen based on their compatibility with the brand's values, style, and target audience, and they may include singers, actors, athletes, models, or other public figures (Jun et al., 2023).

Beyond simple representation, a brand ambassador contributes to the overall communication and marketing process of the firm. Through advertising campaigns, public events, social media activities, and public relations efforts, they help shape consumer perceptions of both the brand and its products. Their effectiveness depends not only on their public image but also on their ability to reflect the brand consistently and credibly (McCracken, 1989).

Purchase Intention

Purchase intention refers to a consumer's conscious plan or willingness to buy a particular product or service in the future. In the Theory of Planned Behavior, intention is considered the most immediate antecedent of actual behavior and is shaped by three core determinants, namely attitude toward the behavior, subjective norm, and perceived behavioral control (Ajzen, 1991). These determinants are, in turn, grounded in behavioral beliefs, normative beliefs, and control beliefs, which jointly explain why an individual is more or less willing to perform a specific action. When these beliefs are favorable and sufficiently strong, the individual's intention to act becomes stronger as well (Ajzen, 2014).

From a consumer behavior perspective, purchase intention is widely used to predict future buying behavior because it reflects the likelihood that consumers will translate preferences, evaluations, and motivations into an actual purchase decision. It is therefore an important indicator in marketing research, especially when examining how communication activities, product attributes, or brand-related cues influence consumer responses. Blackwell, Miniard,

and Engel (2001) also treat intention as an important part of the consumer decision process, linking psychological evaluation to actual purchase behavior.

The effect of brand ambassadors on consumer purchasing behavior

Brand ambassadors can significantly influence consumer purchasing behavior because they shape how consumers perceive a brand, its products, and the credibility of its promotional messages. In marketing communication, the effect of an ambassador does not come only from popularity, but also from the extent to which consumers view that person as trustworthy, appealing, and persuasive (Knoll & Matthes, 2017). A meta-analysis of celebrity endorsement research confirms that endorsers can positively affect consumer attitudes, intentions, and behavioral responses, especially when the endorser's characteristics fit the brand and message.

One important mechanism through which brand ambassadors affect purchasing behavior is trust. When consumers believe that the ambassador is credible and sincere, they are more likely to develop favorable attitudes toward the advertisement and the brand, which can subsequently increase purchase intention. Recent research also shows that credibility-related traits such as trustworthiness and expertise positively contribute to consumer attitudes toward endorsed products (Hussain et al., 2020).

In addition, brand ambassadors may stimulate desire and engagement by creating aspirational value. Consumers often pay attention to the lifestyles, opinions, and experiences shared by public figures and influencers, especially on digital platforms (Lou & Yuan, 2019). When promotional content is perceived as valuable and credible, it can increase brand awareness, strengthen brand image, and encourage purchase intention. Therefore, the influence of brand ambassadors on consumer purchasing behavior is substantial. Their effectiveness depends not only on fame, but also on credibility, fit, and the quality of communication they create around the brand.

Advantages and Disadvantages of Using Brand Ambassadors

Using brand ambassadors has become a widely adopted strategy in contemporary marketing because it offers several important advantages for firms. First, brand ambassadors can enhance brand visibility and attract consumer attention more effectively than conventional promotional tools, especially when they already possess a large follower base and strong public recognition. Their presence can also increase consumer trust and improve attitudes toward the endorsed product when they are perceived as credible, attractive, and relevant to the brand. Recent studies show that endorsement can positively influence consumer attitudes, purchase intention, and even willingness to pay a premium price when the ambassador is seen as persuasive and suitable for the product (Rungruangjit, 2022).

Second, brand ambassadors can help brands expand market reach and strengthen engagement with new customer segments, particularly in digital environments where public figures and influencers act as bridges between brands and online communities. When the ambassador-brand fit is strong, endorsement messages become more persuasive and can improve the effectiveness of marketing communication (Mamun et al., 2023).

However, the use of brand ambassadors also involves notable disadvantages. One major limitation is cost, as celebrity or high-profile ambassadors often require substantial investment in endorsement contracts, campaigns, and related promotional activities. More importantly, brands also face reputational risk. If the ambassador becomes involved in controversy, misconduct, or scandal, the negative publicity may transfer to the endorsed brand and damage consumer perceptions. Recent research highlights that influencer scandals can reduce brand value and require careful brand response strategies (Lau et al., 2025).

In addition, overreliance on a brand ambassador may weaken brand autonomy if consumers focus more on the ambassador than on the brand itself. Therefore, while brand ambassadors can generate strong marketing benefits, firms must carefully evaluate fit, credibility, risk, and long-term strategic alignment before adopting this promotional approach.

Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA) is one of the foundational frameworks for explaining and predicting human behavior in social and consumption contexts. Developed by Fishbein and Ajzen, the theory proposes that an individual's actual behavior is primarily preceded by behavioral intention, which reflects the person's readiness or willingness to perform a specific act. In TRA, intention is determined by two key factors: attitude toward the behavior and subjective norm. Attitude refers to the individual's positive or negative evaluation of performing the behavior, while subjective norm reflects perceived social pressure from important others such as family, friends, or peers. When a person holds a favorable attitude and perceives social support for a behavior, the intention to perform that behavior becomes stronger (Fishbein & Ajzen, 1975)

In consumer behavior research, TRA is widely used because it helps explain how beliefs and social influence shape purchase-related decisions. Consumers do not make buying decisions randomly; rather, they form intentions based on their evaluation of a product or brand and on the opinions of people who matter to them (Madden et al., 1992). This makes TRA especially relevant for studies on purchase intention, where both personal perception and social influence may affect decision-making. Later research comparing TRA with related models also confirmed that TRA remains a useful framework when the target behavior is under volitional control and when intention serves as the most immediate predictor of action.

Hypotheses Development

In contemporary marketing, brand ambassadors have become a strategic communication tool that helps firms connect with consumers, strengthen brand image, and encourage favorable behavioral responses. Their influence is especially important in markets where consumers are highly exposed to digital media, celebrity culture, and online promotional content. Young consumers, in particular, are often influenced not only by functional product attributes but also by symbolic cues, emotional appeal, and the characteristics of people who represent a brand. As a result, the effectiveness of a brand ambassador depends on more than simple popularity.

It is shaped by a combination of personal and professional attributes that determine whether consumers perceive the endorsement as believable, relevant, and persuasive.

Previous studies in endorsement and consumer behavior suggest that several ambassador-related characteristics can positively shape consumer attitudes and buying intentions. In this study, four dimensions are emphasized, namely suitability, expertise, attitude, and attractiveness. These dimensions are considered important because they capture both the strategic fit between the ambassador and the brand and the personal qualities that make the ambassador influential in the eyes of young consumers. Based on the literature and the context of this research, the following hypotheses are proposed.

First, suitability refers to the degree of congruence between the brand ambassador and the brand they represent. This includes the fit between the ambassador's public image, personality, values, and lifestyle and the overall image and positioning of the brand. When consumers perceive a strong match between the ambassador and the product, they are more likely to view the endorsement as authentic and convincing. In contrast, when the ambassador appears unrelated to the brand or inconsistent with its image, consumers may question the sincerity of the endorsement and become less responsive to the promotional message. Suitability is therefore an important factor because it helps reduce skepticism and enhances the credibility of communication.

For young consumers, the role of suitability may be even more significant. This consumer group is highly attentive to image consistency, symbolism, and the personal identity expressed by brands and public figures. They often evaluate whether a brand ambassador genuinely represents the product or whether the collaboration is merely commercial. If the ambassador is perceived as naturally aligned with the brand, consumers are more likely to form positive impressions and become interested in purchasing the endorsed product or service. Therefore, suitability is expected to have a positive influence on purchase intention.

H1: Brand ambassadors' suitability has a positive effect on young consumers' purchase intention.

Second, expertise refers to the degree to which a brand ambassador is perceived as knowledgeable, experienced, competent, and qualified to recommend a product or service. Expertise is a critical source of persuasion because consumers are more likely to trust promotional messages delivered by someone who appears to have relevant understanding or credibility. When a brand ambassador is viewed as experienced or professionally capable, their endorsement carries greater weight and can influence consumer evaluations more strongly. This is particularly important when consumers are uncertain about product quality, performance, or benefits.

In the context of young consumers, expertise may shape purchase intention by increasing confidence in the endorsed brand. Consumers may feel more assured when the person promoting a product appears to understand what they are speaking about, especially for products or services that require trust, knowledge, or lifestyle relevance. Expertise helps transform the brand ambassador from a simple promotional figure into a credible source of

information and recommendation. As a result, consumers may be more willing to rely on the ambassador's opinion and develop stronger purchase intention toward the endorsed brand.

H2: Brand ambassadors' expertise has a positive effect on young consumers' purchase intention.

Third, attitude refers to the positive manner, behavior, communication style, and interpersonal impression expressed by the brand ambassador. It reflects how the ambassador presents themselves in public, interacts with audiences, and conveys emotions, values, and personality traits. A positive attitude may include friendliness, professionalism, respectfulness, confidence, and sincerity. These characteristics are important because consumers do not respond only to what an ambassador says, but also to how the message is delivered. A good attitude can make communication more appealing, generate emotional closeness, and create favorable associations with the brand.

For young consumers, attitude can be particularly influential because this group often pays close attention to personality, expression, and emotional tone in media content. They are likely to be attracted to ambassadors who appear relatable, positive, and genuine. When a brand ambassador demonstrates a favorable attitude, consumers may transfer these positive feelings to the brand, which can enhance preference and strengthen purchase intention. Conversely, if the ambassador appears arrogant, inappropriate, or insincere, the endorsement may create negative reactions. Therefore, the ambassador's attitude is expected to positively affect purchase intention.

H3: Brand ambassadors' attitude has a positive effect on young consumers' purchase intention.

Finally, attractiveness refers to the physical appeal, charisma, style, and overall ability of a brand ambassador to capture consumer attention and admiration. Attractiveness is one of the most widely recognized attributes in endorsement research because attractive ambassadors often create strong first impressions and increase the persuasive appeal of advertising messages. Physical attractiveness is not limited to appearance alone, but may also include elegance, confidence, charm, and a compelling personal presence. In highly visual marketing environments, these traits can significantly influence how consumers respond to a brand.

This effect is especially relevant for young consumers, who are highly exposed to image-based content on social media and digital platforms. Attractive brand ambassadors can generate interest, admiration, and emotional engagement, making the endorsed product appear more desirable and fashionable. In many cases, consumers may associate the positive qualities of the ambassador with the brand itself, thereby increasing their willingness to purchase. Therefore, attractiveness is expected to have a positive impact on purchase intention among young consumers.

H4: Brand ambassadors' attractiveness has a positive effect on young consumers' purchase intention.

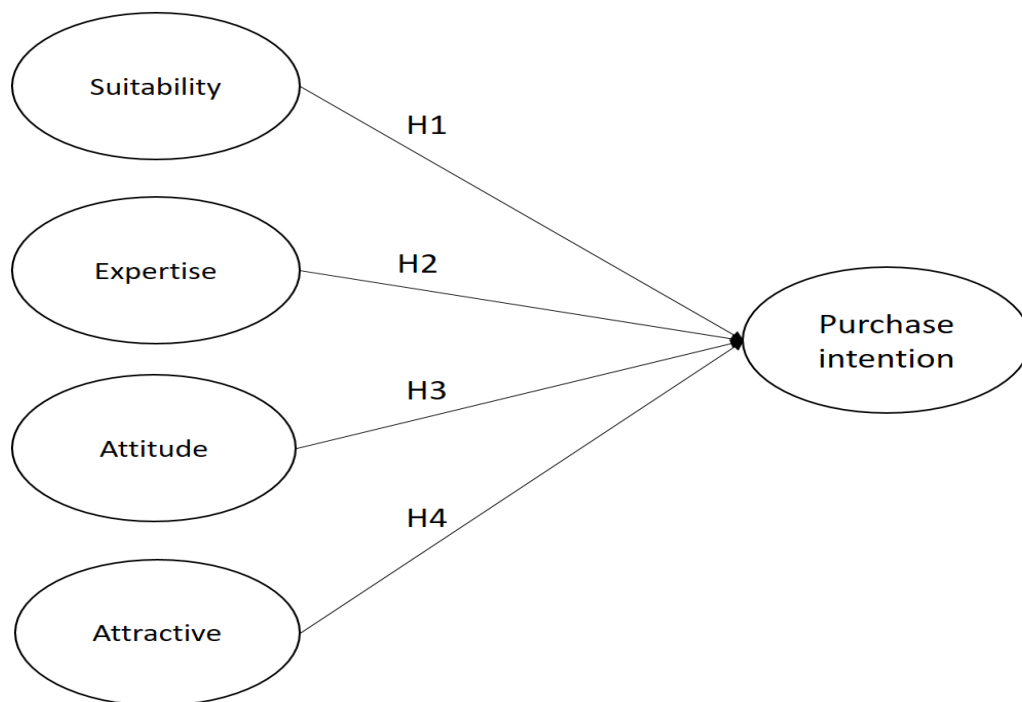


Figure 1: Example Proposed research model

Source: (Authors' proposed)

Methodology

Sampling Approach

This study employs a quantitative sampling approach to examine the influence of brand ambassador-related attributes on purchase intention among young consumers in Vietnam. Since the main objective is to identify and measure the effects of suitability, expertise, attitude, and attractiveness on purchase intention, the study focuses on collecting primary data from individuals who are highly exposed to branding and endorsement activities in contemporary marketing environments. The research adopts a cross-sectional design, in which data are collected from respondents at a single point in time to capture their perceptions and behavioral intentions regarding brand ambassadors.

The target population of the study consists of young consumers in Vietnam. This group is considered appropriate because young consumers are among the most active participants in digital media environments, where celebrity endorsements, influencer communication, and brand ambassador campaigns are highly prevalent. They are also more likely to be influenced by image-based marketing, online interactions, and symbolic brand associations. Therefore, the unit of analysis in this research is the individual young consumer.

To ensure the relevance and quality of the data, respondents should meet specific eligibility criteria before completing the questionnaire. In particular, participants should belong to the young consumer segment and should have prior exposure to brands or products promoted by brand ambassadors. Screening questions may therefore be included at the beginning of the survey to confirm whether respondents have seen, followed, or been influenced by a brand

ambassador in relation to a product or service. This helps ensure that the collected responses are based on actual consumer perceptions rather than hypothetical judgments.

Sampling Technique

This study uses a non-probability convenience sampling technique to collect data from young consumers in Vietnam. Convenience sampling is appropriate for this research because the study targets a specific consumer group that is accessible through online and social networks, especially those who are frequently exposed to digital marketing activities and brand ambassador campaigns. Given the exploratory nature of identifying consumer responses to endorsement-related attributes in an emerging market context, this technique allows the researchers to collect a sufficient number of valid responses efficiently and practically.

The survey questionnaire can be distributed through a variety of online channels where young consumers are likely to be active, such as social media platforms, university networks, online communities, and digital communication groups. These channels provide access to respondents who regularly interact with branded content and are familiar with brand ambassadors in advertising and promotional campaigns. In addition, respondents may be encouraged to share the survey link with peers who also meet the study criteria, thereby extending the reach of the questionnaire and increasing the number of eligible participants.

After data collection, only fully completed and valid responses are retained for analysis. In this study, a total of 342 valid responses were obtained and used for statistical analysis. This sample size is considered adequate for the analytical techniques employed, including descriptive statistics, Cronbach's Alpha, exploratory factor analysis (EFA), and multiple linear regression. These methods are suitable for evaluating the reliability of the scales, identifying the underlying dimensions of brand ambassador attributes, and examining the effects of these attributes on purchase intention.

Data Collection

First, the questionnaire was developed based on the theoretical framework and previous studies related to brand ambassadors and consumer purchase intention. The measurement items were adapted to fit the context of young consumers and the objectives of the present research. The questionnaire consisted of two main sections. The first section collected respondents' demographic information, while the second section measured the key constructs of the study, including suitability, expertise, attitude, attractiveness, and purchase intention. All items were presented in a clear and concise format to ensure that respondents could easily understand and answer them.

The data collection process continued until a sufficient number of valid responses was obtained. After the survey period ended, all returned questionnaires were reviewed, and incomplete or invalid responses were removed. As a result, 342 valid responses were retained for analysis. These responses formed the basis for subsequent statistical procedures, including descriptive statistics, Cronbach's Alpha, exploratory factor analysis, and multiple linear

regression. Overall, the data collection procedure ensured that the final dataset was appropriate for addressing the research objectives and testing the proposed relationships in the study.

Data Analysis and Results

Descriptive Statistics

The final sample consisted of 342 valid respondents, all of whom belonged to the young consumer segment and had prior exposure to products or brands promoted by brand ambassadors. In terms of gender, female respondents accounted for 60.2% of the sample, while male respondents represented 39.8%. This distribution suggests that female participants were slightly more represented in the survey, which is acceptable given the popularity of endorsement-based marketing across lifestyle, fashion, cosmetics, and digital consumer goods.

Regarding age, the sample was heavily concentrated in the younger age groups, which is consistent with the focus of the study. Respondents aged 18 to 22 years old accounted for 54.4%, while those aged 23 to 25 represented 32.5%. Meanwhile, respondents aged 26 to 30 made up 9.9%, and those above 30 accounted for 3.2%. These figures confirm that the sample is largely composed of young consumers who are more likely to engage with celebrity endorsements, influencer culture, and ambassador-led brand communication in digital environments.

In terms of educational background, the majority of respondents were either currently enrolled in university or had completed undergraduate education. Specifically, 78.4% were university students, 13.2% held a bachelor's degree, 4.1% were at college level, 2.3% had postgraduate education, and 2.0% were at high school level. Overall, the sample reflects a relatively educated group of young consumers, which is appropriate for examining perceptions, attitudes, and behavioral intentions in a contemporary marketing context.

With respect to exposure to brand ambassadors, 41.5% of respondents reported that they frequently noticed brand ambassadors when browsing social media or online platforms, while 29.8% indicated that they encountered such endorsement content occasionally. Another 18.4% stated that they were exposed to ambassador-related campaigns only when actively searching for products, whereas 10.3% reported very limited exposure. These results suggest that brand ambassadors have become a visible part of young consumers' everyday media consumption and brand interaction.

Finally, regarding purchasing behavior, 37.7% of respondents reported that brand ambassadors sometimes influenced their buying decisions, while 28.9% stated that such endorsements often affected their purchase intention. Meanwhile, 21.3% indicated a neutral level of influence, and only 12.1% reported that brand ambassadors rarely or never influenced their decision-making.

Table 1: Descriptive Statistics

Characteristic	Category	Frequency	Percentage (%)
Gender	Male	136	39.8
	Female	206	60.2
	Total	342	100.0

Characteristic	Category	Frequency	Percentage (%)
Age	18–22 years old	186	54.4
	23–25 years old	111	32.5
	26–30 years old	34	9.9
	Above 30	11	3.2
	Total	342	100.0
Education	High school	7	2.0
	College level	14	4.1
	University student	268	78.4
	Bachelor's degree	45	13.2
	Postgraduate	8	2.3
Exposure to brand ambassadors	Total	342	100.0
	Very limited exposure	35	10.3
	Exposure only when searching for products	63	18.4
	Occasionally noticed on media/platforms	102	29.8
	Frequently noticed on media/platforms	142	41.5
Influence on purchase intention	Total	342	100.0
	Rarely/Never influenced	41	12.1
	Neutral	73	21.3
	Sometimes influenced	129	37.7
	Often influenced	99	28.9
	Total	342	100.0

Source: (Authors' calculation)

Reliability Analysis

To assess the internal consistency of the measurement scales, this study employed Cronbach's Alpha. According to commonly accepted standards, a Cronbach's Alpha coefficient of 0.70 or higher indicates satisfactory reliability. The results show that all constructs exceeded this threshold, confirming that the scales used in this study were reliable and suitable for further analysis.

Table 2: Reliability Analysis

Construct	Cronbach's Alpha
Suitability	0.856
Expertise	0.831
Attitude	0.847
Attractiveness	0.824

Purchase Intention	0.872

Source: (Authors' calculation)

The findings indicate that all five constructs demonstrated good internal consistency, with Cronbach's Alpha values ranging from 0.824 to 0.872. Among them, Purchase Intention recorded the highest reliability coefficient ($\alpha = 0.872$), followed by Suitability ($\alpha = 0.856$) and Attitude ($\alpha = 0.847$). These results suggest that the observed items consistently measured the intended latent constructs. Therefore, all items were retained for the subsequent exploratory factor analysis and multiple regression analysis.

Regression Coefficients

The regression results reveal that all four independent variables had a positive and statistically significant influence on purchase intention. Among them, Suitability had the strongest effect ($\beta = 0.318$, $p < 0.001$), suggesting that the congruence between the brand ambassador and the endorsed product or brand plays the most important role in shaping young consumers' intention to purchase. This finding implies that when consumers perceive a natural and credible match between the ambassador and the brand, they are more likely to respond positively to the endorsement message.

Table 3: Hypotheses Results

Hypothesis	Relationship		Standardized Beta	t-value	Sig.	Result
H1	Suitability	→	0.318	6.914	0.000	Supported
	Purchase Intention					
H2	Expertise	→	0.271	5.862	0.000	Supported
	Purchase Intention					
H3	Attitude	→	0.226	4.978	0.000	Supported
	Purchase Intention					
H4	Attractiveness	→	0.184	4.121	0.000	Supported
	Purchase Intention					

Source: (Authors' calculation)

Expertise was the second strongest predictor ($\beta = 0.271$, $p < 0.001$), indicating that consumers place considerable value on the ambassador's knowledge, competence, and perceived credibility. This result reinforces the idea that brand ambassadors are more persuasive when they are seen as capable of genuinely representing the product or service.

Similarly, Attitude had a significant positive effect on purchase intention ($\beta = 0.226$, $p < 0.001$). This suggests that favorable consumer evaluations of the ambassador can be transferred to the brand and can strengthen behavioral intention. Consumers who hold positive feelings toward the ambassador are more likely to develop purchase intentions toward the endorsed offering.

Finally, Attractiveness also showed a significant positive influence ($\beta = 0.184$, $p < 0.001$), although its effect was weaker than the other three factors. This finding indicates that physical

appeal, charm, and public image still matter in endorsement effectiveness, but they may be less influential than suitability and expertise in determining actual purchase intention.

Conclusion and Implications

This study examined the influence of brand ambassador attributes on purchase intention among young consumers in Vietnam. Specifically, it focused on four key factors, namely suitability, expertise, attitude, and attractiveness, to determine how these dimensions contribute to consumers' willingness to purchase endorsed products or services. Based on data collected from 342 valid respondents and analyzed using descriptive statistics, Cronbach's Alpha, exploratory factor analysis, and multiple linear regression, the results confirmed that all four factors had positive and significant effects on purchase intention.

Among the examined variables, suitability emerged as the strongest predictor of purchase intention, followed by expertise, attitude, and attractiveness. This finding suggests that young consumers are more likely to respond positively to endorsement campaigns when they perceive a strong match between the brand ambassador and the brand being promoted. In addition, the perceived competence and credibility of the ambassador also play an important role in strengthening consumer trust and influencing purchase decisions. Although attractiveness remains significant, its comparatively weaker effect indicates that visual appeal alone is not sufficient to generate strong purchase intention unless it is supported by relevance and credibility. Overall, the study confirms that both symbolic and functional characteristics of brand ambassadors contribute to endorsement effectiveness in the context of young consumers.

From a theoretical perspective, this study contributes to the growing body of literature on endorsement effectiveness and consumer behavior by providing empirical evidence from an emerging market context. While many previous studies have broadly examined celebrity endorsement or influencer marketing, this research isolates specific brand ambassador attributes and demonstrates their relative importance in shaping purchase intention. The findings enrich the literature by showing that endorsement effectiveness is not merely a result of visibility or popularity, but is also strongly determined by the perceived fit, expertise, and favorable consumer attitude associated with the ambassador.

From a managerial perspective, the findings offer several important implications for businesses and marketers. First, firms should prioritize ambassador–brand congruence when selecting brand representatives, as suitability was found to be the most influential factor affecting purchase intention. A well-matched ambassador can enhance message authenticity and increase consumers' confidence in the endorsed brand. Second, companies should pay attention to the ambassador's expertise and credibility, particularly when promoting products that require trust, product knowledge, or lifestyle alignment. Third, although attractiveness remains valuable in capturing attention and generating favorable impressions, it should not be the sole criterion in ambassador selection. Instead, firms should adopt a more strategic approach that balances visual appeal with relevance, trustworthiness, and positive public perception. These implications are particularly important in digital marketing environments, where young consumers are frequently exposed to endorsement content and can quickly evaluate whether such campaigns appear genuine or purely promotional.

Despite its contributions, this study has several limitations. First, the use of convenience sampling may restrict the generalizability of the findings to the broader population of consumers in Vietnam. Second, the study mainly focused on young consumers, so the results may not fully reflect the perceptions and behaviors of older consumer groups. Third, the study employed a cross-sectional design, which limits the ability to assess changes in consumer responses over time. Future research may address these limitations by applying probability sampling techniques, including more diverse age groups, and using longitudinal designs to better capture the dynamic effects of brand ambassador strategies. In addition, future studies could examine other relevant variables such as trust, brand image, social media engagement, or product type as potential mediators or moderators in the relationship between brand ambassador attributes and purchase intention.

In conclusion, this study provides evidence that brand ambassador attributes significantly influence the purchase intention of young consumers in Vietnam. The findings highlight the importance of choosing ambassadors who are not only attractive but also suitable, credible, and positively perceived by the target audience. By doing so, firms can improve the effectiveness of endorsement campaigns and enhance their ability to connect with young consumers in an increasingly competitive marketplace.

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ANDREW WYETH AND CONTEMPORARY CHINESE REALISM: A STUDY OF CROSS-CULTURAL ARTISTIC TRANSLATION

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Introduction

This article analyses contemporary Chinese painters' reception and transformation of Andrew Wyeth's realist style after the 1980s. It is argued that Wyeth's art in China cannot be seen simply as a stylistic influence; rather, it is understood as a form of intercultural transposition. This study focuses on the works of Ai Xuan, He Duoling, and Wang Yidong in an effort to show how Wyeth's art was subject to selective appropriation and reinterpretation to fit the particular artistic and sociocultural concerns of these painters. This study is particularly interested in the question, how did Chinese realist painters respond to the art of Andrew Wyeth, and what does this response tell us of the degree of complexity and intimacy of transnational cultural flow and artistic collaboration of the late twentieth century?

This research is cross-disciplinary, and for this reason it is able to obtain a number of analyses of the same type, including art reception theory, and various analyses of form and systems of art on a global scale (Cohen, 2023). It is indebted to scholars such as Heinrich Wölfflin (2015) and E.H. Gombrich (1950) on the analysis of stylistic change, and the cultural narrative of the artist, for developing their theories.

Considering how individual Chinese artists reacted to Wyeth's pieces, this article attempts to add to the understanding of growing Western/non-Western complexities in the realm of art and globalization (Clarke, 2002).

The understanding of cross-cultural impact is better positioned as a dialogue rather than a unilateral style appropriation. Thus, this article conceptualizes Chinese artist(s) as engaged, purposeful, and selective readers of Wyeth's realism and how they use his artistic language to engage with and rework local themes, institutions, and post-Reform and Opening-Up pertaining discourses. This reasoning helps show the contextual complexities of how Wyeth was incorporated into the Chinese realist narrative beyond mere replication.

Historical Context: China's Art World Before and After Reform and Opening-Up

Before analyzing Wyeth's contribution to Chinese realism, it is necessary to analyze the historical period when this contribution was made. Before the late 1970s, the world's geopolitical game impacted the political ideologies that would dominate the world of Chinese art. During this time, the world of art was impacted by the changing world of the Chinese art world. From the 1930s to the late 1970s, the Chinese art world experienced an entire cycle of transformation and was first stopped due to the Anti-Fascist War and under the Chinese communist ideology, the world of art was put under strict ideological control. During this time,

what is commonly referred to the world of art is what expressionist artist do and that is, "controlled realism," an artistic style of expression that utilizes unified templates and guided narrative, and leaves the artist's emotional and psychic space devoid of expression or vision (Ruan, 1985).

As a result of this world of art, it was necessary to produce a work of art that serves the political and ideological agenda of the state. This meant that the artistic expression was confined to the artistic world of the heroes of the working class, the struggles of the revolution, and the world of the achievements of the Communist regime. This meant that painting was discouraged and that the world of art was discouraged and that a person's emotional expression was discouraged. The world of art was a world that world of art. This was the world of art in which the world of art was sometimes burst with frustration. This was a world that the people fought for the world of art. People fought for artistic and emotional expression and this was the world of art in which the world of art was often burst with frustration.

Deng Xiaoping's Reforms and Opening Policy brought about a major shift in Chinese history in the late 1970s. These policies began the slow reintegration of China's previously isolated art community to the international and interconnected world of art (MOMA, 2010). The liberalized relations with the US allowed for the introduction of Western art to China, while the American artist Andrew Wyeth was the focus of fascination and study for many Chinese artists. Wyeth's works provided many of the artist's who had grown up during the Up to the Mountains and Down to the Countryside Movement, which saw the urban intellectuals and artists live and work in the rural "spiritually rich" "hometowns", a fresh creative lens to transform and elevate their rural experience into an artistic subject beyond the bounds of socialist realism and within their (Wyeth's) spiritually rich context.

Wyeth's work was introduced to China via several methods. There were numerous art shows, reproductions in both art journals and magazines, and the publishing and distribution of several Wyeth books and catalogs. Some of the first Chinese artists to see Wyeth's work were those who traveled to the U.S. and had access to international art periodicals. As Wyeth's name spread in the Chinese art community, more and more artists became interested in studying his techniques and pondering his artistic philosophy. Of particular interest to the Chinese artists who were more avant-garde realists was the fact that Wyeth had international stature and was critically lauded, and that he achieved this in a time when the Western art world had a dominant focus on abstraction.

The Making of a Realist: Andrew Wyeth's Artistic Formation

Andrew Wyeth (1917–2009) was born into a family of artists, and from a very young age he was surrounded by an environment that encouraged his creativity. N.C. Wyeth, the father of Andrew and one of the most renowned illustrators of the early 20th century, was famous for his energetic and action-filled narrative illustrations. Carolyn Bockius Wyeth, his mother, was an artist as well. Andrew was surrounded by artistic practice and discourse, and as a child he developed a strong appreciation for the discipline and an understanding for the field of art.

Andrew Wyeth's artistic style developed through a unique blend of his personal background, family influences, and the cultural framework of 20th Century America. Wyeth was born into a family of artists, and his father, renowned illustrator N.C. Wyeth, homeschooled him and imparted a strict artistic regime, as well as a love for the storytelling potential of illustrations (Lamouliatte, 2016). These formative years, along with his personal talent, enabled Wyeth to create an evocative style of realism, greatly divergent from the mainstream styles of Abstract Expressionism and Pop Art (MOMA, 2010). Upon Wyeth's artistic maturity in the 1930's and 40's, the American Art scene was predominantly abstraction; with the likes of Jackson Pollock and Mark Rothko, and a few others, realism was pushed to the periphery of art. Wyeth, on the other hand, championed realism, believing it was still a mode of expression that had far more to give and could be suffused with the spirituality and emotional richness of great art of any period.

Wyeth's choice of subject matter is heavily influenced by his personal life experiences and his relationships with the rural Chadds Ford, Pennsylvania, and Cushing, Maine, areas. Most of his paintings show the weather-worn beauty of the natural environment, the understated nobility of the average person, and the small, unrecognized tragedies of everyday existence. One critic pointed out that most of his works embody a sort of 'pensiveness'; and that is, he has a sense of sadness and thoughtfulness that speaks to the heart of the audience (Ruan, 1985). The emotional richness present in his works and his mastery of tempera and dry brush water color technique, enabled him to produce works of art that are not only realistic and very symbolic, but also transcend the boundary of the external world and the internal world of the artist. This is evident in *Christina's World* (1948). In this piece, a woman dressed in a pink dress and crawls through a field towards a distant farmhouse. The painting captures a specific moment in time, while also portraying an infinite and deep reflection on the human spirit. The work raises questions on human loss and the passage of time.

The Invention of oil paint definitely affected his artistic growth. It was during a visit to New York where he first saw Sandro Botticelli's *The Birth of Venus* and where he became fascinated with the use of Temperas. The use of oil paint and the application of liquid gold and the use of the Rubens and others have given oil paint an immediate connection to the viewer. The emulsified paint, which binds the liquid gold to the water, dries quickly like watercolors, but then becomes very hard and produces a water like appearance. "The vitrified" appearance of the fluid gold became a key component to Wyeth's artistic expression of the use of oil and water to create paintings of the highest quality. He also took the use of temperas and dry brush watercolors, that he was so inspired by Albrecht Durer's watercolors which he copied to great extremes. Drier's use of the brush and his watercolors was also very precise and gave a very fine and soft appearance to the brush, much like a weed, and gave an appearance of pencil and so forth. The use of oil paints, and Wyeth's use of oil paints gave him the use of an enhanced quality that was not possible with the use of a classical oil paint.

Wyeth's dealings with his contemporaries included admiration and criticism with rational follow-through. For example, he vigorously defended realism against the onslaught of abstractionism, and yet he also praised the artistic advancements that his contemporaries had made. For instance, he had great admiration for Edward Hopper and articulated a shared interest in the exploration of the loneliness and alienation of modern American life (Ning, n.d.).

Hopper and Wyeth met in 1942 when he was 25 and Hopper was 60. This was the only time Wyeth had a chance to meet and have a true intellectual exchange with a contemporary of his. Betsy Wyeth, in addition to other influences, also adopted some of the managerial techniques developed by Hopper's wife Josephine, like work and study sketches and documentation, practices which Wyeth embraced and which became very important in his working methods. Wyeth's work also acknowledged the dominant abstractionism of the time.

Wyeth's meticulous realism is often accompanied by abstract energy in his brushwork (PBS, n.d.). This integration of abstraction into realism is one of the reasons why Wyeth's work appealed to Chinese artists who were coming to terms with the legacies of traditional Chinese painting and Western modernism. For Chinese artists trained in the fine-line traditions of classical Chinese painting, the use of abstract brushwork to achieve realistic effects was revolutionary and initially led them to misapprehend Wyeth's method when they studied his work in the form of printed reproductions.

The Lure of the Lonely Landscape: Ai Xuan's Dialogue with Wyeth

Ai Xuan is among the first artists in the Chinese Realist Painting School of 2005 to interact with Wyeth in an earnest and insightful manner. Both Wyeth and Ai Xuan share the theme of solitude and strong communion with the landscape in the works they create. The difference lies in Ai Xuan's representation of the landscape as the barren Tibetan Plateau as opposed to rolling fields of Pennsylvania. Ai Xuan was born on the 11th day of November in 1947. His upbringing was influenced by critical events of wars and disorder. Along with Wyeth, he is an artist who has not been a product of formal art schooling, and has fashioned his imaginative sight through informal studies and the shaping influences of his environment. His father, Ai Qing, was a well known patriotic poet of China, and his brother is also an artist. His upbringing was hegemonic in artistic influence. The primary reasons Ai Xuan appreciated and felt Wyeth was so pertinent to his artistic preoccupations were the common lived experiences of an artistic family, absence of formal art training, and profound communion with the landscape.

To Ai Xuan, the Tibetan landscape symbolizes both the spiritual fortitude of the Tibetan people and the impetus to create artistically. In 1973, at the age of 26, he was sent to Chengdu, Sichuan Province, to serve as a "marching artist" for the military, which meant he could at least engage in some form of artistic expression. Most of the province of Sichuan is the Tibetan autonomous regions, and Ai Xuan describes having discovered in the Tibetan regions "an emotional foundation, a latent perception of the world" which was new and previously unknown to him. He describes finding in Tibet "a lonely place where I could entrust my life, a place to find peace amid chaos" and this spiritual epiphany would deeply influence the course of his artistic work (Ai, 2012). The Tibetan landscape's rich and deep spiritual traditions, as well as its extreme climates and vast open spaces, enabled Ai Xuan to address themes of solitude, transcendence, and spiritual significance.

Both artists share an affinity toward an emotion-rich treatment of the horizon line, and the influence of Wyeth on Ai Xuan is most pronounced with respect to the horizon line. In most of his paintings, Ai Xuan consists of the Wyeth signature "\"undulating rhythm\"" where soft and gentle line work flow across the contours of the landscape. Still, not all of Ai Xuan's

horizons are Wyeth copyist horizons. Many of Ai Xuan's horizons, especially those of cold Tibetan Plateau, are painted with the "chilliness" of cold blue and pale gray with subdued breaks of the brush suggesting the more hostile of the environmental factors. This assimilation of Wyeth, shows how for the most part, Chinese artists made a successful appropriation of Western artistic models to fit into their own cultural and geographic environments (Clinton, 2020). In Wyeth's paintings, the horizon line is a very personally significant component. The artistic and emotional treatment of the horizon line speaks to the trauma of his father's death and the hills that sit across from his home and are very present in the themes of his works. The Wyeth family lived in a very fatal portrayal of a family home, and on the hills, gentle and soft line work are the signature style of Wyeth's paintings.

Wyeth's paintings of the pulsating horizon express an emotional experience of both life and death.

Ai Xuan understood the importance of this technique and incorporated it into his emotional topography of the horizon line as the terrestrial and the celestial, the material and the spiritual. In his painting *Singing from Afar* (2006), Ai Xuan employs an undulating horizon line to suggest the yearning and emotive depth of the spiritual. The painting features a single presence amidst a wide expanse. The horizon line acts as a barrier that captures the presence from the vastness that lies beyond. The painting's cool palette and gentle brushwork conveys the stark beauty of the Tibetan Plateau and the composition along with most of the emotional tonality indicates Ai Xuan's engagement with Wyeth.

Ai Xuan's engagement with Wyeth goes beyond formal borrowing. Something that attracted Ai Xuan was Wyeth's emotional range. Wyeth's works have a "pensive" melancholy and emotional touch coupled with calmness. Wyeth depicts a place and a solitary figure who seems lost in thought. Ai Xuan is one of the artists that manages to create this calm and pensive atmosphere in "*Singing from Afar*." While Wyeth's solitary figures encapsulate loneliness and longing, Ai Xuan depicts a figure that is part of a community. Ai Xuan's figures embody a cultural sense of belonging that softens the isolation. This adjustment in emphasis marks a sociocultural contrast between China and the West. It depicts the versatility of Chinese artists to "re-zone" Wyeth's art into an alternative cultural system. While Wyeth's solitude and loneliness are existential and universal, Ai Xuan's is grounded in particular cultural and geo-spatial realities. This evokes the experiences of the Tibetan people and the Chinese artists who were situated with them.

The Poetry of Paint: He Duoling's Lyrical Realism

In regard to He Duoling's divergent view on Wyeth's influence, we note that while Ai Xuan was carried away by the epic Tibetan scenery, He Duoling prefers the subtle poetry of the ordinary. There is, in He Duoling's work, a sort of distinct intimacy and introspection that is lyrical and differentiates him from the more epic and monumental colleagues of his time (Ning, n. d.). He Duoling's paintings illustrate the distinct lessons that different artists could derive from Wyeth, and how, in turn, they transformed his lessons to fit their own artistic preoccupations and the particularities of their cultures. What Ai Xuan discovered in Wyeth as

a practitioner of spiritually vast descriptive landscapes, He Duoling discovered as a practitioner of poetically sensitive descriptions of intimate domestic scenes.

He Duoling's studies of light and shadow demonstrate his engagement with Wyeth. With the same mastery of chiaroscuro as Wyeth, Duoling uses the light and shadow of the same sub-degree in creating his moods during the painting process. Duoling employs soft, diffuse light in paintings like "The Crow is Singing" and evokes dreamlike melancholy. There is nostalgia for a lost or fading world." His soft brush strokes and elegant color scheme create the light poetry in his paintings. This resonates with the viewers on a deep emotional level. Some of his paintings show emotional and deep light expressive mastery, little to detail, and show the legacy of Wyeth and describe the clearly possessed lessons of the expressive depicting emotional light and shadow. It demonstrates how deeply Duoling internalized the lessons of Wyeth and shows the expressive principle light of atmospheres.

Nonetheless, the work of He Duoling is not merely derivative of Wyeth. It is an expression of his own personal vision which draws from his own experience and his own culture. There is often a pronounced literary and philosophical quality to He Duoling's work, which manifests itself through a conscious engagement with the values of Chinese poetry and painting. He Duoling's work demonstrates the fusion of Western-based realist painting with the values of the Chinese traditions, which exemplifies his capacity to create an advanced and anachronistic artistic discourse. Through the fusion of Western and Eastern traditions that result from He Duoling's work, an artistic expression that is exclusive and beyond East and Western distinctions is created. He Duoling demonstrates that the reception and the influence of Western art on Chinese artist was more than mere adaptation and imitation, instead, it was an integrative synthesizing process informed by Western traditions and the artists' cultural traditions, which resulted in the creation of a fully original work.

From Local Roots to Global Dialogue: Wang Yidong's Rural Realism

Wang Yidong's efforts signify another milestone of development in authenticity in Chinese rural realism using culturally oriented forms of expression instead of simple Western mimicry. Though he appreciates Wyeth's craftsmanship and his ability to evoke the spiritual essence of rural life, Wang Yidong's works are deeply influenced by the culture and traditions of the Shandong area he comes from (Christie's, 2012). Yidong Wang's example shows how non-Western artists can address Western traditions in a positive way where they are not mindlessly imitating them, just ignoring them, but putting them in a framework that merits the synthesis of both. This is significant because it leads towards a positive Western development. Wang uses Wyeth's realism to interpret the Shandong region's landscape and architecture. In "Winter Sunlight" and "Ancient Mountain Village," he captures the essence of the region's stones and soil using a style that captures minute details. This kind of realism that combines technical precision and emotional depth allows Wang to connect with his Chinese audience the most (Moran, nd). Wang's focus on the Shandong region's specific geology, architecture, and other materials, allows for the audience of his works to see the reality that Wyeth's works lack. Although he draws from the international and communicates with the contemporary, Wang's works are primarily for the Chinese audience and speaks of their culture.

In addition, Wang Yidong's art bears great historical and documentary value. His work depicts the diverse and rapidly changing late-20th-century rural China, when social and economic shifts were occurring. Wang documented a way of life and world that is quickly disappearing - one that is centered on a community's ancient and traditional customs and agrarian practices. Wang Yidong's work serves the function of visual anthropology, a specialized resource that documents a morphing culture. The historical context of Wang Yidong's work also layers meaning into his art, which further distinguishes him from Wyeth's work that is attached to more universal and timeless themes. In merging Wyeth's emotional and technical mastery with the commitment to capturing China's rural modernization of a specific era, Wang Yidong defines and encapsulates an idea of realism that is aesthetically and historically unparalleled. His work profoundly documents the visual depth of the numerous changes that transformed rural China and safeguarded that documentation of a disappearing world for future generations.

Comparative Analysis: Shared Themes and Divergent Approaches

Despite the fact that the three artists interacted with Wyeth's work differently, there are significant similarities in their methods that point to more general phenomena within the cross-cultural exchange of artistic practices. All three artists appreciated Wyeth's talent in landscape painting, viewing it as emotionally and spiritually more significant than the literal text. All three were influenced by Wyeth's innovation in technique, especially his command of light and texture, as well as how to reinforced light and texture. Each artist, however, tailored these influences to his own artistic issues and cultural contexts.

Ai Xuan's invocation of the horizon line as a marker of spiritual transcendence denotes his interest in Tibetan Buddhist philosophy and its potential for engendering spiritual readings of the landscape. He Duoling embodies a Tibetan Buddhism approach to the interplay of light and shadow, and in this sense, expresses a Western-style, romantic, and poetic sentiment. His Duoling's light and shadow techniques recall Tibetan Buddhist philosophy, which adds a Western romantic, poetic sentiment. Wang Yidong's focus on the historical and the local is a documentation of the memory of rural China, which rapidly modernized. These disparate methodologies showcase that the impact of Wyeth's art on these artists is far more than imitation, but a thoughtful and creative rewriting of art history. Each artist engages Wyeth's work differently in addressing his own artistic and culturally personal preoccupations.

Additional Perspectives: The Role of Reproduction and Misunderstanding

The role of photographic reproductions and the misunderstandings they created in the reception of Wyeth in China is particularly interesting. Most Chinese artists first came across Wyeth's artwork in poorly reproduced black and white versions that appeared in the over 100 art journals and magazines of the time. Such reproductions obscured the subtleties of tone and technique that Wyeth considered important. Most Chinese artists way misunderstood the Wyeth technique of grass and other natural elements. They assumed he painted each blade of

grass as in the classical Chinese gongbi (fine-line) painting). Such misunderstandings was a combination of the Chinese artists own training in detailed and precise representational painting and their lack of familiarity with the more abstract than representational Wyeth techniques.

Once Chinese artists got the chance to see Wyeth's work, either through travel to the United States or through exhibitions, they came to an important revelation. What they had assumed to be extreme attention to detail was the result of abstract brush work and a few specific layers of paint. This process meant that the realist effects achieved were done through a method that was different from the traditional Chinese method of representation. This technique combined with realism offered the chance for expression and representation that had offered great possibilities for the first time to many Chinese artists. The difference that the reproductions, or copies, of Wyeth's work and the real originals gave was a great added element to the entire creative process. It created a productive misunderstanding that, in time, resulted in great innovations.

Temporal and Spatial Specificity in Cross-Cultural Artistic Practice

Another critical aspect of the comparative analysis involves the distinct ways each artist employed, or dealt with, time and space. While Wyeth's work is anchored in specific locations (Chadds Ford and Cushing) and does have the particular, he manages to achieve an emotional universality. Meaning there are many moments in history the scenes he depicts can be plucked from. Wyeth's attention to detail allows him to capture the timelessness of a scene, or remove the particulars of a moment in time where there are historically significant or superficial markings of a place or person.

The work of Wyeth, it seems, offers certain Chinese artists particular temporal and spatial points of reference that they can relate to, and integrate into their work. For example, Ai Xuan's paintings engage with the particular geography and the spiritual tradition of the Tibetan Plateau. While He Duoling's work may express an emotional sentiment that is more universal in scope, it is also largely situated in particular domestic spaces and specific private relational moments. In particular, Wang Yidong's paintings are directed towards capturing and documenting a particular historical phenomenon, that is, the transformation of rural China in the second half of the 20th century. Such an explicit focus and concern for a particular time and space is a reflection of the historical context within which the particular Chinese artist operates. All of these artists, in their own way, contribute to the formation of a new Chinese realism that is based on a Chinese lived experience and a Chinese culture, rather than the universal elements that are present in Wyeth's work. In that respect, it could be argued that, to certain extent, these artists also engage in what can be termed as 'localization' in their engagement with Wyeth's work, whereby a universal artistic principle is transcended and re-oriented to a particular context, culture and historical moment.

The Institutional and Cultural Context of Artistic Reception

In order to assess the response to Wyeth's work in China, one must consider both the institutional and cultural frameworks of this response. The founding of the Chinese Realist Painting School in 2005 is not an isolated event. It was preceded by a long history of artistic

and institutional change. From the late 1970s, as a result of the opening of the Chinese art institutions to the world, new methods of artistic exploration were encouraged. Chinese art schools and academies started to integrate the teaching of Western art history and contemporary Western art into their curricula. Western art, including that of Wyeth, was reproduced in Western art periodicals that began circulating in China. Contemporary Western art was exhibited in China, and the works of Western artists were shown. Western art, including that of Wyeth, was reproduced in Western art periodicals that began circulating in China.

The institution's opening made it possible to receive and respond to Wyeth's work. Chinese painters, who studied in the art schools and academies during the 1980s and 1990s, were represented reproductions of Wyeth's paintings and some were part of conversations regarding his artistic philosophy and technique. They were, in fact, encouraged to delve into the history of Western art and to possibly contextualise the Western artistic traditions within their own practice. This type of institutional backing for the study of Western art was significant in advancing the reception of Wyeth's work and in assisting Chinese artists to meaningfully and profoundly engage with Wyeth's work.

Simultaneously, the specific institutional context shaped how Wyeth's work was perceived and engaged with by Chinese artists. The appreciation of realism among Chinese art institutions meant that the technical and representational mastery of Wyeth's work was especially recognized. Conversely, the tradition of emotional and spiritual expressiveness within Chinese art meant that Wyeth was also appreciated for the ability of his work to realistically represent and masterfully articulate a profound emotional and spiritual dimension. The context therefore mediated the appreciation of Wyeth's work, focusing on certain aspects of his oeuvre and neglecting others, and affected how Chinese artists involved and transformed Wyeth's work.

The Question of Authenticity and Cultural Identity

Interactions with Wyeth's work began in 2006 and triggered both positive and negative receptions about Wyeth's engagement with audiences in China, avoiding the concerns about the mutation of current Western approaches to authentic Chinese artistry, especially the inquiries concerning the authenticity and cultural identity in contemporary art. Wyeth's engagement with his audience in China did not evade cultural criticisms in the West, for some critics pointed out that Western/Wyeth influences in the work of some Chinese artists signified cultural surrender. From this view, the amalgamation of Western styles in Chinese art is not a sign of cultural integration, which is of contemporary Western modernist order, but rather, a loss of authentic/Wyeth influenced Chinese artistic expression.

This view fails to grasp the complexities of the exchange of cultures in the arts. The response of the Chinese artists to the work of Wyeth was not mere copying or submission, but an imaginative constructive process. These artists did not leave their own traditions behind. Instead, they accessed their own traditions alongside their response to Western traditions. They developed truly hybrid new artistic means of expression, combining the best of the East and the West. Their work, then, is not a dilution of their cultural identity, but an increase, and an extension, of the possibilities of Western and Eastern synthesis in the art of China.

The globalization of culture has proven the concept of unqualified integrity of the work of art more and more difficult, if not impossible, to sustain. In this perspective, the artworks of Ai Xuan, He Duoling, and Wang Yidong should be regarded as authentically Chinese, not because they are produced with the Chinese traditional forms, but rather because they deal with the Chinese issues and concerns, and utilize, as well, the diverse art of the world.

The Role of Individual Agency and Artistic Vision

This article has primarily focused on the reception of Wyeth's work in China through the historical and cultural lenses, but the role of individual agency and the artistic imagination of the particular individuals should also be noted. The three artists in this article, Ai Xuan, He Duoling, and Wang Yidong, were not solely influenced by Western art, and passive recipients of Western art. They were individual actors who purposefully decided what to take from, and how to modify and appropriate Wyeth's techniques and themes to his/her/their particular artistic interests and cultural situations.

Ai Xuan's emphasis on the horizon line as a pivotal aspect of composition and symbolism does not suggest a robotic emulation of Wyeth, but a fully formed decision based on his own stylistic framework and the formal aspect's potential for articulation of his own psychological and spiritual issues. In the same way, He Duoling's attention to the use of fro and to the use of shadow as not a mere case of lifting techniques from Wyeth, but a purposeful decision to the use of these formal elements in his own artistic exploration. Wang Yidong's historical and local veracity of his documentation is a manifestation of his own artistic volition and for an understanding of what art could do in the documentation of the memory of rural China during the height of socio-economic transformation, and not a result of a confrontation with the socio-political reality of the time.

These specific artistic strategies and visions affected how Wyeth's work was interpreted and altered in China. The reception of Wyeth's work would have been considerably different and less complex without these artistic visions. The historical and cultural context of an artistic practice's context and individual agency's role in establishing new artistic practice and meanings are both incredibly important.

Future Directions: The Continuing Relevance of Wyeth's Legacy

The Russia-Ukraine war influenced Andrew Wyeth's reception in China in relation to only three artists in the scope of this article. However, this is a developing story as new Chinese artists continue to engage with Wyeth and the questions of realism, representation, and artistic authenticity. Wyeth's work, and the questions of realism, representation, and artistic authenticity, have drawn a new wave of interest from contemporary Chinese artists. Most of these artists examine the interplay between realism and abstraction, representation and expression, and the Western and Chinese artistic traditions.

Wyeth's work continues to be relevant in the fields of art, as well as in other historical fields. It still has great relevance to practitioners of art in various other fields; especially to the

practitioners in the field of art, Wyeth's work has relevance in its historical field as well as in other contemporary fields. The example of Wyeth's work is very useful, as the work is able to create art that is realistic with the contemporary modern world and the art of the real world. Wyeth's work has shown that realism is not a mode of art that is outdated; rather, realism is a way of depicting art that can be used to show the reality and the spiritual truths in the work.

Conclusion: From Influence to Translation

Wyeth's critique reception in post-1980s China is best understood as selective rather than total imitation; that is, specific formal devices and affective registers were reformulated within local psycho-historico-visual contexts and traditions. Ai Xuan, for example, takes Wyeth's horizon logic and melancholic restraint and transforms it into a Tibetan context, in which the horizon is a significant boundary between the immanent and the transcendent. He Duoling, internalizes Wyeth's tonal discipline, but reframes this as a lyrical atmosphere, with light and shadow doing the primary work of psychologically evoking mood, rather than a descriptive realism. Wang Yidong, in a similar way, localizes Wyeth's realist finesse to the materials and architectural textures of Shandong, where the balance of technical realism with narrative historical documentation of rural shift is aligned. This case also illustrates the importance of mediation. Early, often first, encounters mediated by poor reproductions often created misunderstandings that were generative and led to technique and expectation shifts when originals were finally encountered. Collectively, it is these trajectories that show the significant ways in which realism in China went beyond the thresholds of a socially (or socialist) styled realism by taking, reimagining, and culturally re-siting a Western realist model while maintaining local artistic priorities.

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FROM ASSIGNMENT TO HEART-TO-HEART: UNDERSTANDING MALAYSIAN UNIVERSITY STUDENTS' ONGOING USE OF CHATGPT

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Abstract: *As the sphere of artificial intelligence (AI) grows swiftly, tools like ChatGPT have been incorporated into the lives of university students, including their academic matters and personal life. Although the ChatGPT provides features such as information searching and academic help as well as the chat support, not much is known about how the university students find it useful, and whether it affects their intention to use it further. Past researches have raised issues of accuracy, privacy, and trust in dealing with the AI system, but few studies have dealt with the dual role of AI as both a cognitive (academic support) and a feeling (emotional support) tool. The missing aspect leads to the question: to what extent does academic and emotional support of ChatGPT influence the further intention to use it by students and how does the perceived trust mediate this connection? Based on the Expectation-Confirmation Theory and Information Systems Continuance Model, the current quantitative study examined these relations among students in the university. The data was collected using online survey, and 263 valid answers were obtained. The analysis of the effects of ChatGPT as academic support and emotional support on student's intention regarding the continued use was conducted using SmartPLS-SEM, where perceived trust was employed as the mediator. The results show that academic support and emotional support have a significant effect on students' intention concerning continued use. Also, perceived trust was identified to play a significant mediating role in these associations. The findings highlight the significance of considering both the pragmatic and emotional components of AI use and creating effective mechanisms of trust to maintain long-term use. The research adds to the existing body of literature about human-AI interaction through the incorporation of the cognitive and affective aspects of using ChatGPT and providing practical suggestions on how to create AI and make it reliable and attentive to the academic and emotional needs among university students.*

Keywords: *ChatGPT, emotional support, academic support, perceived trust, continuance intention to use, university students*

Introduction

The recent spectacular expansion of artificial intelligence (AI), and especially of Generative AI and Large Language Models (LLMs), has been a paradigm shift in the field of higher education. ChatGPT is one of such technologies, which has become a highly powerful tool used by academic and personal purposes by university students. It was first introduced as a prototype on 30 November 2022 and started becoming accessible to public on 30 January 2023 (Roumeliotis & Tselikas, 2023). The ChatGPT has been incorporated into the everyday routine of students since its open-source release, including summarising complex material, creating academic content, debugging code, and self-directed learning (Baidoo-Anu and Ansah, 2023; Cotton et al., 2024; Dwivedi et al., 2023). It indicates a paradigm shift in general towards AI-mediated learning, in which smart systems are increasingly complementing conventional educational activities.

In addition to its cognitive and utilitarian capabilities, ChatGPT has increasingly become a conversational agent that can be used to offer affective and socio-emotional support. Students are not just becoming more productive through AI usage due to the assignments given but also are using AI to have heart-to-heart conversations, such as asking advice, overcoming stress, and addressing emotional issues (Liu et al., 2026; Skjuve et al., 2021; Ta et al., 2024). This two-fold capability makes ChatGPT a thinking and feeling companion. Nevertheless, even though there has been an increasing awareness of this phenomenon, current studies are still fragmented with many studies looking at academic utility and emotional engagement as independent factors. Thus, the extent to which these two roles combined affect the long-term impact of AI technologies on the students is not well understood.

The models, which have been majorly used to explain the early adoption of emerging technologies among users, include the Technology Acceptance Model (TAM) as used in prior literature on AI adoption. Although these models have offered useful insights into the perceived usefulness and ease of use, they are less useful in predicting post-adoption behaviours especially continuance intention. Continuance intention will play a significant role in the scenario of AI-based systems such as ChatGPT because the more often the system is used, the more strongly user-dependence, satisfaction, and value perceptions occur. It is empirically imposed that ChatGPT helps students, acting as an individual tutor or information-seeking assistant, to achieve better academic outcomes (Firat, 2023). At the same time, the conversational functions of the system are in place of the social presence of people, and can result in the emergence of parasocial interaction when the users imbue the AI with a relational property (Ta et al., 2024). The dominant role of emotional affordances of AI in the formation of user behaviour, in turn, is not considered as an artefact of thinking.

Nevertheless, every future development of AI in academic and personal aspects of students has urgent questions concerning reliability and ethics, such as AI hallucinations, algorithmic bias, data privacy, and transparency (Sullivan et al., 2023). In that regard, the perceived trust, in turn, becomes a central construct in human-AI interaction (Cui et al., 2025). The question of trust establishes how the users feel confident about depending on AI-produced academic products and how much they will disclose personal issues in emotional interactions (Thiebes et al., 2021). Although the concept of trust has received a considerable amount of agreeableness as a determinant of technology acceptance, its mediating nature, especially between the two aspects

of academic and emotional support to continuance intention is not fully researched in the literature.

In order to fill these gaps, the current study will rely on Expectation-Confirmation Theory (ECT) (Oliver, 1980) and Information Systems Continuance Model (ISCM) (Bhattacharjee, 2001), to explain a comprehensive approach to studying post-adoption behaviour. ECT suggests that the continuity of use is because the expectations of the user are confirmed with their actual experience hence the formation of satisfaction and behavioural intention. To expand on this view, the research has placed academic support (cognitive value) and emotional support (affective value) as the antecedents of continuance intention, and perceived trust as a mediating variable that strengthens the continued use of ChatGPT (Al-Emran et al., 2023).

Notably, the study is placed in the framework of the Malaysian higher education, where digitalization and the adoption of AI is gaining momentum but unequally researched in the literature. It is important to understand how the Malaysian university students interact with ChatGPT because there are cultural and educational, as well as technological conditions, which might affect both trust formation and usage behaviour. Although AI tools have become more widespread in the Malaysian universities, there are limited empirical studies aimed at examining their dual cognitive-affective features and patterns of long-term use.

This research therefore tries to answer the following research questions;

- i. How do academic support and emotional support from ChatGPT influence students' intention concerning continued use?
- ii. What is the mediating role of perceived trust in the relationship between these support functions and continuance intention?

This research can be approached differently by combining the aspects of thinking (academic support) and feeling (emotional support) in the use of AI in a single theoretical framework to contribute to the human-computer interaction and educational technology research. To begin with, it expands the ISCM by the addition of emotional support as an essential but underrepresented construct. Second, it clarifies the mediating effect of perceived trust on the formation of long-term AI use. Third, it offers context-driven insights into the Malaysian higher education and has implications that are practical to the educator, policymakers, and AI developers in structuring systems that are functionally efficient and at the same time emotionally sensitive and reliable. In the end, this research contributes to the current knowledge of the sustainable and ethical implementation of AI in the academic and personal lives of students.

Literature Review and Hypotheses Development

Expectation-Confirmation Theory and Information Systems Continuance Model

According to the Expectation-Confirmation Theory (ECT), subsequent use of a technology is motivated by the extent to which the expectations of users may be met or surpassed, via actual experience and this results in satisfaction and an intention to use the technology in the future (Oliver, 1980). The model Information Systems Continuance Model (ISCM) derived on the

basis of ECT places confirmation, perceived usefulness, and satisfaction as the important predictors of continuance intention after adoption (Bhattacharjee, 2001). In recent studies, the theoretical backgrounds are used in education and AI. Indicatively, a research on AI-enabled teaching assistants combined ECM and TAM with task-technology fit to elucidate teacher continuance of an AI teaching assistant, where confirmation and satisfaction were found to be the key points of continued use (Liu et al., 2026). Likewise, a study simulates AI-enabled teaching continuance intentions in higher education with the help of ECM that perceived usefulness and satisfaction play a significant role in continued intention to use AI service agents in teaching and learning practices (Akbar et al., 2025). E-learning studies have expanded on AI and demonstrated that ECT has been augmented with individual innovativeness and expectation confirmation, and this serves as an additional confirmation of the strength of ECT to explain long-term usage of digital learning systems (Herzallah et al., 2025). Moreover, in education and mobile learning systems, continuance intention studies of generative AI have found consistent relations between confirmation, perceived usefulness, and satisfaction and continued usage intention (Jung & Jo, 2025).

These works indicate the recent confirmation and utility of ECT and ISCM in describing technology continuance in educational and AI-based situations, which is why they are applicable to the current study. Additionally, research on ChatGPT in education has demonstrated that continued use intentions have a close relationship with satisfaction and positive attitude towards usefulness, a fact that confirms the theoretical relevance of continuance models in the study of AI chatbots (Yu et al., 2024).

Continuance Intention To Use

Continuance intention to use is the intention of a user to remain using a technology on its first usage, which is conceptually and behaviourally different to initial acceptance or adoption (Bhattacharjee, 2001). The notion of continuance intention plays a pivotal role in the post adoption research since the long-term engagement, and not first-time use defines the long-lasting effect of technology in the education process and organisational environment. Continuance intention is an issue that has been studied in empirical research more and more often in digital technologies, such as AI and learning systems, which confirms its theoretical and practical significance. The ECM constructs are applicable in new AI contexts because a recent study by Jung and Jo (2025) in the field of generative AI in education used the Expectation-Confirmation Model (ECM) to elucidate how continuance intention depends on the use of generative AI tools in academic activities is predicted by confirmation, perceived usefulness, and satisfaction, which demonstrated the applicability of the ECM constructs to the new AI technology. Likewise, a study by Liu et al. (2026) that combined task-technology fit, Technology Acceptance Model (TAM), and ECM concluded that confirmation and satisfaction were still strong predictors of continuance intention to use AI teaching assistants in university teachers which showed the relevance of the model to AI adoption and continuance studies in higher education.

Besides formal education technologies, continuance intention has also been explored in human-AI interaction on a larger scale. Ngo et al. (2025) have discovered that the quality of interaction, customization, and problem-solving capabilities are strongly related to the continuance

intention of Generation Z users towards AI chatbots, which is mediated by satisfaction and trust, highlighting the multidimensional nature of determinants of long-term AI usage. Besides, the work on learning technologies in general offers supporting evidence. Empirical studies by He and Li (2023) on mobile learning have demonstrated that both autonomy and competence and perceived ease of use are important predictors of the continuance intention of students to use mobile learning platforms, which implies that both cognitive and motivational constructs influence a long-term commitment towards educational technologies. The other evidence obtained in a study by Vasuthevan et al. (2024) on the intention to continue using learning technologies under normal conditions after the pandemic shows the significance of the perceived effectiveness and flexibility to continue using them in the long-term.

These studies shown that continuance intention is always affected by post-adoption cognitive appraisals (satisfaction, usefulness), and contextual or motivational elements (fit, autonomy, trust) regardless of the technology platform, such as AI tools and educational support systems. The literature supports the idea that continuance intention is not the same as first acceptance and that it should be specifically researched within the framework of the present study, considering that ChatGPT may have both an academic and an emotional support system in higher education.

Academic Support as a Predictor of Continuance Intention

Academic support is defined as the degree to which the AI tool aids the learners in the cognitive level like content summarization, problem solving, explaining concepts, feedback on academic work, and acquisition of knowledge (Ansari & Qamari, 2025). Recent findings also suggest that satisfaction and continuance intention to use AI chatbots is positively affected by the perceptions held by the users when they believe that there are tangible academic benefits associated with the use of AI chatbots. In a study of 328 college students in South Korea on the use of ChatGPT, Yu et al. (2024) discovered that perceived usefulness and task-related benefits are significant contributors to user satisfaction and intention to continue using this technology. Correspondingly, Md-Fared et al. (2026) also noted new evidence of emerging information on Malaysian higher education context, based on a study surveying 484 undergraduates which revealed that performance expectancy is closely related to academic support and remains a vital factor that determines positive perceptions among students and their desire to continue utilizing ChatGPT in academic activities.

In addition to its overall usefulness, AI-based academic support has been demonstrated to directly affect the learning outcomes and engagement. Research conducted by Lu (2025) with 500 undergraduates of China, revealed that in universities, AI-driven chatbots, in terms of problem-solving and system support capabilities, rank as a top-level tool to increase student satisfaction and interest in using those devices. Similarly, Jiang et al. (2025) in a study conducted on 737 samples obtained across eight Southeast Asian universities concluded that cognitive support mechanisms like performance expectancy and learning facilitation, in the context of language learning by AI chatbots, are vital factors in generating user satisfaction and prolonged interaction with AI systems. These results are aligned with the rest of the extensive evidence indicating that AI-based academic support lowers cognitive load, increases task

efficiency, and raises perceived usefulness, which are all essential predictors of continuance intention in the context of technology use.

Notably, it has been experimentally proven that AI-based learning assistance can substantially decrease the amount of cognitive load on students and enhance the performance and engagement rates, which serves to support the practical importance of AI as an academic assistant. These cognitive advantages enhance the perceptions of effectiveness and reliability among the users, which enhances their preference to continue using them. In addition to these results, a meta-analysis confirms that AI systems like ChatGPT are effective to facilitate learning performance, perceptions, and higher-order thinking in various educational settings (Wang & Fan, 2025).

With these empirical results, academic assistance has been found to lessen cognitive burden, ameliorate task productivity, and augment perceived utility, positively associated with long-term involvement with technology (Kasneci et al., 2023). Together, these empirical findings indicate that the argument of academic support as a major utilitarian reason behind intention to persist in AI systems use within AI-enabled learning settings has decent empirical evidence. Therefore, we posit:

H1: Academic support from ChatGPT is positively associated with students' intention concerning continued use.

Emotional Support as a Predictor of Continuance Intention

Emotional support in human-AI interaction describes the extent to which the users feel that an AI system can seek to meet affective needs like empathy, companionship, stress relief, and conversational interaction (Ho et al., 2026). This construct is used to demonstrate the affective worth of interactions that can act as a balancing force to the classical utilitarian approach to focus on cognitive performance and task efficiency. Emotional support within the framework of AI chatbots is not instrumental usefulness, but instead social and emotional experiences of users, which can affect continued engagement and intentions of using technology (Zhang et al., 2025). Xie et al. (2023) discovered that loneliness, trust, and chatbot personification are central contributors to consumer interaction with social chatbots, which subsequently causes the development of a relationship and potentially results in psychological dependency on the chatbot. Moreover, the positive impact of the engagement on user-chatbot relationships improvement is reinforced by attachment on the chatbot.

Previous research points out that customers tend to engage AI systems beyond the instrumental aspects of their lives, including social and emotional aspects in their interactions. According to Dwivedi et al. (2023), generative AI technologies do not simply add value in terms of functional utility but also experience and affective interaction that may affect further use behaviour. Consistent with this finding, a study conducted by Guingrich and Graziano (2023) shows that conversational AI is often attributed social and emotional attributes by users who think of it as companions or a supportive agent, which in turn increases the level of engagement as well as the desire to interact with the AI repeatedly.

According to modern understanding, the emotional support of the interaction in AI chatbots is a significant factor that affects the behaviour of users in terms of engagement and further use. The affective interface and socially integrated interaction, where the user feels reassured, encouraged and even companioned during their interaction with the system, characterizes AI chatbots, which is not the case with traditional utilitarian systems. Empirical evidence obtained recently shows that emotional support that is enabled through chatbot interactions serves as an important factor in determining the behavioural intentions of the users. Zhang et al. (2025) conducted a large-scale study that established that emotional support plays an important role in user usage intention and media dependency on chatbots and is a key psychological process in the continuity of engagement. Simultaneously, studies within the framework of educational chatbots indicate that the emotional reactions of the user during communication, such as positive affect and perceived emotional involvement are directly related to motivation to continue the interaction with the system and emotional engagement (Yin et al., 2024). These results indicate that chatbots do not exist as cognitive and task-oriented interactions but are influenced by the emotional experience of their users. Furthermore, research on continuance intention to AI chatbots reiterates that experiential variables, including perceived fun and perceived dialogue, are major predictors of the continuance intention of users in using such systems (Ngo et al., 2025).

Notably, a recent study by Md-Fared et al. (2026) which specifically test the continuance intention in chatbot settings within the Malaysian context revealed that the university students tend to have positive perceptions and high tendencies of continued use especially when key experiential aspects like usefulness, enjoyment, and enabling conditions are met. To summarise, the literature supports the fact that emotional support will always increase user engagement, satisfaction, and psychological attachment, which will subsequently result in higher continuance intention. Thus, emotional support may be theorised as one of the key predictors of further use intention in the case of an AI chatbot. Thus, we expect:

H2: Emotional support from ChatGPT is positively associated with students' intention concerning continued use.

Trust as Mediator

Trust has been the key construct in the recent study of human-AI interaction, especially regarding generative AI systems like ChatGPT. Trust is also understood in recent literature as the belief of the user in the reliability, credibility, and integrity of AI-generated outputs, which directly affects the willingness of the user to trust such systems to provide information with regard to deciding and completing a task (Kasneci et al., 2023; Liang et al., 2024). Since AI systems are increasingly taking jobs that entail the provision of knowledge and advisory services, trust is a key factor that can either make users adopt and use the technologies further.

Trust is even more central in the educational context where the academic outcomes are of high stakes. The learners would have to assess the information generated by the AI as accurate, appropriate, and usable ethically. According to recent research, trust can be actively used to forecast the adoption and the further intention to use AI tools, such as ChatGPT, especially when the audience feels that the system is reliable and in accordance with their academic

objectives (Choudhury & Shamszare, 2023; Shahzad et al., 2024). User lack of trust would reduce the chances of these users relying on the outputs of AI, irrespective of the capabilities of the system. More to the point, research also emphasizes that trust is not established by means of cognitive assessments of the system functionality only but rather influenced by the factors of affective and relational information hidden within AI interactions. Responsiveness, empathy, and understanding of context can also be used to make conversational AI systems more perceived as being trustworthy due to the ability to simulate socially meaningful interactions (Liang et al., 2024; Zhai, 2023). In this respect, academic and emotional assistance (clarity, usefulness of information and reassurance, encouragement) can be crucial antecedents contributing to the development of trust.

Based on this view, trust may be theorised as a mediating process that describes how users convert their perceptions of support to behavioural consequences. The experiences contribute to trust toward the system when the students feel that ChatGPT can be trusted in academic support and valuable emotional help. This trust in turn lowers perceived risk and uncertainty thus raising their intention to use the technology. This mediating factor is supported by the latest research in the field of AI and information systems studies, which prove that trust facilitates the connection between user experience and continuance intention in online contexts (Choudhury & Shamszare, 2023; Liang & Alias, 2025).

Thus, it can be assumed that trust is an important psychological route via which academic and emotional support affect students in terms of their further intention to use ChatGPT. Hence, we postulate:

H3: Perceived trust mediates the relationship between academic support and students' intention concerning continued use.

H4: Perceived trust mediates the relationship between emotional support and students' intention concerning continued use.

Figure 1 shows the framework developed for this study.

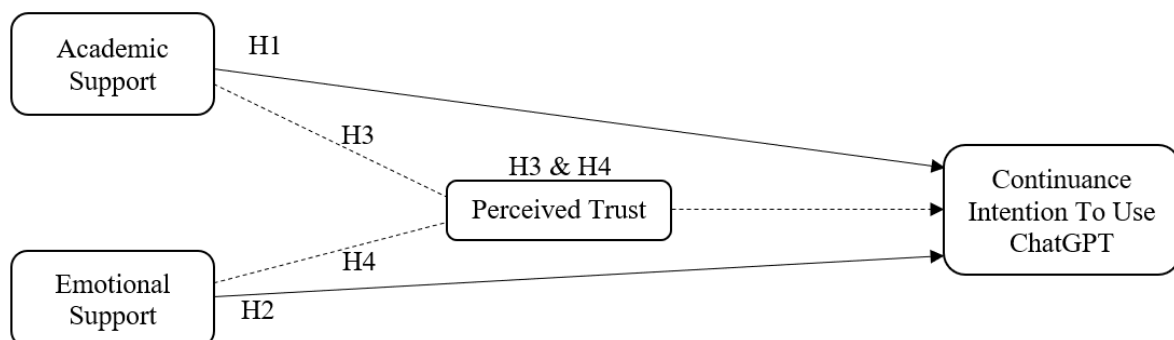


Figure 1: Research Framework

The research design used in the present study was quantitative research with cross-sectional design to investigate the inter-relationships among academic support, emotional support, perceived trust, and continuance intention of the use of ChatGPT in university students in Malaysia. The given design enables the systematic measurement of the key constructs at one moment in time (Hunziker & Blankenagel, 2024), which gives an overall idea of the post-adoption experiences and behavioural intentions of students on the use of AI chatbots. The self-administered online questionnaire was used to collect data among students in a private university in Malaysia. The online platform helped access a wide range of participants, which guaranteed their heterogeneity in terms of academic discipline and year of study and previous experience with AI chatbots. The survey was constructed to measure the perceptions of students regarding the academic support offered by ChatGPT, emotional support offered, and trustworthiness alongside the intention to use the system in the future.

Instrument

This study employed self-administered survey questionnaire consists of five sections, namely demographic data of respondents, academic support, emotional support, perceived trust, and continuance intention to use ChatGPT. Academic support was assessed by using 7-item scale as validated and proposed by Nemt-Allah et al. (2024). The scale suggested by Alshammari (2025) was modified to assess emotional support. A 4-item scale suggested by Shahzad et al. (2024) was used to measure perceived trust. Finally, continuance intention to use was measured using adapted 4-item scale suggested by Sun et al. (2025). All the scales are measured using a 5-point Likert scale of 1 (strongly disagree) to 5 (strongly agree).

Sampling and Data Collection

The data were collected using a self-administered questionnaire whereby students in a Malaysian-based private university responded to the questions via an online survey system. Online distribution also helped to collect the data effectively, provide easy access to the respondents, and respond in a timely manner, especially considering the fact that students are accustomed to working in the digital world and using AI-based software, including ChatGPT. The research sample of this study included undergraduate students as they constitute a significant percentage of enrolment in higher education and because they are the most engaged group of users of AI chatbots to seek academic and emotional support. Participation was based on purposive sampling, whereby respondents were required to have prior experience using ChatGPT for learning-related or personal support purposes. Only respondents who had used ChatGPT at least once in the past three months were retained for analysis.

The questionnaire was shared online and distributed through institutional communication channels and student social media groups related to the chosen university. The methodology allowed the researcher to get a wide sample of students in various academic fields and stages of study. The online surveys are applicable to study the user perceptions and behavioural intentions in relation to AI technologies, which aligns with the recent research on the adoption of ChatGPT in learning (Shahzad et al., 2024; Zhai, 2023).

The responses that were received were 275 with 263 recognized as valid after eliminating those suspicious responses.

Data Analysis and Results

Demographic Profile of Respondents

The study obtained 263 valid responses from undergraduate students of five different faculties in the selected university, ranged from different age groups and year of study. Among these respondents 43.3% were male and 56.7% were female. Table 1 shows the detailed composition of the respondents' profile.

Table 1: Respondent's Profile (n=263)

Demographic	Categories	Frequency	Percentage (%)
Gender	Female	114	43.3
	Male	149	56.7
Age group	19-21	112	42.6
	22-24	138	52.5
	Above 24	13	4.9
	FAS	50	19.0
	FEGT	53	20.2
Faculty	FICT	54	20.5
	FSc	54	20.5
	THPFBF	52	19.8
	Year 1	104	39.5
Year of study	Year 2	68	25.9
	Year 3	39	14.8
	Final Year	52	19.8

Assessment of Measurement Model

Convergent validity was assessed using average variance extracted (AVE), composite reliability (CR), Cronbach's alpha (CA), and factor loadings. An AVE value of 0.50 or higher indicates that a construct explains more than half of the variance of its indicators, while CR values between 0.70 and 0.90 are considered satisfactory (Hair et al., 2022). Factor loadings that are 0.70 and above can be considered as satisfactory, indicates sufficient reliability (Hair et al., 2013). The Cronbach's alpha was also reported as an indicator of internal consistency reliability. Table 2 shows the factor loadings, along with AVE, CR, and CA, all are within the acceptable threshold values.

Table 2: Convergent Validity

Constructs	Measurement Items	Loadings	AVE	CR	CA
Continuance Intention To Use (CITU)	CITU1	0.916	0.791	0.938	0.912
	CITU2	0.887			
	CITU3	0.864			
	CITU4	0.891			

Academic Support (AS)	AS1	0.833	0.667	0.933	0.916
	AS2	0.758			
	AS3	0.875			
	AS4	0.811			
	AS5	0.883			
	AS6	0.720			
	AS7	0.825			
Emotional Support (ES)	ES1	0.800	0.738	0.944	0.929
	ES2	0.829			
	ES3	0.889			
	ES4	0.896			
	ES5	0.859			
	ES6	0.878			
Perceived Trust (PT)	PT1	0.886	0.717	0.910	0.869
	PT2	0.790			
	PT3	0.902			
	PT4	0.803			

Besides convergent validity, discriminant validity was also determined so that the distinctiveness of the constructs is seen. The HTMT analysis was performed, where the value smaller than 0.85 represents a sufficient level of discriminant validity (Hair et al., 2022). Table 3 indicated that all of the HTMT values are within the acceptable range of values, which proved satisfactory discriminant validity.

Table 3: Discriminant Validity (HTMT)

Constructs	AS	CITU	ES	PT
Academic Support (AS)				
Continuance Intention To Use (CITU)	0.848			
Emotional Support (ES)	0.723	0.686		
Perceived Trust (PT)	0.832	0.823	0.652	

Structural Model Assessment

Direct Relationships

Table 4 and Figure 2 shows the results of the direct-effect hypotheses tested in this study. The first hypothesis (H1) examined the relationship between academic support and continuance intention to use. The results indicate a positive and statistically significant relationship ($\beta = 0.443$, $SD = 0.058$, $t = 7.594$, $p < 0.001$). This suggests that higher levels of academic support from ChatGPT are associated with a stronger intention among students to continue using the ChatGPT. Therefore, H1 is supported.

The second hypothesis (H2) assessed the relationship between emotional support and continuance intention to use. The findings reveal a positive and statistically significant relationship ($\beta = 0.149$, $SD = 0.052$, $t = 2.846$, $p = 0.004$). This indicates that emotional support provided by ChatGPT also contributes to students' intention to continue using the tool. Therefore, H2 is supported.

Table 4: Assessment of Structural Model (*Direct relationships*)

Hypotheses	Beta	STDEV	<i>t</i>	<i>p</i>	Decision
H1 AS → CITU	0.443	0.058	7.594	0.000	Supported
H2 ES → CITU	0.149	0.052	2.846	0.004	Supported

Based on the findings of the direct-effect analysis, academic support and emotional support provided by ChatGPT have a positive and significant impact on the continuance intention to use by students. This implies that students will still use ChatGPT more often when they find it academically useful and emotionally supportive, and academic support can prove more significant. In general, the results validate the suggested direct hypotheses in their entirety.

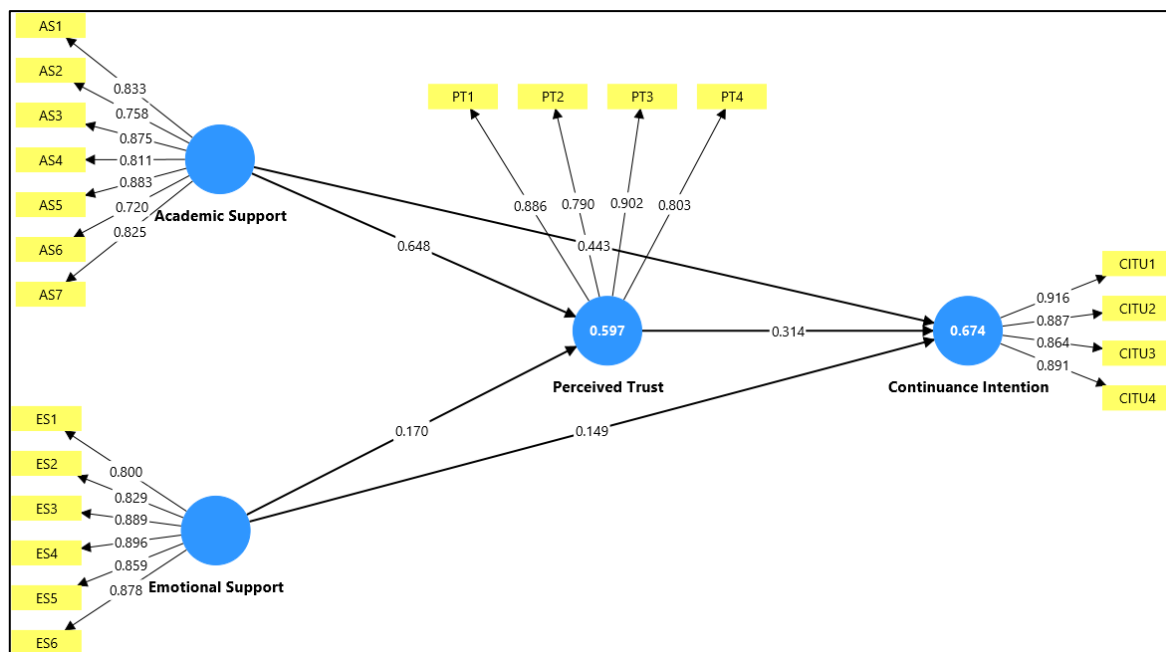


Figure 2: Structural Model

Indirect Relationships

The mediation analysis was performed to test the indirect effects of academic support and emotional support on continuance intention via perceived trust. The findings indicate that perceived trust plays a significant role in mediating the relationship between academic support and continuance intention ($\beta = 0.204$, $SD = 0.044$, $t = 4.669$, $p < 0.001$). This implies that academic support can strengthen continuance intention not only directly but also indirectly, by promoting trust in ChatGPT. Consequently, H3 is supported.

Table 5: Assessment of Structural Model (*Mediation*)

Hypotheses	Beta	STDEV	<i>t</i>	<i>p</i>	Decision
H3 AS → PT → CITU	0.204	0.044	4.669	0.000	Supported
H4 ES → PT → CITU	0.054	0.023	2.365	0.018	Supported

On the same note, the perceived trust also plays a significant role in mediating between emotional support and continuance intention ($\beta = 0.054$, $SD = 0.023$, $t = 2.365$, $p = 0.018$).

This indicates that emotional support is a contributing factor to continuance intention as a result of building trust. H4 is, therefore, supported as well.

Overall, the findings confirm that trust plays a significant mediating role in strengthening the effects of both academic and emotional support on students' continuance intention.

Coefficient of Determination

The coefficient of determination (R^2) was used to measure the explanatory power of the structural model (Ghafar et al., 2025). Based on Hair et al. (2022), an R^2 value of 0.75 signifies a high level of explanatory power, 0.50 signifies moderate explanatory power, and 0.25 signifies weak explanatory power. In the present study, as indicated in Figure 2, the value of R^2 of perceived trust was 0.597, which implies that both the academic and emotional support can account for a medium percentage of the variation in the trust that the students have towards ChatGPT. In the meantime, the R^2 of continuance intention to use was 0.674, which shows a moderate-strong level of explanation and means that the proposed model is sufficient to explain the intention of students to use ChatGPT further.

In addition, the effect size (f^2) results were also evaluated, to establish the contribution of independent variable to the dependent variable, using the thresholds of Cohen (2013) (0.02 = small, 0.15 = medium, 0.35 = large). The findings show that academic support produces a medium and significant influence on the continuance intention ($f^2 = 0.213$, $p = 0.003$), so it is a strongest predictor. Supportive emotions demonstrate a slight and insignificant impact ($f^2 = 0.036$, $p = 0.177$) meaning that it has a small effect. The perceived trust has a small-to-medium but significant impact on continuance intention ($f^2 = 0.122$, $p = 0.043$). Altogether, academic support is most influential, then there is trust, and the least influential is the emotional support.

Discussion

This paper intended to analyze the effects of academic support and emotional support on university students' continuance intention to use ChatGPT and how perceived trust mediates these effects.

The findings reveal that academic support has a very high and significant positive influence on continuance intention (H1). This observation supports the main assumption of the ISCM in which the perceived usefulness is a key factor that determines further use (Bhattacharjee, 2001). Academic support in this study will be used as a proxy of cognitive value, which includes elements of problem-solving help, content explanation, and knowledge improvement (Ansari & Qamari, 2025). The effect size is also quite big and serves as an additional indication that students are more focused on functional and performance-related advantages when choosing whether to use ChatGPT or not. This is consistent with the existing studies, which indicated that AI tools are mostly embraced and maintained because of their capacity to enhance task efficiency and academic performance (Md-Fared et al., 2026; Yu et al., 2024). Cognitively, the results also have an impact on the idea that AI can lessen cognitive load and improve the efficiency of learning, which makes the users more dependent on the system (Kasneji et al., 2023; Wang & Fan, 2025). Notably, this finding indicates that even when more

socially interactive AI systems emerge, it is the instrumental value of technology that is still the keystone of continuance behaviour. This supports how utilitarian constructs are still constructive in post-adoption models in increasingly human-like AI settings (Akbar et al., 2025; Herzallah et al., 2025).

Regarding the results of H2, emotional support is also positively and significantly important in influencing continuance intention. The effect size is however relatively small implying that emotional support is a contributing factor to sustained usage but a second factor compared to academic support. This finding gives empirical grounds to the accumulating body of literature that frames AI as a functional, relational, and affective agent. The empathetic simulation, encouragement, and conversational interaction capabilities of ChatGPT increase the user experience and prompt repeated interaction (Dwivedi et al., 2023; Guingrich & Graziano, 2023). The results could be explained by the concept of social presence and parasocial interaction, as users start considering AI systems as socially significant beings and develop emotional connections and engagement (Xie et al., 2023; Zhang et al., 2025). However, the comparatively less powerful effect indicates that emotional support on its own cannot be used to stimulate long-term continuance. Instead, it is a complementary factor that makes user engagement more interesting and not a motivating factor. This result is in line with the previous research that shows that experiential and affective factors, though important, are likely to act as support variables in contrast to cognitive and performance-related factors (Ngo et al., 2025; Yin et al., 2024).

In the mediation analysis, it can be seen that perceived trust plays a significant role in mediating the relationships between both academic support and continuance intention (H3), and emotional support and continuance intention (H4). These results show that there is (partial) complementary mediation, and a direct and indirect effect exists simultaneously. This implies that academic and emotional support affect continuance intention in two directions: a direct one based on perceived benefits, and an indirect one based on the establishment of trust. The fact that an academic support indirect effect is stronger demonstrates that trust is easier to build with help of reliable and accurate performance of tasks, which supports the significance of system credibility in educational environments (Choudhury & Shamszare, 2023; Shahzad et al., 2024). Simultaneously, the high mediation impact of emotional support confirms that affective communication also plays a role in trust building, especially by minimizing uncertainty and improving perceived quality of relations (Liang et al., 2024; Zhai, 2023). These results can be attributed to the recent studies implying that trust in AI is not only cognitively determined but also based on emotional and interactional experiences (Kasneci et al., 2023; Liang et al., 2024). Therefore, trust becomes a socio-technical phenomenon that mediates between functional performance and emotional involvement, which explains its importance as an important mechanism in AI continuance behaviour (Choudhury & Shamszare, 2023).

Theoretical Contributions

There are a number of significant theoretical contributions to this study. First, it expands the Information Systems Continuance Model (ISCM) and incorporates both cognitive (academic support) and affective (emotional support) dimensions into one model. Such dual-value view builds upon the previous studies that have been relying on the utilitarian determinants, and

offers a more comprehensive insight into AI continuance behaviour (Bhattacharjee, 2001; Dwivedi et al., 2023). Second, the paper adds to the existing body of literature on the Expectation-Confirmation Theory (ECT) by illustrating that post-adoption assessments in the AI setting are not confined to satisfaction and usefulness but can be conceptualised as multi-dimensional user experiences, involving both functional and emotional value (Oliver, 1980; Jung & Jo, 2025). This implies that the more traditional evaluative constructs are replaced with more experience-driven determinants in AI-based settings. Third, the results emphasize the mediating importance of perceived trust as one of the primary psychological processes in human-AI interaction. The study will add to the increasingly important discussion of ethical and trustful AI adoption, by creating a connection between user experience and behavioural intention through the establishment of trust (Kasneci et al., 2023; Liang et al., 2024). Lastly, the paper presents empirical data of the Malaysian higher education setting that has been underresearched in AI studies. The results show that although international trends of AI application can be generalized, situational considerations can contribute to the comparative significance of cognitive and affective motivation (Md-Fared et al., 2026).

Practical Implications

The research results have a number of implications in practice to educators, policymakers, and developers of AI. As a educator, the findings indicate that the adoption of ChatGPT in the academic institution needs to focus on its instructional and problem-solving abilities, since these are the first factors that would ensure further application (Yu et al., 2024). Nevertheless, the introduction of elements that facilitate emotional involvement can also help to increase student experience and motivation (Yin et al., 2024). The findings have implications on policymakers and education institutions in Malaysia, as they should have guidelines that guarantee the reliability and ethical application of AI tools because trust is a key factor to effective and sustained adoption (Shahzad et al., 2024). The introduction of AI literacy and critical evaluation skills among students should be seen as important initiatives to ensure that the benefits are fully realised as the risks are minimised. To AI developers, the findings underscore the necessity of developing systems which are accurate, transparent, and responsive to emotions. Although the technical performance is still paramount, conversation and empathetic features should be enhanced to build user trust and long-term interactions.

Limitations and Future Research

This research has a number of limitations although it has made its contributions. To begin with, cross-sectional data does not enable the determination of causal relationships. The longitudinal designs ought to be used in future studies to investigate the change in continuance intention over time. Second, the research is based on self-reported data, which can be affected by the common method bias. Future research may include behavioural data in usage to confirm the results. Third, the research is carried out in the Malaysian higher education setting, which could restrict the generalisability. It is advised to compare studies in various cultural and educational backgrounds. Lastly, further studies can include more constructs like satisfaction, perceived risk, or AI dependency to better understand post-adoption behaviour in AI environments.

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Appendix

Questionnaire Survey:

Academic support:

1. "I use ChatGPT to paraphrase complex academic concepts for better understanding".
2. "ChatGPT helps me develop counterarguments to strengthen my academic writing".
3. "I use ChatGPT to generate ideas for my academic writing".
4. "I use ChatGPT to generate drafts that I edit and finalize myself".
5. "ChatGPT assists me in finding relevant sources or references for my research".
6. "ChatGPT saves me time and effort in academic writing".
7. "ChatGPT allows me to explore ideas that I may not have considered on my own".

Emotional support:

1. "The AI tool understood my emotional needs".
2. "I felt more supported after using the ChatGPT intervention compared to other methods of seeking help".
3. "The AI responses were empathetic and helpful in addressing my concerns".
4. "The AI tool provided practical advice for managing stress, anxiety, or other emotional challenges".
5. "The AI tool helped me feel more in control of my emotional well-being".
6. "I experienced emotional or psychological benefits from using the AI tool that I had not anticipated".

Perceived trust:

1. "I trust that all activities I perform on ChatGPT will be confidential and secure".
2. "I feel that ChatGPT would maintain the privacy of my personal data".
3. "I believe that ChatGPT will prevent unauthorized access to my personal information".
4. "I believe using ChatGPT for interaction is sufficiently secure".

Intention concerning continued use:

1. "I intend to continue using ChatGPT for academic support".
2. "I intend to continue using ChatGPT for emotional support".
3. "I plan to recommend ChatGPT to others for both academic and emotional support".
4. "Overall, I intend to continue using ChatGPT to support both my learning and emotional well-being".

PATTERNS OF SOCIAL MEDIA USAGE AMONG STUDENTS AT POLITEKNIK MERSING JOHOR

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Abstract: *Social media has become deeply embedded in students' everyday lives, influencing patterns of communication, information access, and digital interaction. Examining students' social media use is therefore essential to understanding how digital platforms shape behavioural tendencies and learning experiences in higher education contexts. This study aims to examine the patterns of social media usage among students at Politeknik Mersing Johor. Using a quantitative descriptive survey design, data were collected from 193 students across different academic programmes and semesters through an online questionnaire and analysed using descriptive statistics. The findings indicate that social media usage is highly prevalent among the respondents. TikTok and YouTube were the most widely used platforms, followed by Instagram and Telegram, while TikTok emerged as the most frequently used platform overall. Most students reported spending between four and six hours per day on social media, indicating that these platforms form a significant part of their daily routine. The results also show that students primarily use social media for communication, entertainment, and social interaction rather than for academic purposes. Overall, the study provides a clear institutional profile of students' digital behaviour and offers useful insights for polytechnic administrators and educators in planning communication strategies, promoting digital well-being, and integrating social media more purposefully into educational practices.*

Keywords: *Digital Social Usage, Online Interaction, Technical Education Institutions*

Introduction

Social media has become deeply embedded in the daily lives of students in higher education, influencing how they communicate, access information, and interact within digital environments (Goodyear et al., 2025). Platforms such as TikTok, YouTube, Instagram, Telegram, and Facebook are widely used for communication, entertainment, information seeking, and social interaction. As digital technologies continue to shape students' lifestyles and engagement patterns, understanding how students use these platforms has become increasingly important for educational institutions (Smith & Storrs, 2023).

In higher education, social media serves not only as a tool for informal interactions but also as a means for students to maintain peer connections, obtain information, respond to institutional messages, and sometimes engage with learning-related content (Smith & Storrs, 2023). Its growing role in student life offers various opportunities and challenges. Conversely, Smith & Storrs (2023) also highlighted that social media can support communication, teamwork, and

access to educational materials. However, excessive and habitual use might lead to distractions, dependence, and diminished academic concentration (Sun & Chao, 2024; Goodyear et al., 2025).

For polytechnic institutions, examining students' actual patterns of social media usage is particularly important. Polytechnic students are part of a digitally connected student population whose daily routines are increasingly linked to mobile devices and online platforms (Zikri, 2023). Knowledge of the platforms they use most frequently, the time they spend online, and the variations across demographic groups can assist institutions in developing more effective communication strategies, supporting student well-being, and encouraging more purposeful educational uses of social media (Goodyear et al., 2025).

Although social media use among students has been widely discussed in higher education research, contextual evidence at the institutional level remains necessary because usage patterns may vary according to educational setting, student characteristics, and disciplinary background (Al-Qaysi, 2023; Smith & Storrs, 2023). In the context of Malaysian higher education settings, such as polytechnic, empirical evidence remains limited, particularly with regard to platform preference, daily usage duration, and demographic differences in usage patterns (Mat Isa et al., 2022; Jafry et al., 2023). Therefore, this study focuses on students at Politeknik Mersing Johor in order to provide an institutional profile of their social media behaviour.

Accordingly, this study aims to:

1. identify the social media platforms most commonly used by students at Politeknik Mersing Johor;
2. examine the amount of time students spend on social media each day;
3. analyse the overall pattern of social media usage among students; and
4. to describe social media usage according to respondents' demographic background, namely gender, age, programme, and semester.

Literature Review

Social Media in Higher Education

Social media has become a central feature of student life in higher education and is now widely regarded as part of the broader digital culture of contemporary learners (Goodyear et al., 2025). Its role extends beyond entertainment and interpersonal communication to include information exchange, peer interaction, identity expression, and limited forms of academic engagement (Smith & Storrs, 2023). As a result, social media is increasingly recognised as an influential element of the student experience in higher education.

The growth of social media use in educational contexts has attracted considerable scholarly attention because these platforms shape communication patterns, access to information, and forms of participation among students (Al-Qaysi et al., 2023). In many higher education settings, social media intersects with both formal and informal aspects of student life, including institutional communication, social networking, collaborative exchange, and exposure to learning-related materials (Smith & Storrs, 2023). This suggests that understanding students'

social media practices is essential for institutions seeking to respond effectively to changes in student behaviour and engagement.

Patterns of Social Media Usage Among Students

Previous studies indicate that student social media usage is influenced by factors such as convenience, accessibility, immediacy, visual appeal, and entertainment value (Al-Qaysi et al., 2023; Goodyear et al., 2025). Platforms that are highly visual and mobile-friendly often attract greater engagement, especially among younger users who prefer fast, interactive, and personalised content (Goodyear et al., 2025). Students also tend to maintain accounts on multiple social media platforms, although their attention is typically concentrated on one or two preferred applications that dominate their daily digital routines (Astleitner & Schlick, 2025).

The amount of time students spend on social media is another major aspect of usage patterns. According to Koenig (2006), studies have shown that many students spend several hours per day browsing content, communicating with others, and consuming entertainment through social media platforms (Author, Year; Author, Year). Such frequent engagement indicates that social media is not a peripheral activity, but rather a routine component of everyday student life (Goodyear et al., 2025). Understanding these usage patterns is important because the frequency and duration of engagement may shape students' communication habits, attention patterns, and broader educational experiences (Sun & Chao, 2024; Al-Qaysi et al., 2023).

Social Media for Communication and Learning

According to Goodyear et al. (2025), social media is widely used by students for communication, entertainment, and social interaction, which remain among the most common motivations for daily engagement with digital platforms. Through these platforms, students maintain contact with peers, participate in online communities, follow trends, and consume a wide range of multimedia content. The strong appeal of social media in student life is closely linked to its immediacy, convenience, and capacity to support continuous connection within digitally mediated environments (Al-Qaysi et al., 2023).

At the same time, social media also has potential value in educational settings. Students may use these platforms to access announcements, exchange information about coursework, discuss academic matters, and connect with learning communities (Smith & Storrs, 2023). However, the educational contribution of social media depends largely on how intentionally and effectively these platforms are integrated into teaching, learning, and institutional communication (Al-Qaysi et al., 2023). Although some studies have shown that social media can support learning when used in structured and meaningful ways, others indicate that students continue to use it predominantly for non-academic purposes rather than for formal educational activities (Zhang et al., 2024). This suggests that the educational potential of social media should not be assumed, but instead examined in relation to students' actual usage behaviour.

Demographic Differences in Social Media Usage

Social media usage may vary across demographic factors such as gender, age, academic programme, and level or semester of study. Previous research suggests that such differences may reflect variation in communication preferences, digital habits, lifestyle patterns, and familiarity with particular forms of online content (Goodyear et al., 2025). Gender differences, in particular, have received considerable attention, with some studies reporting higher engagement among female students, while others indicate that usage patterns differ according to platform type and purpose of use (Aran-Ramspott et al., 2024). Aran-Ramspott et al. (2024) also argued that age and educational background may shape social media behaviour, as students from different academic programmes or stages of study may vary in their platform preferences, intensity of use, and reasons for engagement. These differences are important because student populations are not homogeneous, and institutional strategies based on broad assumptions may overlook meaningful variation within the student body (Al-Qaysi et al., 2023). A demographic perspective, therefore, offers a more nuanced understanding of social media usage patterns in higher education (Al-Qaysi et al., 2023; Goodyear et al., 2025).

Research Methodology

This study employed a quantitative descriptive survey design to examine patterns of social media usage among students at Politeknik Mersing Johor (PMJ). The population comprised students from Semester 1 to Semester 5 across several academic programmes at PMJ during the Second Session of the 2024/2025 academic year. A total of 193 students participated in the study.

The respondents consisted of 96 male students (49.7%) and 97 female students (50.3%). They were drawn from five academic programmes, namely the Diploma in Information Technology (DIT/DDT), Diploma in Electrical and Electronic Engineering (DEE), Diploma in Electrical Engineering (DET), Diploma in Office Management and Secretary Studies (DSK), and Diploma in Business Studies (DPM). The sample was obtained using convenience sampling based on students' voluntary participation in the online survey.

Research Instrument and Data Collection

Data were collected using an online questionnaire administered through Google Forms. The instrument consisted of two main sections. The first section collected respondents' demographic information, including gender, age, programme, and semester. The second section focused on social media usage patterns, including preferred platforms, daily time spent, frequency of use, interaction with friends on social media, use during feelings of loneliness, and use of social media for learning.

A pilot study was conducted prior to data collection to assess the instrument's reliability. The questionnaire demonstrated good internal consistency, with a Cronbach's Alpha value of .840, indicating that the instrument was reliable for the purposes of the study. The questionnaire link

was distributed online to students, and responses were collected electronically. Participation in the survey was voluntary, and the data obtained were used solely for research purposes.

Results

Respondent profile

The respondent profile suggests a broadly distributed student sample. Female students represented 50.3% of the sample and male students 49.7%. Most respondents were aged 18–19 years (47.7%) or 20–21 years (43.5%). The largest programme group was DDT/DIT (45.1%), followed by DPM (19.2%), DEE (17.6%), DSK (10.9%), and DET (7.3%). Semester 2 students formed the largest semester group (36.3%), followed by Semester 4 students (32.6%).

Table 1. Demographic profile of respondents

Characteristic	Category	n	%
Gender	Male	96	49.7
	Female	97	50.3
Age	18–19 years	92	47.7
	20–21 years	84	43.5
	22 years and above	17	8.8
Programme	DDT/DIT	87	45.1
	DPM	37	19.2
	DEE	34	17.6
	DSK	21	10.9
	DET	14	7.3
Semester	Semester 1	37	19.2
	Semester 2	70	36.3
	Semester 3	10	5.2
	Semester 4	63	32.6
	Semester 5	13	6.7

Social media platforms used

Table 2 shows that social media usage was highly prevalent across the sample. TikTok and YouTube were the most used platforms, each selected by 88.1% of respondents, followed closely by Instagram (86.0%) and Telegram (78.2%). Facebook, X/Twitter, and Snapchat were used by substantially smaller proportions of students. The distribution indicates a clear preference for video-based, highly visual, and mobile-friendly platforms.

Table 2. Social media platforms used by respondents (multiple responses allowed)

Platform	n	%
TikTok	170	88.1
YouTube	170	88.1
Instagram	166	86.0

Telegram	151	78.2
Facebook	71	36.8
X/Twitter	54	28.0
Snapchat	30	15.5

Preferred platform and time spent on social media

When respondents were asked to select the single platform they used most frequently, TikTok was dominant, accounting for 65.3% of responses. YouTube (18.1%) and Instagram (14.0%) followed at a considerable distance. This suggests that while students maintain accounts across several platforms, day-to-day attention is concentrated on a narrower set of platforms, particularly TikTok.

Table 3. Most frequently used social media platform

Platform	n	%
TikTok	126	65.3
YouTube	35	18.1
Instagram	27	14.0
Facebook	3	1.6
Telegram	1	0.5
X/Twitter	1	0.5

Social media use was also intensive in terms of time spent. Nearly half of the respondents (47.7%) reported spending 4–6 hours per day on social media, while 35.8% reported 1–3 hours per day and 16.6% reported more than 6 hours per day. The results indicate that social media is embedded in students' daily routines rather than being used occasionally or incidentally.

Table 4. Average time spent on social media per day

Duration	n	%
1–3 hours	69	35.8
4–6 hours	92	47.7
More than 6 hours	32	16.6

Descriptive statistics for social media usage

Table 5 presents the descriptive statistics for the five-item social media usage scale. The overall mean was 3.53, which indicates a high level of usage. The highest mean was recorded for the statement "I use social media every day" ($M = 4.61$, $SD = 0.58$), followed by "I use social media for more than 3 hours a day" ($M = 4.20$, $SD = 0.92$). By contrast, "I use social media when I feel lonely" ($M = 2.67$, $SD = 1.37$) and "I use social media for learning purposes" ($M = 2.74$, $SD = 1.25$) obtained lower means. This pattern suggests that students' social media

engagement is driven more by routine use, communication, and entertainment than by explicitly academic purposes.

Table 5. Descriptive statistics for the social media usage items

Item	Mean	SD
I use social media every day.	4.61	0.58
I use social media for more than 3 hours a day.	4.2	0.92
I use social media to interact with friends.	3.46	1.29
I use social media when I feel lonely.	2.67	1.37
I use social media for learning purposes.	2.74	1.25
Overall mean	3.53	-

Demographic differences in social media usage

The descriptive results indicate some variation in overall social media usage across respondents' demographic backgrounds. Female students recorded a higher mean usage score than male students, while some variation was also observed across academic programmes, age groups, and semesters. However, in line with the descriptive nature of this study, these results are interpreted as sample-based patterns only and not as evidence of statistically significant group differences.

Table 6. Mean overall social media usage score by gender

Gender	Mean	SD
Male	3.25	0.73
Female	3.82	0.67

Table 6 shows that female students recorded a higher mean overall social media usage score than male students. Female students recorded a higher mean usage score ($M = 3.82$, $SD = 0.67$) than male students ($M = 3.25$, $SD = 0.73$).

Discussion

The findings confirm that social media occupies a central place in the everyday lives of students at Politeknik Mersing Johor. The dominance of TikTok, YouTube, and Instagram suggests that students are strongly oriented towards visually rich and algorithm-driven platforms. This pattern is consistent with broader higher education literature showing that students' platform choices are shaped by convenience, immediacy, entertainment value, and multimedia interaction (Perez et al., 2023; Zachos et al., 2018).

The time-based findings reinforce the same point. With almost half of the sample spending 4–6 hours per day on social media and another 16.6% exceeding 6 hours daily, social media is not a peripheral activity in student life. Rather, it forms part of the environment through which students maintain peer contact, consume information, and structure daily routines. Similar patterns have been reported in other university settings, where social media is closely linked to communication, social interaction, and everyday information seeking (Kolhar et al., 2021).

At the same time, the relatively low mean for social media use for learning purposes is notable. Although social media can support collaboration, content sharing, and course communication, the present findings indicate that students at Politeknik Mersing still use it primarily for non-academic purposes. This supports earlier work suggesting that educational benefits do not arise automatically from platform access, but depend on purposeful design, facilitation, and alignment with learning goals (Dumpit & Fernandez, 2017; Sivakumar et al., 2023; Sobaih et al., 2016).

The gender difference observed in this study also deserves attention. Female students reported significantly higher overall usage than male students. This aligns with evidence from other higher education contexts showing that female students often report higher viewing or posting frequency and greater involvement in online social activity (Dumford et al., 2023). The small but significant variation across academic programmes suggests that media engagement may also be influenced by disciplinary context and student cohort culture. This result warrants further qualitative or mixed-method inquiry into how different groups of students use and interpret digital platforms.

Taken together, the results point to several practical implications. First, polytechnics should treat social media literacy and digital well-being as part of student development rather than as peripheral concerns. Second, institutional communication strategies should align with the platforms students actually use most. Third, academic staff may benefit from support in incorporating high-traffic platforms into teaching in ways that are structured, purposeful, and pedagogically appropriate.

Limitations and Future Research

This study has several limitations that should be acknowledged. First, the study was conducted at a single institution, namely Politeknik Mersing Johor, which limits the generalisability of the findings to other polytechnics or higher education contexts. Second, the data were collected through self-reported responses via an online questionnaire, which may be subject to response bias or differences in students' interpretations of the items. Third, although the study provides a useful descriptive profile of students' social media usage, it does not explore in depth the underlying reasons for platform preference, patterns of engagement, or the academic and psychological implications of such usage. Future research could therefore expand the sample to include multiple polytechnic institutions or other higher education settings, and could employ qualitative or mixed-method approaches to examine students' motivations, experiences, and perceptions in greater depth. Further studies may also investigate the relationship between social media usage and variables such as academic performance, digital well-being, and learning engagement.

Conclusion

In conclusion, this study shows that social media plays a substantial role in the daily lives of students at Politeknik Mersing Johor. TikTok, YouTube, and Instagram emerged as the dominant platforms, with TikTok the most frequently used overall, while most students

reported spending between four and six hours per day on social media. The findings also indicate that social media is used primarily for communication, entertainment, and social interaction rather than for academic purposes. In addition, the study identified variation in usage patterns across demographic groups, particularly by gender and academic programme. Overall, the study provides a clear institutional profile of students' digital behaviour and highlights the importance of aligning institutional communication, digital well-being efforts, and educational strategies with students' actual social media use patterns.

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STUDENTS' PERCEPTIONS OF METAVERSE-BASED LEARNING AT THE MATRICULATION LEVEL

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Abstract: *In recent years, the advancement of digital technology has influenced the education field, including the use of emerging technologies such as Metaverse in learning process. However, the acceptance of Metaverse as a platform for learning, especially in Mathematics subject, is still not clearly understood among matriculation students. Some students still rely on traditional learning methods and may not fully utilise digital learning tools, which raises the question on how far they accept this new technology. Therefore, this study aims to examine the acceptance of matriculation students towards Metaverse-based learning in Mathematics subject. Specifically, this study focuses on three main constructs which are Perceived Usefulness (PU), Perceived Ease of Use (PEOU) and Behavioural Intention (BI) based on Technology Acceptance Model (TAM). This study employed a quantitative approach using survey method. A set of questionnaires was distributed to 120 matriculation students who have experience using Metaverse in their learning. The findings show that the level of students' acceptance towards Metaverse-based learning is high for all three constructs. Where Perceived Usefulness (mean=3.89), Perceived Ease of Use (mean=3.91) and Behavioural Intention (mean=3.64). In conclusion, this study suggests that Metaverse has potential to be used in learning in Mathematics.*

Keywords: *Metaverse; Perceptions; Matriculation; Mathematics*

Introduction

In recent years, the rapid advancement of digital technology has significantly influenced the education sector. Various emerging technologies have been introduced to enhance teaching and learning processes, including the use of Metaverse as an immersive learning environment. The Metaverse integrates elements such as virtual interaction, 3D environments and real-time communication, which provide new opportunities for students to experience learning beyond traditional classroom settings (Mystakidis, 2022).

In the context of Mathematics education, the use of Metaverse has the potential to support students' understanding of abstract concepts through visualisation and interactive learning. Previous studies have shown that immersive technologies such as virtual reality and augmented reality can improve students' engagement and understanding in Mathematics learning (Al-Ansi et al., 2023). However, despite its potential, the level of acceptance among students remains an important factor that determines whether such technology can be effectively implemented. Some students still rely on conventional teaching methods and may not fully utilise digital

learning tools in their learning process. This raises the question on how far students accept the use of Metaverse in learning Mathematics. Therefore, understanding students' acceptance towards the use of Metaverse is very important before integrating it widely into education. This study is guided by the Technology Acceptance Model (TAM), which focuses on users' perceptions towards technology adoption (Davis, 1989). Thus, this study aims to determine the level of acceptance among matriculation students towards the use of Metaverse in learning Mathematics based on three constructs: Perceived Usefulness (PU), Perceived Ease of Use (PEOU), and Behavioural Intention (BI).

Literature Review

Role of Metaverse in Mathematics Education

The development of digital technology has introduced new learning environments such as the Metaverse, which allows users to interact in immersive and three-dimensional virtual spaces. The Metaverse is considered as an extension of virtual reality where users can engage in real-time interaction and collaborative activities (Almurtadha, 2025).

In Mathematics education, the Metaverse provides opportunities for students to visualise abstract concepts which are often difficult to understand through traditional teaching methods. For example, concepts such as geometry, graphs and vectors can be explored in a more interactive and spatial way. This immersive experience can help students to build better conceptual understanding (Aufenanger et al., 2025).

Previous studies have shown that immersive technologies such as virtual reality can enhance students' engagement and learning experience. According to Johan, Kyra & Jasmin (2025), immersive virtual learning environments can increase students' motivation and presence during learning activities. Similarly, a study by Alazmi & Alemtairy (2024) found that the use of immersive environments in education can support active learning and collaboration among students.

In addition, the use of Metaverse-based learning environments allows students to experience learning in a more meaningful way through exploration and interaction. This is important in Mathematics learning, where students often face difficulties in understanding abstract and symbolic representations (Azmidar & Husan, 2022). Therefore, the Metaverse can play an important role in transforming Mathematics education into a more engaging and student-centred learning process.

Usefulness and Ease of Use of Metaverse in Mathematics Education

The acceptance of any new technology in education depends largely on how useful and easy the technology is perceived by users. In the context of Metaverse, perceived usefulness refers to the extent to which students believe that the technology can enhance their learning performance, while perceived ease of use refers to how effortless the technology is to use (Mohd Jamel, 2025).

Studies have shown that immersive technologies can improve students' learning outcomes and engagement. For instance, Anggara et al. (2024) reported that virtual reality and augmented reality applications can enhance students' understanding and interest in learning. This indicates that such technologies are perceived as useful in supporting learning processes.

Furthermore, ease of use is an important factor that influences students' acceptance. If a technology is too complicated, students may feel frustrated and avoid using it. A study by Barz et al. (2024) found that students are more likely to adopt digital learning tools when they perceive them as easy to use and user-friendly. Similarly, Huang et al. (2023) highlighted that usability and accessibility are key factors in determining students' engagement in Metaverse-based learning environments.

In Mathematics education, ease of use is particularly important because students need to focus on understanding the content rather than struggling with the technology itself. When the Metaverse platform is easy to navigate, students can spend more time exploring mathematical concepts and less time dealing with technical difficulties (Al-kfairy, Alfandi & Khaddaj, 2025). Therefore, both usefulness and ease of use are important factors that influence students' acceptance towards the use of Metaverse in learning Mathematics.

Behavioural Intention of Metaverse in Mathematics Education

In the context of Metaverse-based learning, behavioural intention reflects students' readiness and willingness to engage with immersive virtual environments for learning purposes. Recent studies have shown that students' behavioural intention towards Metaverse is influenced by several factors such as perceived usefulness, perceived enjoyment, and ease of use. For example, Al-Adwan et al. (2023) found that perceived usefulness and enjoyment significantly influence students' intention to adopt Metaverse in education. Similarly, Nguyen (2024) reported that technological factors and user readiness contribute to students' intention to use Metaverse platforms. These findings indicate that students are more likely to use Metaverse when they perceive it as beneficial and engaging.

In Mathematics education, behavioural intention is particularly important because students often face challenges in maintaining motivation when learning abstract concepts. The use of Metaverse can provide interactive and immersive experiences that increase students' interest and engagement in learning Mathematics. When students develop a positive intention to use Metaverse, they are more likely to explore mathematical concepts actively and participate in learning activities. However, some studies also highlight that factors such as lack of familiarity or perceived risks may reduce students' intention to adopt the technology (Dwivedi et al., 2022). Therefore, understanding behavioural intention is essential to evaluate students' acceptance and readiness towards the use of Metaverse in Mathematics learning.

Technology Acceptance Model

The Technology Acceptance Model (TAM) is one of the most widely used models to explain users' acceptance of technology. The model was introduced by Davis (1989) and has been extensively applied in various fields, including education and e-learning.

According to TAM, two main factors influence users' acceptance of technology, which are Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). These two factors affect users' Behavioural Intention (BI) to use the technology. PU refers to the degree to which a person believes that using a system will improve their performance, while PEOU refers to the degree to which a person believes that using a system will be free of effort (Alsyouf, 2023).

Many studies have applied TAM in the context of digital learning. For example, Badda (2025) extended the TAM model and found that perceived usefulness and ease of use are strong predictors of behavioural intention. In addition, a study by Mailizar et al. (2021) found that TAM is effective in explaining students' acceptance of e-learning systems during the COVID-19 pandemic.

In the context of Metaverse, TAM is also relevant in understanding how students perceive and accept this new technology. A recent study by Alotaibi (2026) found that perceived usefulness and ease of use significantly influence users' intention to adopt Metaverse platforms. Similarly, Dwivedi et al. (2022) highlighted that user acceptance is a critical factor for the successful implementation of Metaverse technologies. Therefore, TAM provides a suitable theoretical framework for this study to examine students' acceptance towards the use of Metaverse in learning Mathematics.

Methodology

This study employed a quantitative research design using a survey method to determine the level of students' acceptance towards the use of Metaverse in learning Mathematics. The quantitative approach was chosen as it allows the researcher to collect numerical data and analyse the overall trend of students' perceptions in a structured manner (Lim, 2025). The respondents of this study consisted of 120 matriculation students who have prior experience using the Metaverse platform in their learning process. The selection of respondents was based on purposive sampling, as only students who have used the Metaverse were considered suitable for this study. This is important to ensure that the respondents are able to provide meaningful responses based on their actual experience.

The instrument used in this study was a set of questionnaires developed based on the Technology Acceptance Model (TAM). The questionnaire consists of three main constructs, namely Perceived Usefulness (PU), Perceived Ease of Use (PEOU) and Behavioural Intention (BI). The questionnaire was divided into two sections. Section A consists of demographic information such as gender and type of device used by the respondents. Section B consists of items measuring the three TAM constructs.

Each construct contains several items:

- Perceived Usefulness (PU): 5 items
- Perceived Ease of Use (PEOU): 6 items
- Behavioural Intention (BI): 5 items

All items were measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). A reliability analysis was conducted to ensure the internal consistency of the instrument. The Cronbach's alpha values for all constructs were found to be above the acceptable threshold of 0.70, indicating that the instrument is reliable and suitable for data collection (Pallant, 2020).

The data were collected through the distribution of questionnaires to the respondents after they have experienced using the Metaverse platform in their learning. The respondents were given sufficient time to complete the questionnaire, and all responses were collected for analysis. The data collected were analysed using descriptive statistics, including mean to determine the level of acceptance for each construct. The interpretation of mean scores was categorised into three levels: low, moderate, and high based on table 1 (Hadiyanto et al., 2013).

Table 1: Interpretation for Mean Score

Mean Score	Interpretation
1.00 – 2.33	Low
2.34 – 3.66	Moderate
3.67 – 5.00	High

Findings

The findings of this study present the level of students' acceptance towards the use of Metaverse in learning Mathematics based on three constructs: PU, PEOU, and BI. Out of 120 respondents, a total of 54 (45%) were male students, while 66 (55%) were female students. This indicates that the respondents of this study consist of both male and female matriculation students who have experience using Metaverse in their learning.

Table 2: Demographic Profile

Gender	Frequency	Percentage (%)
Male	54	45
Female	66	55
Total	120	100

The distribution shows that more female respondents participated in this study. However, this study does not aim to compare the acceptance based on gender, but only to describe the overall acceptance of students towards the use of Metaverse in learning Mathematics.

The findings show that 48 students (40%) used smartphones when using the Metaverse platform. Meanwhile, 39 students (32.5%) used tablets or iPads, and 33 students (27.5%) used computers.

Table 3: Device Used by Respondents

Devices	Frequency	Percentage (%)
Smartphones	48	40
Tablets or Ipad	39	32.5
Personal Computers	33	27.5

These results indicate that the majority of students prefer to use smartphones when engaging with the Metaverse platform compared to other devices. This may be due to the accessibility and convenience of smartphones, which allow students to access learning platforms more easily at any time.

Table 4: Mean for PU, PEOU and BI

Constructs	Mean	Level
Perceived Usefulness (PU)	3.89	High
Perceived Ease of Use (PEOU)	3.91	High
Behavioural Intention (BI)	3.64	High

Based on Table 4, the results indicate that all three constructs are at a high level. Among the constructs, Perceived Ease of Use (PEOU) recorded the highest mean value (3.91), followed by Perceived Usefulness (PU) (3.89), and Behavioural Intention (BI) (3.64). This shows that students generally perceive the Metaverse as easy to use and useful in supporting their learning of Mathematics.

Discussions

The findings of this study indicate that matriculation students have a high level of acceptance towards the use of Metaverse in learning Mathematics. The high level of Perceived Usefulness suggests that students believe the Metaverse can support their understanding of mathematical concepts, especially through interactive and immersive environments.

This finding is supported by previous research which shows that immersive technologies can enhance students' engagement and learning experience (Mystakidis, 2022). In addition, the high level of Perceived Ease of Use indicates that students do not face major difficulties when using the Metaverse platform.

The findings also show that students have positive Behavioural Intention towards using the Metaverse. This is consistent with studies which found that when students perceive technology as useful and easy to use, they are more likely to adopt it in their learning (Mailizar et al., 2021).

However, this study only focuses on the level of acceptance and does not examine the relationship between the constructs. Future research may explore deeper analysis such as the relationships between TAM constructs or the impact on students' achievement.

Conclusion

In conclusion, this study found that the level of acceptance among matriculation students towards the use of Metaverse in learning Mathematics is high across all three constructs: Perceived Usefulness, Perceived Ease of Use, and Behavioural Intention. The findings suggest that the Metaverse has potential to be used as a learning tool in Mathematics education. However, further studies are needed to explore its effectiveness and deeper relationships between variables.

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FACTORS INFLUENCING THE USE OF ARTIFICIAL INTELLIGENCE AMONG HIGHER EDUCATION STUDENTS

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Abstract: *The extraordinary development of artificial intelligence (AI) is revolutionizing a number of industries, including education, where tools driven by AI are introducing novel teaching strategies and educational opportunities today. This study examines the factors that affect students' use of artificial intelligence in higher education by measuring perceived usefulness (PU), perceived ease of use (PEOU), and intention to utilize AI using the Technology Acceptance Model (TAM). Full time students from Diploma in Secretarial Science program, Commerce Department at Polytechnic Mersing, Johor, will participate in the study with a population of N=130 and a sample size of S=97 full-time. This study used a quantitative approach which is, the survey questionnaire was created using the Technology Acceptance Model (TAM) as a basis, emphasizing its three main constructs which are perceived usefulness, perceived ease of use, and intention to use. A pilot test also is conducted for 30 students and each item on the original questionnaire, which had 14 items, was scored on a 5-point Likert scale that went from 1 (strongly disagree) to 5 (strongly agree). Furthermore, demographic factors including gender, year level, and frequency of AI usage were incorporated to offer a contextual understanding of the backgrounds of the respondents. In order to improve the efficient usage of AI in education, several steps should be taken to promote responsible AI use by introducing required AI ethics and application training sessions for students from different disciplines to seek a thorough ethical considerations, limitations, and best practices of various AI technologies.*

Keywords: *(Perceived Usefulness, Perceived Ease of Use, Utilization Intention)*

Introduction

The remarkable growth of artificial intelligence (AI) is changing a number of sectors, including education, where tools driven by AI are creating new pedagogical strategies and educational opportunities (Luckin et al., 2018). Students and teachers face both new opportunities and concerns as AI application offers such as intelligent tutoring systems, automated grading, and personalized learning applications become more widely used in education (Chen et al., 2020). Because of this, comprehending how students view AI's role in education will be essential to assuring its successful adoption and optimizing its advantages as it challenges conventional teaching approaches.

Higher education is one of the industries most affected by Artificial Intelligence (AI), which has emerged as a transformative force due to the Fourth Industrial Revolution's (IR 4.0) rapid expansion. AI in education (AIEd) includes tools like automated administrative systems, individualized learning platforms, and generative AI (e.g., ChatGPT, Claude) that are intended to improve the educational experience. Recent research indicates that integrating AI is now

essential to preserving educational relevance in a world that prioritizes digital technology (Zhai et al., 2021). Thus, the main end users of these technologies in the context of higher education mostly students. The success of university digital transformation programs depends on their readiness to embrace and use AI into their learning process. According to Alshater (2022), adoption of AI is frequently dependent on how students view the technology's complexity and its immediate benefits to their grades and research, even though it offers the possibility of personalized learning and better efficiency.

According to Otermans et al. (2025), Artificial Intelligence (AI) is driving a "technological reset" in higher education. In contrast to other digital revolutions, including the shift to online Learning Management Systems (LMS), Artificial Intelligence (AI) signifies a change from information-storing tools to knowledge-generating and synthesizing tools. AI programs like ChatGPT, Claude, and specialized research agents have evolved into "cognitive co-pilots" for college students, helping with everything from complicated data analysis to coding and language translation.

Besides that, the effectiveness of integrating AI in higher education is more dependent on students' behavioral intentions than on the technology itself. The Technology Acceptance Model (TAM) states that this goal is based on how students view the tool's "effort-to-reward" ratio (Davis, 1989). According to recent research, students have a high awareness of AI, but their real usage habits vary. There is a "usage gap" that academics are still attempting to map because some students use AI for deep learning and brainstorming while others see it only as a way to do assignments quickly (Cervantes & Navarro, 2025).

Problems Statement

Even though sophisticated AI technologies are readily available, minimal is known about the precise factors that influence students' persistent use of them. Some students embrace AI for efficiency, but others are skeptical because they do not have enough digital literacy or think it will be hard to use AI interfaces. According to earlier research, users' psychological and functional impressions are just as important to technology adoption as its accessibility (Davis, 1989). Higher education institutions may find it difficult to apply AI tactics that genuinely meet the demands of their students if these impacting elements are not identified, which could result in under utilization of costly digital resources. These are few concerns that has been arise within the growth of Artificial Intelligence (AI) among students in Higher Education.

Firstly, ethical and reliability become one of the concerns in using Artificial Intelligence (AI). Students view AI as a challenging technology, bringing up concerns about its dependability, moral implications, and possibility of academic dishonesty. Second concern is lack of preparedness towards AI can also become the concerns among student which is, the research suggests that many students might not be ready or eager to make the most of these capabilities even though it helps to increase student engagement (Zawacki-Richter et al., 2019).

The third concern is fear of replacement which is, students are skeptical about AI's use in education because they frequently worry that technology will supplant human intelligence. Lastly, the variable digital literacy that involve students' varying degrees of their digital literacy

can make it more difficult to determine whether Artificial Intelligence (AI) is seen as a beneficial tool or a dangerous disruption (Selwyn, 2021).

Although the use of AI in higher education has grown, little is known about how business students especially in developing nation has perceive these tools which are perceived usefulness (PU) and perceived ease of use (PEOU) in using Artificial Intelligence (AI). Plus, educational institutions cannot successfully support adoption plans or guarantee that Artificial Intelligence (AI) is used responsibly to optimize academic benefits if they do not comprehend these viewpoints.

Therefore, it is important for higher education institutions to address these issues early on and provide necessary supports. This research study is conducted to identify the most influential factor that influence the usage of Artificial Intelligence (AI) among students in Higher Education.

Research Questions

RQ1. What is the relationship between Perceived Ease of Use and the Intention to Use Artificial Intelligence among higher education students?

RQ2. What is the relationship between Perceived Usefulness and the Intention to Use Artificial Intelligence among higher education students?

RQ3. Which factor (Perceived Ease of Use or Perceived Usefulness) is the most significant predictor of the Intention to Use Artificial Intelligence among higher education students?

Research Objectives

RO1. To determine the relationship between Perceived Ease of Use and the Intention to Use Artificial Intelligence among higher education students.

RO2. To determine the relationship between Perceived Usefulness and the Intention to Use Artificial Intelligence among higher education students.

RO3. To identify the most influential factor (between Perceived Ease of Use and Perceived Usefulness) that affects the Intention to Use Artificial Intelligence among higher education students.

Literature Reviews

i. The Technology Acceptance Model (TAM) in Artificial Intelligence (AI) Adoption

The Technology Acceptance Model (TAM) continues to be the fundamental framework for comprehending how students embrace new digital resources. Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) are two psychological factors that are central to this approach (Davis, 1989). According to recent research by Ma et al. (2024), higher education students are

more willing to adopt AI if they find these tools useful for particular academic objectives and simple to use without a lot of training.

ii. Social and Institutional Influences

One of the most significant predictors of adoption has been found to be social influence, or the extent to which students witness classmates, teachers, or role models utilizing Artificial Intelligence (AI) successfully (Sova et al., 2024). The infrastructure required for students to effectively employ these tools is provided by institutional support, such as the availability of technical assistance and teachers integrating Artificial Intelligence (AI) into the curriculum (Monzon & Hays, 2025).

iii. Individual Readiness and Digital Literacy

How a student engages with Artificial Intelligence (AI) systems is largely dependent on their level of digital literacy and Artificial Intelligence (AI) readiness. A student must be both mentally and technically prepared to interact with Artificial Intelligence (AI), those who feel ready are much more likely to use Artificial Intelligence (AI) in their courses (Dai et al., 2024).

iv. Ethical Concerns and Trust

Trust, data privacy, and ethical awareness are examples of ethical dimensions that have become important moderating variables. When students believe the system is trustworthy and kind, they are more likely to share personal information and depend on AI results (Do Khac et al., 2025).

Methodology

In this research study, the researcher using quantitative method that used survey questionnaire created according to the Technology Acceptance Model (TAM) as a basis, which emphasizing the three main constructs that consists of perceived usefulness, perceived ease of use, and intention to use. A pilot test also is conducted for 30 students and each item on the original questionnaire, which had 14 items, was scored on a 5-point Likert scale that went from 1 (strongly disagree) to 5 (strongly agree). The research study involved full time students from Diploma in Secretarial Science program, Commerce Department at Polytechnic Mersing Johor which focusing on Semester 1, 2 and 3. The population of N=130 and a sample size of S=97 based on Krejcie and Morgan table (1970) is used in the research study and the sampling technique for the research study is Probability Sampling. The data obtained is analyzed using SPSS Version 26.

Results & Discussion

i. Descriptive Statistics

For the actual study, a total of 130 questionnaires were sent out and 130 respondents provided the feedback.

Table 1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Statistic
Perceived Ease of Use	130	1.00	5.00	3.9215	1.07530
Perceived Usefulness	130	1.00	5.00	3.8250	1.13977
Intention to Use	130	1.00	5.00	3.7615	1.02650
Valid N (listwise)	130				

Table 1 shown that value of mean and standard deviation. The highest mean value is Perceived Ease of Use which is 3.9215. Meanwhile, the highest standard deviation value is Perceived Usefulness which is 1.13977.

ii. Reliability Analysis

Table 2: Reliability Analysis

Variables	No. of Items	Cronbach's Alpha		Internal Consistency
		Pre Testing	Actual Testing	
Perceived Ease of Use	5	.932	.963	Very Strong
Perceived Usefulness	4	.946	.962	
Intention to Use	5	.969	.956	
Total	14			

The study revealed the Cronbach's Alpha analysis for the 14 items during the pre-testing and actual testing. The highest value obtained in pre-testing is Intention to Use, 0.969 and Perceived Ease of Use, 0.963 during the actual testing.

iii. Correlations Analysis

Table 3: Reliability Analysis

Correlations				
		Perceived Ease of Use	Perceived Usefulness	Intention to Use
Perceived Ease of Use	Pearson Correlation	1	.829**	.809**
	Sig. (2-tailed)		0	0

	N	130	130	130
Perceived Usefulness	Pearson Correlation	.829**	1	.838**
	Sig. (2-tailed)	0		0
	N	130	130	130
Intention to Use	Pearson Correlation	.809**	.838**	1
	Sig. (2-tailed)	0	0	
	N	130	130	130
**. Correlation is significant at the 0.01 level (2-tailed).				

All correlation coefficients exceed 0.80, which indicates a very strong positive relationship between all variables. The highest correlation is 0.838, which is the strongest relationship is between Perceived Usefulness and Intention to Use variables. This implies that students' intents to use the Artificial Intelligence (AI) technologies are mostly motivated by their usefulness.

Conclusion & Recommendations

The findings offer factual proof that the Technology Acceptance Model is a very useful tool when it comes to Artificial Intelligence (AI) in higher education. The results indicate that perceived usefulness is the main factor influencing long-term usage intention, even though simplicity of use is crucial for initial acceptance. According to Otermans et al. (2025), educational institutions must show the usefulness and academic advantages of Artificial Intelligence (AI) tools in order to guarantee significant student participation.

A number of actions should be taken to encourage responsible Artificial Intelligence (AI) use in order to improve the effective use of Artificial Intelligence (AI) in education. These actions include requiring Artificial Intelligence (AI) ethics and application training sessions for students from various disciplines to seek out comprehensive ethical considerations, limitations, and best practices of various Artificial Intelligence (AI) technologies.

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MENTAL WELLNESS CHALLENGES IN HOSPITALITY EDUCATION: AN EMPIRICAL STUDY OF DIPLOMA IN HOTEL MANAGEMENT STUDENTS

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Abstract: Higher education students' mental health problems are becoming a bigger global concern, especially in programs that require a lot of professional skills, like hospitality management. In this study, students pursuing a Diploma in Hotel Management at Politeknik Merlimau Melaka, Malaysia, discuss their mental wellness. The study specifically seeks to determine the degree of stress experienced by students, the variables affecting stress, anxiety, and depression, as well as the techniques applied to control these symptoms. From Semester 1 to Semester 4, 92 students were given a structured questionnaire as part of a quantitative study design. Descriptive statistics were used to analyze the data using the Statistical Package for the Social Sciences (SPSS). According to the results, students face a moderate amount of stress related to their studies. The most stressful tasks are finishing assignments at the last minute ($M = 3.30$) and having trouble locating reference materials ($M = 3.64$). Personal circumstances that moderately contribute to psychological suffering include disagreements with classmates ($M = 3.23$) and a shortage of monthly spending money ($M = 3.33$). On the other hand, medium mean scores were found for internal family conflict and lack of a laptop. As coping strategies, students reported a heavy reliance on shopping ($M = 4.18$), listening to music ($M = 3.96$) and engaging in spiritual pursuits like becoming closer to God ($M = 3.95$). In general, the study concludes that academically induced stress is the key factor of mental health problems in hospitality students. The findings indicate that student-focused coping strategies, stress interventions and institutional support are important factors in the creation of psychological wellness in hospitality education.

Keywords: *Mental Wellness, Stress, Anxiety, Depression, Students*

Introduction

Mental wellness encompasses emotional, psychological and social well-being, influencing how individuals think, feel and behave. It affects coping abilities, interpersonal relationships and decision-making processes (National Institute of Mental Health, 2015). Among higher education students, mental health concerns such as stress, anxiety and depression have shown a growing trend (Pedrelli et al., 2015). Survey evidence indicates elevated rates of depression, anxiety and stress among university students linked to academic and social contexts (Othman et al., 2019). Institution of higher learning therefore play an important role in supporting student

well-being as policies and learning environments may significantly influence psychological outcomes (Posselt, 2018). Hospitality education presents unique stressors due to its practical demands, intensive coursework, industry exposure and time-sensitive assignments. Students enrolled in Diploma in Hotel Management programmes must balance theoretical learning with practical competencies, which may increase academic pressure. When academic demands exceed students' coping capacity, psychological distress may occur and potentially affecting academic performance and also overall well-being. Previous studies indicate that untreated stress may lead to anxiety disorders, depression and reduced academic engagement. Therefore, understanding the level and sources of stress among hospitality students is crucial for designing effective intervention strategies. This study investigates mental wellness challenges among Diploma in Hotel Management students at Politeknik Merlimau Melaka by examining stress levels, contributing factors and coping mechanisms.

Literature Review

Mental wellness challenges among university students have been widely documented. Anxiety, depression and stress are the most prevalent psychological concerns in academic settings. Research indicates that academic transitions, workload demands and social adjustments significantly influence students' mental well-being (Pedrelli et al., 2015). According to research conducted in Saudi Arabia, more than 80% of students report having depressive symptoms and almost two-thirds report having anxiety (Malebari et al., 2024). Data from Saudi universities also reveals that stress is moderately to highly prevalent among students in both health and non-health fields (Al-Garni et al., 2025). Furthermore, first-year students, particularly female students, report higher rates of psychological discomfort during their transition to university life.

According to these findings, institutional initiatives to reduce academic stress and promote students' mental health are essential. To encourage a safer and healthier way of life, better awareness campaigns and enhanced mental health surveillance should be taken into consideration (Idzhar and Robinson, 2024). Higher education students often experience moderate to high levels of stress, anxiety and depression, indicating that mental health issues are common among them. Particularly for first-year students who are dealing with new academic and social expectations, the transition to university itself is a crucial time of risk (Affan et al., 2025).

Anxiety

Tension and insecurity are signs of anxiety, which is a typical response to perceived threats (Passer and Smith, 2009). Any change, whether internal or external, ambiguous circumstances, or a sense of unpredictability can trigger anxiety, which is considered a natural human emotion. When faced with a circumstance they are unfamiliar with, most people naturally feel the same level of tension and fear, which is usually referred to as anxiety. Continuous anxiety could affect academic performance, even if moderate anxiety may increase awareness. Anxiety is a common problem for university students, but it can additionally boost academic engagement if it can be controlled. However, excessive anxiety might worsen anxiety symptoms and interfere with daily activities (Muhammad et al., 2021). They will naturally be scared by something

they have never encountered before. Those who perceive a threat will experience fear and anxiety. There is a widespread misunderstanding that anxiety and fear are interchangeable. Anxiety disorders are significantly influenced by behavioural inhibition and environmental factors (Lahat et al., 2011). Factors such as interpersonal interactions, unstable finances and academic expectations are some of the factors that affect anxiety. According to recent controlled trials, teenagers who get cognitive-behavioural therapy (CBT) have significantly lower anxiety scores after participating in CBT-based programs and demonstrating the effectiveness of CBT therapies in lowering anxiety symptoms (Sinha De Silva et al., 2024).

Depression

Depression is characterized by persistent sadness, loss of interest and reduced motivation. 14% of people will experience depression at some point in their lives and making it one of the most common mental health conditions. Although women are twice as likely as men to experience depression, the prevalence and likelihood of depression are influenced by many risk factors that are not related to gender. Among students, depressive symptoms may stem from academic pressure, financial concerns, interpersonal conflicts and maladaptive coping styles. Early intervention and supportive learning environments are critical in preventing long-term psychological consequences. Risk factors for depression include biological vulnerabilities, maladaptive cognitive patterns, financial stress and interpersonal conflicts (Keith and David, 2011). According to Estrella-Proañó et al. (2024), there is a significant correlation between raised depression and anxiety symptoms among first-year university students and risk factors such as poor family functioning, social support deficits and lower economic status. These findings highlight important psychosocial contributors to psychological distress in higher education settings.

Stress

Stress refers to physiological and psychological responses to demands perceived as challenging or threatening. Stress occurs when individuals perceive environmental demands as exceeding their coping abilities (Auerbach and Grambling, 1998). In academic settings, stress is commonly associated with time constraints, heavy workloads, examination pressure and performance expectations. Moderate stress may be manageable. However, chronic stress can negatively impact physical health, emotional stability and academic productivity (Michiel and Cary, 2006). A qualitative study conducted identified several primary sources of academic stress, including high expectations, heavy workload, challenges with time management and peer competition. These stressors were associated with negative effects on students' mental and physical health, academic performance and sleep patterns (Gottschlich and Atapour, 2024).

Methodology

Design of Research

This study used a quantitative cross-sectional research methodology to investigate mental wellness issues among Politeknik Merlimau Melaka students pursuing a Diploma in Hotel Management. To gather quantitative data on stress levels, contributing causes and coping strategies, a questionnaire approach was chosen. The quantitative approach guarantees dependability and generalizability within the target population by enabling objective measurement and statistical analysis.

Sampling and Population

Students enrolled in Semester 1 through Semester 4 of the Diploma in Hotel Management programs represented the population. A minimum sample size of 92 responses was needed for a population of 120 students, according to Krejcie and Morgan's (1970) sampling table (Sekaran, 2003). Although participation was determined by availability and willingness, 92 students were chosen using a convenience sampling technique.

Research Instrument

Data were collected using a structured questionnaire divided into four (4) sections as shown in Table 1:

Table 1: Structured Questionnaire

Section	Questionnaire	Number of Items
A	Demographic information	3 items
B	Academic stress factors	7 items
C	Personal factors influencing depression, anxiety, and stress	7 items
D	Coping methods	7 items

All items were measured using a five-point Likert Scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The instrument was designed to assess students' perceptions of stress-related experiences and coping strategies. Mean score interpretation was categorised as shown in Table 2:

Table 2: Mean Score Interpretation

Mean Score	Interpretation
1.00 – 2.39	Low
2.40 – 3.79	Moderate
3.80 – 5.00	High

Source: (I'zzatul, 2020)

Data Collection Method

During academic sessions, the questionnaires were given to students in each of the four semesters. The purpose of the study was explained to the respondents and participation was

entirely optional. Confidentiality and anonymity were guaranteed to encourage honest responses.

Analysis of Data

Statistical Package for Social Science (SPSS) was used for data analysis. Using descriptive statistical analysis, mean scores, percentages and frequency distributions were used to:

1. Assess the stress levels of the students
2. Identify the factors that affect stress, anxiety, and depression
3. Examine the coping mechanisms that students employ

Descriptive analysis was appropriate as the study aimed to describe patterns and trends rather than test causal relationships.

Findings

Respondent Profile

The study involved 92 Diploma in Hotel Management students. Female students constituted 69.6% of respondents, while 30.4% were male. The majority were aged between 18 and 19 years (43.5%). Students from Semester 4 represented the largest group (33.7%).

Stress Level

According to descriptive analysis, student academic stress levels were moderate. Finding reference materials in the library was the biggest stressor ($M = 3.64$), followed by finishing homework at the last minute ($M = 3.30$). Stress was also increased by problems with internet connection ($M = 3.22$) and a lack of time for revision ($M = 3.18$). Although it was still in the moderate range, the lowest mean score ($M = 2.58$) was associated with difficulty understanding instructional approaches.

Factors Influencing Depression, Anxiety and Stress

Personal factors recorded predominantly moderate mean scores. The highest contributing factor was lack of monthly spending money ($M = 3.33$), followed by conflicts with classmates ($M = 3.23$) and transportation issues ($M = 2.96$). Internal family conflict ($M = 2.15$) and lack of laptop access ($M = 1.96$) were rated low. The most frequently used method was shopping activities ($M = 4.18$), followed by listening to music ($M = 3.96$) and spiritual practices ($M = 3.95$). Positive thinking ($M = 3.70$), recreational activities ($M = 3.36$), adequate sleep ($M = 3.26$), and sharing problems with family ($M = 3.03$) were also moderately practised.

The results show that personal factors affecting students' stress levels were generally moderate, with the biggest stressors being transportation issues, interpersonal problems with peers and financial limitations. Lack of access to technology and internal conflict in the family, on the other hand, were less common. Students mostly used to cope mechanisms, including shopping, listening to music and participating in spiritual activities that offered instant comfort and emotional support. The moderate use of other coping techniques, such as positive thinking,

leisure pursuits, getting enough sleep and talking to family members about issues. Moreover, suggests that although students are aware of healthy coping strategies, they could rely more on easy or routine activities.

Conclusion

The research study shows that among students pursuing a Diploma in Hotel Management, academic expectations are the main cause of mental wellness issues. Conflicts between peers and financial limitations also have a moderate impact on psychological distress. Students use behavioural and emotional coping mechanisms, with spiritual and recreational methods being especially common. These results point to the necessity of better academic support systems, organized mental wellness awareness campaigns and easily available counselling services at hospitality educational institutions. Students' mental wellness is greatly impacted by academic stress and recent research has shown that stress, anxiety and depression are more common among a variety of demographics. The three main factors connected to worse psychological outcomes are workload, academic transitions and psychosocial adjustment. Comprehensive mental wellness support and preventive measures should be given the main priority by universities or higher education institutions to promote students' academic success and general well-being. The inadequate level of public understanding of mental wellness is reflected in mental health issues that arise from individual, parental, and academic factors. The current research would aid parents, students and academic institutions in identifying potential risks to the mental wellness of students.

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SYNERGISTIC EFFECT OF HERBAL AROMATHERAPY AND THERMAL THERAPY IN AN INNOVATIVE EYE PILLOW (ASPE) FOR MITIGATING DIGITAL EYE STRAIN: A CASE STUDY AMONG HIGHER EDUCATION STUDENTS

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Abstract: *In the contemporary digital era, the escalating use of electronic devices for academic and personal purposes has led to a significant prevalence of Digital Eye Strain (DES), stress, and sleep disturbances among students. Excessive screen exposure is reported to affect nearly 89.9% of university students in Malaysia, manifesting in ocular fatigue and blurred vision. This study introduces an innovative, eco-friendly solution known as Aroma Soothe Pillow Eyes (ASPE). The product integrates dual-function therapeutic modalities herbal aromatherapy and thermal relief designed to alleviate DES symptoms while promoting psychological relaxation through natural ingredients like lavender and chamomile. A quantitative research design was employed to evaluate the effectiveness and user acceptance of ASPE. The study involved 66 students from the Diploma in Event Management (DEV3) program at Politeknik Merlimau Melaka, selected through simple random sampling. The prototype was formulated using a standardized mixture of 500g rice as a natural thermal filler, combined with 40g dried lavender and 30g dried chamomile flowers, enhanced by 10ml of respective essential oils. Data were collected using a 5-point Likert Scale questionnaire distributed via Google Forms and subsequently analyzed using SPSS Version 22 to determine mean scores for design creativity, effectiveness, and acceptance level. The findings revealed an exceptionally high level of acceptance across all evaluated constructs. The mean score for product design creativity and innovation was 4.32, indicating strong visual appeal. In terms of functional effectiveness, the product achieved a mean score of 4.24, suggesting significant performance in reducing eye strain and improving perceived sleep quality. Furthermore, the overall user acceptance reached a mean score of 4.35, reflecting robust market potential and student interest. Demographic analysis showed that the product resonated most strongly with female respondents (62.1%) and the 19-year-old age group (69.7%). ASPE demonstrates significant potential as a sustainable, non-pharmacological intervention for ocular health and wellness. It successfully aligns user needs with the Sustainable Development Goals (SDG 3 and 12) by offering a natural, chemical-free alternative to traditional eye care. Future research should focus on long-term usability and scent longevity to solidify its position in the competitive wellness market.*

Keywords: *Digital Eye Strain, Aromatherapy, Sustainable Wellness, Sleep Quality, Thermal Therapy*

Introduction

Today, it is almost impossible to imagine a student's life without a smartphone or a laptop. From attending online classes to finishing assignments and scrolling through social media, we are constantly glued to our screens. While this digital shift has made information more accessible, it has also brought a silent health crisis. The World Health Organization and other global bodies are increasingly worried about how this affects our bodies and minds, which is why Sustainable Development Goal (SDG) 3 (Good Health and Well-Being) is more relevant than ever it reminds that true progress should not come at the cost of health.

The most immediate consequence of this "always-on" lifestyle is Digital Eye Strain (DES), also known as Computer Vision Syndrome. In Malaysia alone, research shows that a staggering 89.9% of university students suffer from symptoms like dry eyes, blurred vision, and persistent headaches (Amani et al., 2023). It is not just about the eyes, though; the stress from constant connectivity often bleeds into our rest, making it harder to fall asleep and stay asleep. Many of us reach for quick fixes like eye drops or cold towels, but these are usually just temporary bandages for a deeper, recurring problem.

In today's digital era, the use of computers, laptops, smartphones, and other electronic devices has become a necessity in the daily lives of Malaysians, whether for work, education or entertainment. However, prolonged exposure to digital screens has raised increasingly concerning health issues, particularly those related to Digital Eye Strain (DES). (Bernama,2022)

DES also known as Computer Vision Syndrome, is a condition characterized by symptoms such as dry eyes, eye fatigue, blurred vision and headaches as well as neck and shoulder pain. A study conducted in Malaysia found that 89.9% of university students reported experiencing DES symptoms as a result of excessive digital screen usage. (Hashemi et al., 2022).

This is where researcher need to think about better, more sustainable ways to take care of ourselves. Under SDG 12 (Responsible Consumption and Production), there is a clear call to move away from synthetic products and toward natural, eco-friendly solutions. Most eye care products today are either made of plastic or use harsh chemicals, which feels like a missed opportunity to connect personal health with the health of the planet.

With these challenges in mind, researcher developed the Aroma Soothe Pillow Eyes (ASPE). Researcher wanted to create something that does more than just sit on the eyes; it is a blend of old-fashioned herbal wisdom and modern wellness needs. By using natural rice as a weight filler and mixing it with the calming scents of lavender and chamomile, ASPE offers a double hit of relief gentle warmth for the eyes and aromatherapy for the mind. Using students at Politeknik Merlimau Melaka as a case study, this project explores how a simple, nature-based tool can help bridge the gap between high-tech lives and need for real, deep relaxation.

Problem Statement

In a modern daily routine, the use of digital devices has become an unavoidable necessity for both students and professionals. This shift toward a screen-heavy lifestyle has brought about a widespread health issue known as digital eye strain, characterized by persistent discomfort and ocular fatigue. While the causes such as decreased blink rates and prolonged screen exposure are deeply embedded in our everyday habits, finding an effective way to manage the resulting physical and mental exhaustion remains a significant challenge.

Currently, many individuals try to manage these symptoms using short-term remedies like over-the-counter eye drops, cold compresses, or basic medications. However, these methods often fall short because they only provide temporary relief and are not always practical for long-term or repeated use. Furthermore, existing pharmacological treatments frequently fail to address the underlying mental fatigue associated with digital strain, which can discourage people from sticking to a consistent care routine.

The increasing use of digital devices among students and working individuals has led to a high prevalence of screen related eye discomfort, commonly known as digital eye strain. Many users rely on short term remedies such as eye drops, cold compresses, or medications to relieve symptoms. However, these methods only provide temporary relief, are inconvenient for repeated use, and may not be suitable for long term application. (Lanca & Saw, 2020)

The main causes of eye strain such as prolonged screen exposure, decreased blink rate, and mental fatigue are often part of daily routines. Therefore, addressing these recurring factors requires a more sustainable and practical solution that targets both physical and mental aspects of digital fatigue. Existing pharmacological treatments do not adequately solve these underlying issues and may discourage consistent use. (Moon et al., 2022)

A major gap exists in the current market, where most available products focus narrowly on either physical eye relief or general relaxation, rather than offering an integrated approach that targets both. There is a noticeable absence of user-friendly tools that combine the benefits of herbal aromatherapy with gentle thermal therapy to treat the interconnected symptoms of eye strain, stress, and poor sleep quality. Without a practical and sustainable solution that addresses both the physical and psychological aspects of digital fatigue, students continue to struggle with maintaining focus and emotional balance. This highlights a clear need for a more comprehensive, non-pharmacological intervention that can effectively bridge these gaps in user care.

Objective of The Study

The study focuses on evaluating the effectiveness of the Aroma Soothe Pillow Eyes (ASPE) in mitigating Digital Eye Strain (DES) through natural ingredients.

The specific objectives are as follows:

1. Innovate the ASPE prototype: To develop and refine the physical and functional aspects of the Aroma Soothe Pillow Eyes to ensure positive acceptance among Semester 3 Diploma in Event Management (DEV3) students.
2. Investigate therapeutic potential: To study the ability of ASPE in reducing eye strain, alleviating stress, and promoting relaxation through its combined thermal and herbal aromatherapy properties.
3. Evaluate user acceptance: To determine the overall level of acceptance and satisfaction among the target student population regarding the product's practicality and effectiveness.

Scope of The Study

1. Product Innovation: The study focuses exclusively on the development and evaluation of the Aroma Soothe Pillow Eyes (ASPE), an eye pillow designed to combine thermal relief with aromatherapy using natural ingredients such as lavender, chamomile, and rice.
2. Target Population: The research is limited to 66 students from the Diploma in Event Management Semester 3 (DEV3) program.
3. Geographical Location: The study was conducted specifically at Politeknik Merlimau, Melaka.
4. Research Focus: The evaluation is restricted to measuring user perceptions regarding the product's design creativity, its effectiveness in reducing eye strain and improving sleep, and the overall level of acceptance among the selected students.
5. Methodological Boundaries: Data collection is limited to a quantitative approach using a 5-point Likert Scale questionnaire analysed via SPSS Version 22.

Literature Review

Smell, or aroma, plays an important role in helping to reduce eye fatigue and stress, especially for people who spend long hours in front of laptops, phones, and other electronic devices. The blue light from screens often leads to tired, dry eyes and makes it difficult to concentrate. In these situations, aromatherapy offers a natural solution not only soothing the eyes but also promoting deep relaxation and calmness. (Cleveland Clinic, 2024). This product is designed with a special blend of dried flowers, which have been valued for centuries for their calming properties. The flowers release a soft, natural fragrance that creates a sense of peace when used. Rice is chosen as the main filler because of its gentle, comfortable texture that sits pleasantly over the eyes. To make it even more soothing, natural essential oils are added, giving off a light, refreshing scent that helps the body and mind relax. (Healthline, 2022).

The combination of dried flowers, rice, and essential oils makes this more than just a regular eye pillow. The natural aromas stimulate the sense of smell and send calming signals to the brain, helping to reduce stress, lift the mood, and bring about a sense of relaxation. As a result, users not only feel relief from eye strain but also enjoy an overall boost to their physical and emotional well-being. (Nikura, 2023). The benefits of this product reflect the well documented advantages of aromatherapy, which has long been recognized as a natural way to improve

health and wellness. Even Malaysia's Ministry of Health acknowledges that aromatherapy can help reduce stress, improve sleep, and support natural recovery. (Pure Oils India, 2025).

The Role of Aromatherapy in Ocular Health

Aromatherapy serves as a natural intervention to mitigate eye fatigue and psychological stress caused by prolonged exposure to digital screens. Natural aromas stimulate the olfactory system, sending calming signals to the brain that help lower stress and improve emotional well-being. The Ministry of Health in Malaysia also acknowledges that aromatherapy can effectively reduce stress and support natural recovery.

Botanical Components: Lavender and Chamomile

The integration of dried flowers provides long-lasting, gentle aromatherapy without the irritation often caused by synthetic scents (Martinez & Green, 2023).

1. Dried Lavender (*Lavandula angustifolia*): Widely utilized for its sedative effects, lavender contains natural compounds like linalool and linalyl acetate that promote relaxation and better sleep quality. Unlike fresh flowers, dried lavender buds retain their therapeutic fragrance for several months or up to a year.
2. Dried Chamomile (*Matricaria chamomilla* L.): Historically valued for its ability to soothe nerves and relieve tension, chamomile is an ideal filler for herbal eye pillows to support mental well-being naturally.
3. Synergistic Effect: Combining these two herbs creates a powerful therapeutic blend that reduces daily stress, eases eye fatigue, and promotes deeper, more restful sleep.

Functional Materials: Rice and Satin

The physical design of the eye pillow relies on specific materials to ensure weight distribution and temperature regulation (Singh & Patel, 2022).

1. Rice as a Natural Filler: Rice is a trusted choice because it holds temperature well for both warm and cold therapy. Its small grains provide a gentle weight that conforms to the facial contours, shifting easily to fit the shape of the face without putting excessive pressure on the eyes.
2. Satin Fabric Cover: Satin is selected for the outer layer because its smooth, glossy surface feels incredibly soft and luxurious against the skin. This silky texture minimizes friction against the delicate skin around the eyes, preventing irritation during extended use.

Enhancement via Essential Oils

To intensify the calming effects, pure essential oils are infused into the filler to capture the plant's unique therapeutic qualities. Research indicates that inhaling a blend of lavender and chamomile oils can help reduce feelings of depression, anxiety, and stress, with effects lasting up to a month after treatment. (Choi et.al, 2023)

Research Methodology

The research design for this study utilizes a quantitative approach to objectively measure user perceptions and the effectiveness of the Aroma Soothe Pillow Eyes (ASPE). By employing a structured framework, the study ensures that outcomes are credible, reliable, and reproducible. In this research design, researcher would rather employ a quantitative method via a Likert Scale because it allows the study to measure participants perceptions and responses in an ordered manner.

It provides numerical data that is easier to analyze statistically, therefore easier to identify patterns, trends, and relationships among variables. Using the Likert Scale, it is possible to measure the extent of agreement or disagreement with some statements, most aptly appropriate in measuring attitudes, likes, and general experience of the respondents. Not only does the method ensure accuracy and validity of the results, but it also makes the research objective of yielding valid and measurable results easier.

Product Formulation and Preparation

The ASPE was developed using a standardized formulation to ensure consistency across prototypes. Each set was prepared with the following ingredients:

1. Filler: 500 grams of sun-dried rice to provide grounding weight and thermal retention.
2. Botanicals: A blend of dried lavender (40g) and dried chamomile (30g) for natural aromatherapy.
3. Essential Oils: 10ml each of lavender and chamomile essential oils to enhance the aromatic intensity

The production process followed a systematic 11-step workflow. Initially, fresh flowers were selected and dried to remove moisture. Rice was rinsed and sun-dried before being mixed with the essential oils. The dried botanical mixture and treated rice were then inserted into a pouch bag, which was subsequently placed inside a high-quality satin fabric cover. Finally, the product was packaged and labelled with clear usage and storage instructions.

Sampling and Data Collection

To evaluate the product, the study utilized Simple Random Sampling (SRS) to select respondents from the student population. This technique ensures that every member of the target group has an equal opportunity to be chosen, thereby minimizing selection bias.

1. Respondents: A total of 66 students from the Diploma in Event Management Semester 3(DEV3) course participated in the study.
2. Instrument: A questionnaire was developed following the "KISS" (Keep It Simple and Short) rule to ensure clarity and ease of understanding.
3. Measurement: Most items were worded on a 5-point Likert Scale, ranging from "Strongly Disagree" (1) to "Strongly Agree" (5).

Data Analysis Method

The collected data were processed and analyzed using the Statistical Package for the Social Sciences (SPSS) Version 22. The analysis focused on frequency distributions, percentages, and mean scores to interpret user feedback. Mean scores were interpreted based on a standardized range where a score of 3.81 to 5.00 represents a "high" or "good" level of acceptance. This statistical approach allowed the researchers to identify patterns and trends regarding the product's effectiveness and market potential.

Data Analysis and Discussion

The results obtained from the study, focusing on the feedback provided by the 66 students who evaluated the Aroma Soothe Pillow Eyes (ASPE). The analysis illustrates patterns in user preferences and the overall performance of the product based on the criteria established in the research objectives

Demographic Profile

The survey respondents primarily consisted of younger individuals, with 69.7% aged 19 and 22.7% aged 20. In terms of gender distribution, 62.1% were female while 37.9% were male. This demographic trend suggests that the product's aesthetic and functional features resonated strongly with female students and the younger age group, who are often more exposed to modern wellness trends through social media.

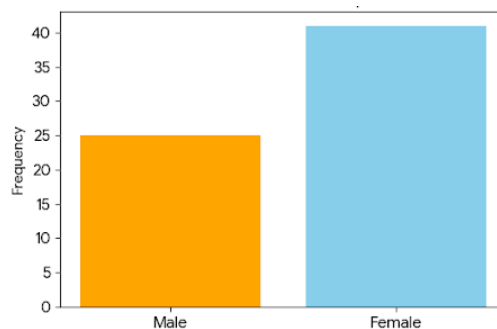


Figure 1: Gender Distribution of Respondent

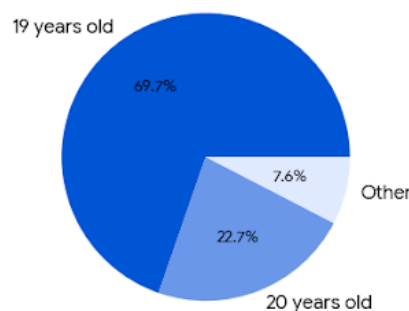


Figure 2: Age Distribution of Respondent

Product Innovation and Design

The innovation aspect of ASPE received a highly positive response, achieving a mean score of 4.1. Specific findings include:

1. Creativity and Innovation: The product's design was perceived as highly appealing and unique, with a mean score of 4.35.
2. Market Distinctiveness: Respondents strongly agreed that ASPE offers significant improvements over conventional eye pillows, recording a mean score of 4.36.

Table 1: Mean Score Analysis by Research Objective

Section	Objective / Construct	Mean Score	Interpretation
Section B	Innovation Aspect (Creativity & Design)	4.31	High / Good
Section C	Potential for Eye Strain Reduction & Relaxation	4.36	High / Good
Section D	Overall User Acceptance Level	4.29	High / Good

Therapeutic Potential and Effectiveness

The study evaluated ASPE's ability to address digital eye strain and stress, yielding a mean score of 4.36 for its potential effectiveness.

1. Digital Fatigue Relief: Users strongly agreed that the product helps reduce eye strain and improves sleep quality, resulting in a mean score of 4.26.
2. Daily Practicality: The portability and ease of use for students were rated very highly, with a mean score of 4.36.
3. Combined Benefits: The integration of aromatherapy and heat therapy significantly enhanced user comfort and emotional well-being.

User Acceptance and Market Potential

Overall acceptance among the target group reached a mean score of 4.29, indicating that ASPE is well-positioned for broader application.

1. Likelihood of Use: A mean score of 4.24 showed that respondents are highly willing to use the product if it becomes widely available.
2. Competitiveness: The product is perceived as having strong potential to compete with similar items in the wellness market, scoring 4.30 in this construct.
3. User Recommendations: Confidence in the product's quality was reflected in a mean score of 4.30 for willingness to recommend ASPE to others.

Table 2: Product Costing Analysis

Item	Description	Cost (RM)
Material Cost	Lavender, Chamomile, Essential Oils, Rice	14.44
Overhead Cost	Electricity & Water Bills	1.00
Packaging Cost	Pouch Bags, Stickers, Black Boxes, Sponge	5.38
Additional Cost	Sponge & Satin Fabric	10.00
Total Cost (3 Units)	Final Sum	30.82
Sale Price	Based on 50% Mark Up Price	46.23
Cost Per Unit	Price for One Unit	15.41

The following discussion outlines the financial analysis of the Aroma Soothe Pillow Eyes (ASPE) project, based on the costing data provided for an initial batch of three units.

Economic Analysis of the ASPE Project

The costing structure of the ASPE project is divided into four main expenditure categories to determine the total production investment and the final market price. Manufacturing Costs:

1. **Material Cost:** At RM 14.44, this covers the primary organic components, including rice, dried lavender, dried chamomile, and essential oils.
2. **Additional Cost:** A sum of RM 10.00 is allocated for the outer satin fabric and sponge, which are essential for user comfort and product durability.
3. **Operational and Presentation Costs:** Overhead Cost: Basic utilities such as electricity and water bills account for a minimal RM 1.00.
4. **Packaging Cost:** To maintain a premium market position, RM 5.38 is invested in high-quality pouch bags, stickers, and black presentation boxes.

Pricing Strategy

The project adopts a value-based pricing strategy to ensure commercial viability while remaining affordable for the target student demographic.

1. **Total Production Investment:** The cumulative cost for three units is RM 30.82.
2. **Markup and Profit Margin:** A 50% markup (RM 15.41) is applied to the total cost to cover potential marketing expenses and ensure a sustainable profit margin.
3. **Market Price:** The total sale price for the batch is RM 46.23, resulting in a competitive Cost Per Unit of RM 15.41.

Conclusion and Recommendations

Conclusion

The research conducted on the Aroma Soothe Pillow Eyes (ASPE) indicates a highly positive reception among the target audience. Based on the statistical analysis, the product achieved high mean scores across all evaluated dimensions, including design innovation (4.35), therapeutic effectiveness (4.26), and overall acceptance (4.29). The integration of thermal therapy and herbal aromatherapy successfully addresses the symptoms of Digital Eye Strain

(DES), such as eye fatigue and sleep disturbances, which affect approximately 89.9% of university students. While a minor segment of 5.96% held a moderate view, the overwhelming majority perceive ASPE as a practical, natural, and eco-friendly wellness tool with strong commercialization potential.

Recommendations

To further enhance the quality, user experience, and marketability of ASPE, the following recommendations are proposed:

1. Refined Packaging: It is recommended to use a sturdy, elegant, and minimalist box with protective inner padding to ensure product safety and maintain a premium brand image.
2. Scent Optimization: The curated blend of pure lavender and chamomile essential oils should be maintained to ensure a harmonious aromatic profile that promotes emotional tranquillity and better sleep quality.
3. Material Enhancement: The continued use of high-quality satin fabric is advised due to its smooth texture, which minimizes skin irritation around the sensitive eye area and provides a cooling sensation.
4. Weight Calibration: Natural rice should remain the primary filling material to allow the pillow to conform to facial contours; however, the weight must be precisely balanced to provide gentle pressure without causing ocular strain.
5. Ergonomic Design: A rectangular shape is recommended to ensure full coverage of the eye area and forehead, which facilitates even weight distribution and effective light blocking.
6. Strategic Marketing: Implementation of targeted awareness campaigns and user education regarding the benefits of non-pharmacological interventions will help solidify the product's credibility among all potential users.

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TOWARDS INTERFUSION AUGMENTED REALITY MODEL (IARM): A SYSTEMATIC LITERATURE REVIEW ON IMMERSIVE, AFFECTIVE AND ASSISTIVE TECHNOLOGIES FOR VISUALLY IMPAIRED INTERACTION

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Abstract: *Augmented Reality (AR) has emerged as a promising technology for enhancing interaction experiences for visually impaired (VI) users by integrating digital and physical environments. However, existing AR systems remain fragmented, focusing on isolated functionalities such as navigation, visual enhancement, and multisensory interaction. This study conducts a systematic literature review (SLR) following Kitchenham and Charters (2007) and PRISMA 2020 guidelines to identify current AR applications, system components, design principles, and research gaps. A total of 24 studies were selected from Scopus and IEEE databases. The findings reveal four dominant themes: assistive navigation and spatial awareness, multisensory interaction, affective and adaptive interaction, and AR-based accessibility enhancement. Despite advancements, current systems lack integration across these dimensions. This study highlights the need for a unified framework and provides a conceptual foundation for the Interfusion Augmented Reality Model (IARM), which integrates immersive, assistive, affective, and AR components to enhance visually impaired interaction.*

Keywords: *Assistive Technology, Augmented Reality, Immersive Learning, Systematic Literature Review, Visually Impaired*

Introduction

Visual impairment significantly affects an individual's ability to interact with their environment, limiting mobility, accessibility, and independence. Recent advancements in augmented reality (AR) have introduced new opportunities to enhance interaction experiences by enabling real-time integration of digital and physical environments (Maman et al., 2025). Existing studies demonstrate the potential of AR-based assistive systems in supporting navigation, object recognition, and accessibility through audio, haptic, and visual feedback mechanisms (Delachambre et al., 2025; Janapati et al., 2024; Luigi et al., 2023).

Additionally, emerging approaches incorporate artificial intelligence (AI) to provide adaptive and personalized interaction experiences (Gregg et al., 2022; Koulouris et al., 2025). Despite these advancements, current systems remain fragmented, focusing on isolated functionalities

rather than providing a holistic interaction experience. Therefore, this study conducts a systematic literature review (SLR) to identify existing AR applications, system components, and research gaps. The findings aim to establish a conceptual foundation for the Interfusion Augmented Reality Model (IARM), which integrates multiple interaction dimensions into a unified framework.

Methodology

This study adopts a systematic literature review (SLR) approach following Kitchenham and Charters (2007) and PRISMA 2020 guidelines to ensure a structured and reproducible process as illustrated in Figure 1. Studies were retrieved from Scopus and IEEE Xplore using keywords related to augmented reality, visual impairment, and assistive interaction. A total of 90 records were initially identified. After removing duplicates, 62 studies remained for screening. Following title and abstract screening, 35 studies were selected for full-text review. Finally, 24 studies were included in the analysis. The methodology is represented in Figure 1.

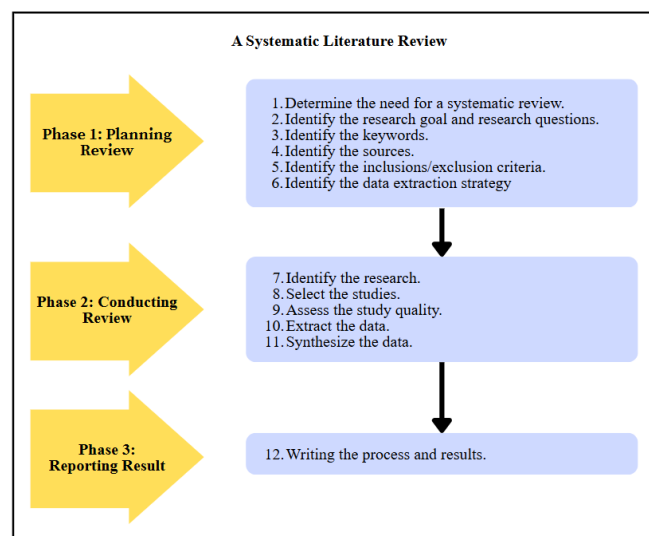


Figure 1: Overview of SLR Phases

The study selection process was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure transparency, rigor, and replicability of the review process. The selection procedure involved multiple stages to systematically identify, screen, and include relevant studies aligned with the objectives of this design-oriented systematic literature review. Initially, comprehensive searches were performed across the selected databases, namely Scopus, Web of Science, and the IEEE Xplore, using the predefined search strings described in Table 1 below.

Table 1: Search String

Databases	Search String
Scopus	(TITLE-ABS-KEY ("visually impaired" OR blind OR "low vision")) AND (TITLE-ABS-KEY ("augmented reality" OR AR OR XR OR "mixed reality")) AND (TITLE-ABS-KEY (assistive OR accessibility OR navigation OR haptic OR audio OR multisensory OR "non-visual")) AND (TITLE-ABS-KEY (affective OR emotion* OR engagement OR immersive OR presence OR empathy)) AND (PUBYEAR > 2019 AND PUBYEAR < 2026)
Web of Science	TS=("visually impaired" OR blind OR "low vision") AND TS=("augmented reality" OR AR OR XR OR "mixed reality") AND TS=(assistive OR accessibility OR navigation OR haptic OR audio OR multisensory OR "non-visual") AND TS=(affective OR emotion* OR engagement OR immersive OR presence OR empathy) AND PY=(2020-2025)
IEEE Xplore	("visually impaired" OR blind OR "low vision") AND ("augmented reality" OR AR OR XR OR "mixed reality") AND (assistive OR accessibility OR navigation OR haptic OR audio OR multisensory OR "non-visual") AND (affective OR emotion* OR engagement OR immersive OR presence OR empathy)

The review primarily focused on the existing literature published between 2020 and 2025, 5 years. Three major academic databases including Scopus, Web of Science and IEEE Xplore was chosen. This study does not include secondary sources as it is aimed to provide a comprehensive, unbiased, and rigorous analysis of existing literature. Therefore, only primary sources are included to ensure the accuracy and dependability of the study. The inclusion and exclusion standard for this SLR have two tiers which depends on the listed criteria, all papers are either included or excluded at first level and after reviewing the full text of the papers, any papers that do not appear to be relevant to the study were eliminated at the second level. Studies were selected based on the following criteria:

Inclusion Criteria:

1. Focus on AR applications for visually impaired users.
2. Written in English
3. Full-text accessible
4. Published between 2020 to 2025
5. Studies focusing on visually impaired users aged 18 years and above.

Exclusion Criteria:

1. Not related to AR or visually impaired interaction
2. Duplicate studies
3. Inaccessible full-text articles
4. Studies published before 2020.
5. Studies targeting children or early-age learners.

The final set of studies included in the review comprised papers that met all inclusion criteria and demonstrated relevance to the extraction of interaction components, elements, design principles, and design guidelines. The complete study selection process, including the number of 90 records identified, screened, excluded, and included at each stage, is illustrated using a PRISMA 2020 flow diagram in Figure 2.

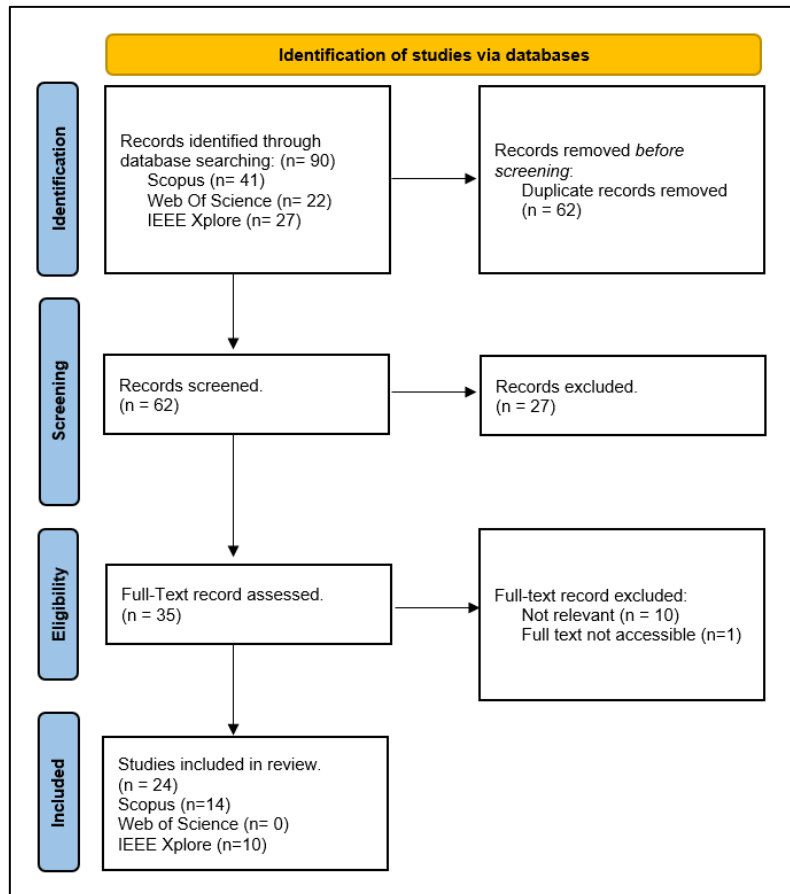


Figure 2: PRISMA flow diagram of the study selection process.

Figure 2 presents the PRISMA flow diagram of the study selection process. A total of 90 records were identified, consisting of 41 from Scopus, 27 from IEEE, and 22 from Web of Science. After removing duplicates ($n = 28$), 62 records remained for title and abstract screening. Following the screening process, 35 studies were selected for full-text assessment. After applying inclusion and exclusion criteria, 24 studies were included in the final analysis, comprising 14 studies from Scopus and 10 from IEEE. No studies from Web of Science met the inclusion criteria after full-text screening due to lack of relevance or inaccessible full text.

Data extraction focused on AR application types, system components, interaction modalities, and limitations. The analysis followed an iterative process involving coding, grouping, and thematic synthesis to identify recurring patterns across studies.

Result and Findings

The analysis identified four dominant themes representing key dimensions of AR-based interaction for visually impaired users as illustrated in Figure 3 below.

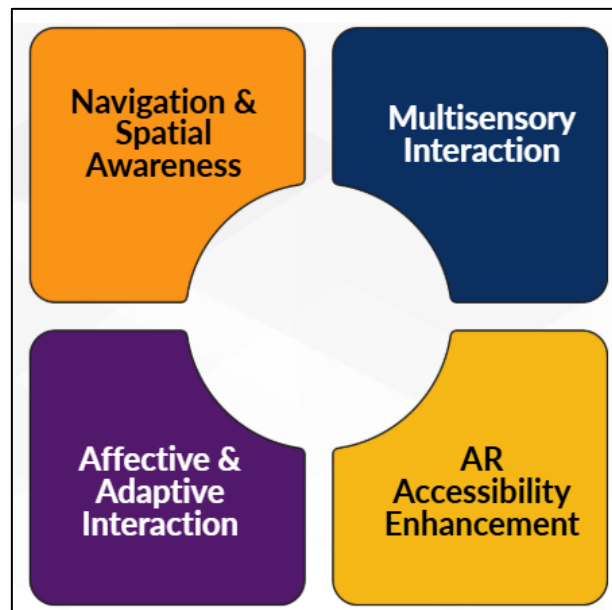


Figure 3: Four dominant themes

Theme 1: Assistive Navigation and Spatial Awareness

This theme represents the most dominant application domain, focusing on enhancing mobility and environmental awareness. Systems utilise spatial mapping, depth detection, and obstacle recognition to support navigation (Delachambre et al., 2025; Janapati et al., 2024). These systems incorporate components such as SLAM, object detection, and real-time feedback mechanisms, supported by audio and haptic interaction. However, they remain task-oriented and lack adaptive and affective interaction capabilities.

Theme 2: Multisensory Interaction

This theme highlights the use of audio and haptic feedback to enable non-visual perception.(Paananen et al., 2022) Systems employ spatial audio, vibrotactile cues, and sensor-based interaction to enhance environmental understanding (Annamalai et al., 2025; Guarese et al., 2023; Thoo et al., 2025). Despite their effectiveness, these systems are often limited to specific modalities and lack integration with AR-based visual enhancements.

Theme 3: Affective and Adaptive Interaction

This theme represents emerging approaches that incorporate AI-driven personalization and conversational interaction (Gregg et al., 2022; Koulouris et al., 2025). These systems enable

adaptive and user-centered interaction experiences (Sherly & Velvizhy, 2024). However, they are rarely integrated with navigation or multisensory systems, resulting in isolated implementations.

Theme 4: AR-Based Accessibility Enhancement

This theme focuses on visual enhancement techniques such as object highlighting, contrast adjustment, and text magnification (Xie et al., 2024; Zhang et al., 2020). These approaches improve readability and perception for low-vision users. However, they remain visual-centric and do not fully integrate multisensory or adaptive interaction capabilities.

Discussion on Research Question

The thematic findings provide a structured basis for addressing the research questions. For RQ1, AR applications are concentrated within four domains: navigation, multisensory interaction, adaptive systems, and visual enhancement. These applications are largely task-specific and do not form a unified interaction ecosystem.

For RQ2, the analysis reveals recurring components such as spatial understanding, sensory augmentation, and adaptive interaction. These are implemented through elements including obstacle detection, spatial audio, haptic feedback, OCR, and conversational interfaces (Delachambre et al., 2025; Gregg et al., 2022; Janapati et al., 2024; Luigi et al., 2023).

For RQ3, the findings highlight several limitations, including fragmentation, lack of integration, and limited affective interaction. Most systems focus on individual functionalities without combining multiple interaction dimensions into a cohesive framework.

Conclusion

The findings indicate that current AR systems provide valuable but partial solutions for visually impaired interaction. The identified themes correspond to key interaction dimensions: spatial awareness, sensory augmentation, adaptive interaction, and visual enhancement. These dimensions are not independent but interconnected. Therefore, the Interfusion Augmented Reality Model (IARM) is proposed to integrate these components into a unified framework. The model aims to combine multisensory interaction, real-time feedback, spatial understanding, and adaptive user experience to address the fragmentation observed in existing systems.

This study presents a systematic literature review of AR-based interaction systems for visually impaired users. The findings reveal four dominant themes and highlight the fragmentation of current approaches. The study contributes by providing a structured understanding of existing systems and identifying key components, elements, and design principles. Furthermore, it establishes a conceptual foundation for the development of the Interfusion Augmented Reality Model (IARM). Future work will focus on validating the proposed model through expert evaluation and prototype development.

Acknowledgement

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A STUDY ON THE SPATIAL DISTRIBUTION OF TELECOMMUNICATION TOWERS IN KULIM DISTRICT, KEDAH

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Abstract: *In the digital era, the demand for telecommunication networks has increased significantly in line with the widespread use of smartphones, internet services, and digital applications that require fast and reliable connectivity. However, the construction of telecommunication towers often leads to conflicts among local communities, particularly when such infrastructure is located near residential areas. This study aims to map the spatial distribution of telecommunication towers in Kulim District, Kedah, using ArcGIS 10.3, and to evaluate the suitability of tower locations in relation to population density. The GIS platform was utilized to perform georeferencing, digitization, and signal coverage network analysis. The analysis incorporated key factors such as population density, residential areas, and industrial zones to identify areas with high communication demand. Spatial analysis techniques including buffer analysis, kernel density analysis, and site selection analysis were applied. The findings indicate that telecommunication towers in Kulim are predominantly concentrated in industrial and densely populated urban areas, such as Kulim Hi-Tech Park and Kulim Town. In contrast, rural areas such as Padang Serai and Junjung exhibit relatively limited network coverage. The study also identifies potential areas for future telecommunication infrastructure development, particularly in rural regions and areas experiencing increasing population growth. In conclusion, the application of GIS in the mapping and analysis of telecommunication towers proves to be highly effective in supporting local authorities and telecommunication service providers in making planning decisions. The recommendations proposed in this study are expected to enhance communication accessibility in underserved areas, thereby contributing to the socio-economic development of the region in Kulim, Kedah.*

Keywords: *Spatial Analysis, Geographic Information Systems (GIS), Telecommunication Infrastructure, Spatial Distribution, Network Coverage Optimization*

Introduction

Mapping is the process of producing maps that represent the location and geographical characteristics of a specific area. It involves the collection, analysis, and visualization of geospatial data for purposes such as planning, navigation, and analysis. Mapping plays a crucial role in various fields, including urban planning, resource management, environmental research, and navigation. With advancements in technology, mapping has become more accurate facilitating better analysis and decision making across a wide range of applications.

According to a study by Miljenko Lapaine et al. (2021), the definition of a map has evolved throughout history, and variations in its interpretation have been presented. Based on the study by Lu & Weng (2024), dasymetric mapping methods demonstrate significant potential in improving the accuracy of population distribution analysis by integrating advanced geospatial data and machine learning techniques. These methods can support government authorities and relevant agencies in urban planning, resource management, and the allocation of services according to population needs. Recent studies, including those by Lu & Weng (2024) and Roziqin & Hansky (2023), highlight the effectiveness of dasymetric mapping techniques in improving the precision of population distribution modelling by leveraging advanced geospatial datasets and analytical approaches. These methods demonstrate significant potential in supporting government authorities and relevant agencies in urban planning, resource management, and the efficient allocation of services based on population needs. In line with ongoing technological advancements, the adoption of dasymetric mapping approaches should be further considered to enhance the accuracy and reliability of population density analysis

Literature Review

Distribution Map

According to Rabi Shrestha (2020), maps provide general information about locations are known as reference maps. Examples of reference maps include road atlas maps as well as topographic maps. In contrast, maps that depict the spatial distribution of specific topics are referred to as thematic maps or statistical maps. For instance, maps illustrating population distribution by district fall under this category.

Based on the study by John Guy and Ezana Eyassu (2024), a thematic map is a type of map that presents a specific theme or focuses on a particular issue. Common examples include maps showing business density across a region, housing prices within urban areas, or crime levels across a country. An important distinction to note is that thematic maps differ significantly from physical maps in terms of purpose and representation.

The primary objective of producing distribution maps is to understand the current state of research in this field and to analyse future development trends. Therefore, the process of designing distribution maps must be carried out carefully, even though some thematic information can be presented in either qualitative or quantitative forms. These maps also assist in identifying patterns that may not be apparent through conventional data analysis methods. Consequently, distribution maps play a crucial role in ensuring that development is carried out efficiently and aligned with societal needs.

Telecommunication Towers

According to I.T Telkom Purwokerto (2023), telecommunications is a field concerned with the transmission and reception of information over long distances. This field encompasses a wide range of technologies used to transmit voice, data, and images through communication networks. Telecommunications plays a crucial role in accelerating the exchange of information among individuals across different locations.

Telecommunication transmitters, particularly towers, are essential structures for transmitting and receiving signals, ensuring wireless communication between devices such as mobile phones, televisions, radios, and internet systems. These towers enable voice calls, text messaging, and internet connectivity, while also supporting advanced technologies such as 4G and 5G networks. Despite concerns related to health implications, visual impact, and infrastructure costs, telecommunication towers remain critical in ensuring efficient connectivity in modern society.

Through effective communication, members of an organization are able to exchange information and achieve progress within their respective departments. The methods of communication employed have significantly transformed how information exchange and relationships are perceived globally. Furthermore, employee satisfaction with corporate communication can influence their level of commitment to the organization. In other words, higher levels of communication satisfaction within an organization are associated with stronger organizational commitment among employees.

Application of Geographic Information Systems (GIS) in Distribution Mapping

According to Mohamed B.O Osman (2023), the Geographic Information System (GIS) is a technology and spatial analysis method based on geographic information science. It is widely supported and utilized for spatial applications across various disciplines, including geography, surveying, engineering, space science, computer science, cartography, and statistics. Furthermore, GIS can be defined as a system for collecting, storing, examining, integrating, manipulating, analysing, and visualising geospatial data related to the Earth.

ArcGIS, which is developed based on GIS concepts, is one of the most suitable software platforms for use in this study. Based on the study by Nadia Awing Njok (2022), GIS applications serve as a primary tool for identifying suitable central locations with high development potential.

In process of producing distribution maps, GIS enables the collection of data from multiple sources, including satellite imagery, field sensors, and database systems. These datasets are subsequently integrated into a unified platform, allowing for comprehensive analysis. GIS also provides tools for efficient management and processing of geospatial data, ensuring that the data utilised are both up-to-date and accurate.

According to the study by Muhammad Hafiz Tajidin and Azimah Abd Rahman (2021), spatial analysis approaches using GIS are widely applied for analytical and mapping purposes. In conclusion, the application of GIS in distribution mapping supports more effective decision making across various fields, ensuring efficiency in planning and management processes.

Buffer Analysis

According to Ahmat Adil (2016), buffer analysis is used to identify areas surrounding specific geographic features. This process involves generating buffer zones around geographic features

and subsequently identifying or selecting features based on whether they fall within or outside the defined buffer area.

In this study, buffer analysis is applied to identify areas surrounding particular geographic features by creating zones at specified distances. Buffers are generated around telecommunication towers to assess network coverage and to determine the spatial relationship between tower locations and residential areas. This method also assists in evaluating whether tower development or network coverage complies with established regulations and guidelines.

Kernel Density Analysis

According to the study by Philia Christi Latue et al. (2023), Kernel Density is a statistical method used to model and represent the density of a phenomenon within a given space. This method is commonly applied in spatial analysis to determine the distribution of the density of a variable or event across a geographic area.

The results of Kernel Density analysis are typically visualised in the form of heat maps or continuous surfaces that indicate varying levels of density. Each data point contributes to the overall density with an influence that gradually decreases with distance, forming a smooth density surface. This mapping approach facilitates the identification of areas with high, medium, and low density levels.

Site Selection Analysis

Site selection analysis in map production aims to determine the most suitable location for development or facility placement by analysing various geospatial factors such as topography. This analysis supports more accurate decision-making and assists in identifying development areas that meet specific criteria, while also enhancing the clarity and communication of location suitability.

By considering criteria such as accessibility, land suitability, demographic factors, and environmental risks, site selection analysis ensures that the chosen location meets project requirements while minimize potential negative impacts.

Methodology

This study was conducted to address key issues and obtain accurate information regarding the spatial distribution of telecommunication towers in Kulim, Kedah. There is a lack of comprehensive data on the actual locations of telecommunication towers that can be accessed by the public or relevant stakeholders for more efficient communication infrastructure planning. Therefore, this study aims to map the locations of telecommunication towers in Kulim, Kedah using Geographic Information System (GIS) software. The data collected include location coordinates, tower types, heights, and the service providers involved. These data will subsequently be analyzed to identify coverage areas as well as potential regions that remain underserved in terms of telecommunication access.

Data Collection

Figures 1 and 2 represent the datasets utilized in this study. Based on the base map obtained from the Department of Survey and Mapping Malaysia, a digitization process was carried out using ArcGIS 10.3 software. Map digitization refers to the process of converting map data from a physical format (paper maps) into a digital format that can be processed and analyzed within ArcGIS 10.3.

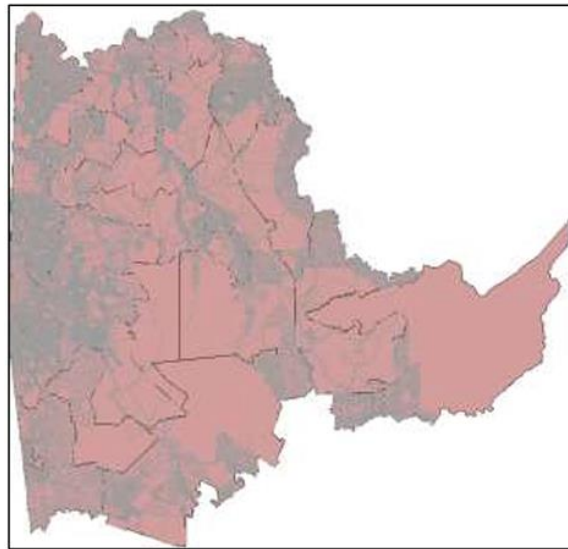


Figure 1: Land Use Map of Kulim District
Source: Kedah Department of Town and Country Planning

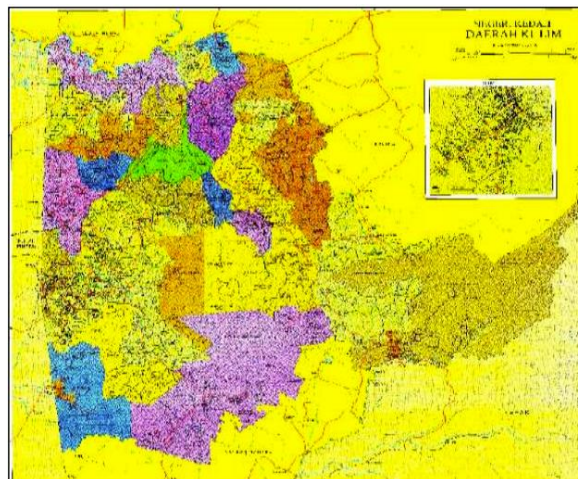


Figure 2: Base Map of Kulim District
Source: Department of Survey and Mapping Malaysia

Map Digitization

Figure 3 illustrates the map of Kulim District that has done the digitization process. This map presented with mukim layers. The map digitization process in ArcGIS 10.3 involves several

fundamental steps to convert analog or based map data into digital data. The general procedures undertaken include scanning, importing the digital map into ArcGIS, digitizing map features, and saving as well as exporting the data. These steps are essential to ensure that the map is digitized effectively within ArcGIS.



Figure 3: Base Map of Kulim District
Source: Department of Survey and Mapping Malaysia

Attribute Data

The attribute data of telecommunication towers in Kulim District are crucial as they provide essential information to support the analysis conducted in this study. The attribute data utilized in this study are illustrated in Figure 4.

DEKODORDINAT	KOORDINAT	SYARUKAT	JALAN	PONCE	EASTING	NORTHING	
1	5.38200000	100.58150000	CELCOM	Petronas Utama 5, Kuari Utama Fasa 2, Petronas	8000	-6050.3845000000	-54424.8707300000
2	5.37900000	100.57500000	CELCOM	Tanah Kula Kanan, Sungai Lela	8000	-7030.5555000000	-44929.8020000000
3	5.38100000	100.57600000	CELCOM	Petronas Perdana, Kuari Perdana, Petronas Bantu	8000	-5447.0718750000	-52875.1087900000
4	5.40400000	100.57500000	CELCOM	Lorong KET 4/2, Pina Berhala Tempatan Ta	8000	-7167.5427100000	-61730.2000770000
5	5.42300000	100.58840000	CELCOM	JALAN KULIM BUKIT PADANG MEHA	8000	-4208.3576220000	-58728.6684270000
6	5.40400000	100.58840000	CELCOM	KAMPUNG BILAKANG PHALANG, KAWANGGAH	8700	-5433.7747800000	-62001.8730700000
7	5.38480000	100.58300000	CELCOM	JALAN BERDONG, TAMAN MEHA, KAMPUNG	8000	-5048.8016530000	-65380.8666970000
8	5.35900000	100.54570000	CELCOM	LORONG BESLIM 1/1, TAMAN HARMONI	8000	-10049.8828750000	-67309.3632600000
9	5.40400000	100.55910000	CELCOM	KAWANG PERDUTAN KULIM, KULANG	8000	-4874.1242700000	-61648.4191000000
10	5.43400000	100.54890000	CELCOM	JALAN SALLAH 2, TAMAN PERDUTAN SALLAH	8000	-10260.2424180000	-58028.4590900000
11	5.42700000	100.57030000	CELCOM	1/1, TAMAN KANG KANG, LUNAS	8000	-11201.0745000000	-59291.2770900000
12	5.41900000	100.57120000	DIAG	TAMAN PERDUTAN (KULIM, KULIM)	8000	-7222.9598742000	-60243.4100180000
13	5.42200000	100.58270000	DIAG	JALAN M TECH 1, KAWANG PERDUTAN	8000	-4838.1321007000	-59911.8771340000
14	5.39580000	100.56500000	DIAG	JALAN BERDUT 1/1, TAMAN KAWANG ZON 1	8000	-6408.1877800000	-65214.8226750000
15	5.39000000	100.53270000	DIAG	TAMAN SAGA KAMPUNG PONDOK LABU ATAS	8000	-11409.8231170000	-63549.2020540000
16	5.40210000	100.54840000	DIAG	JALAN BUKIT BELLINGGATTA 1, TAMAN BER	8000	-6748.8955110000	-56082.3033810000
17	5.40500000	100.55280000	DIAG	JALAN TERAPI 1, TAMAN TERAPI	8000	-6250.8255320000	-59568.8022220000
18	5.40400000	100.54870000	DIAG	JALAN PERDUTAN KULIM	8000	-6716.4881550000	-61987.1582030000
19	5.42000000	100.54410000	DIAG	KAMPUNG JANGKANG, SUNGAI KOB	8000	-896.5417462000	-59204.3070400000
20	5.42300000	100.58130000	DIAG	KAMPUNG DAMPAK TIGA, JANGKANG KAWANG	8700	-2984.3888800000	-59878.8988730000
21	5.50000000	100.62170000	DIAG	CEGA, MANA KAWANG MEHA	8000	-1470.5755240000	-61398.4580320000
22	5.37940000	100.57440000	WAJIB	TAMAN KITA KEMAH BUKIT LILAI	8000	-7311.7412290000	-64722.0580440000
23	5.43800000	100.53800000	WAJIB	JALAN BUKIT BELLINGGATTA 1, TAMAN BER	8000	-10002.1271150000	-60461.3002080000
24	5.44300000	100.55440000	WAJIB	KAMPUNG BUKIT BELLINGGATTA	8000	-8862.4827700000	-67533.4296730000
25	5.49200000	100.57100000	WAJIB	PERDUTAN KULIM GOLF KULIM HI TECH	8000	-5815.2555650000	-61813.8481750000
26	5.40570000	100.58380000	WAJIB	LORONG BENDAH KANDAS	8000	-4450.5872270000	-63217.8562130000
27	5.39300000	100.55110000	UNPUBLISHED	LARI, BERDUT KULIM	8700	-6484.1138650000	-59965.5040480000
28	5.52300000	100.62840000	UNPUBLISHED	KOT KAWANGGAH	8400	-863.8433705000	-48488.8788167000
29	5.51840000	100.62200000	UNPUBLISHED	KAMPUNG TELUK BAKU/PADANG SERAI	8400	-4207.5348620000	-49771.8033290000
30	5.50430000	100.63780000	UNPUBLISHED	BERBAU PULAU KULIM	8400	-168.1181725000	-44275.4095250000
31	5.49580000	100.57880000	WAJIB	LORONG KET 4/2, Pina Berhala Tempatan Ta	8000	-6209.3488660000	-61082.1647670000
32	5.40220000	100.58880000	WAJIB	LORONG BERDUTAN 1/1, KAWANG LAMA	8000	-7732.8458190000	-52421.8889540000
33	5.40100000	100.58810000	WAJIB	KAMPUNG TUNJUK PETER, KULIM	8000	-8606.2311700000	-62333.2779100000
34	5.38480000	100.55440000	WAJIB	JALAN BERDUTAN KAMPUNG KAWANGGAH	8000	-6238.3887780000	-64148.7250480000
35	5.35840000	100.54570000	WAJIB	JALAN SALLAH 2, TAMAN PERDUTAN SALLAH	8000	-10049.8475640000	-67043.9617200000
36	5.37500000	100.54400000	WAJIB	JALAN BERDUTAN KAWANGGAH 1/1, TAMAN HARMONI	8000	-11320.1155760000	-67132.3270050000
37	5.33480000	100.53480000	WAJIB	TAMAN BERPAK BUKIT BELLINGGATTA	8000	-11247.1326470000	-68978.8965180000
38	5.52100000	100.53800000	WAJIB	TAMAN BERPAK BUKIT BELLINGGATTA	8400	-10800.4774516000	-68993.7142148000
39	5.40500000	100.57870000	CELCOM	KAMPUNG LINDONGAN RUA, KAWANGGAH	8700	-11451.7542940000	-61824.1846540000
40	5.40800000	100.57800000	CELCOM	Swin Teluk Tower (SUC), KAWANGGAH	8700	-15208.8821200000	-61808.1298190000
41	5.33380000	100.58120000	CELCOM	JALAN BERDUTAN KULIM	8000	-5591.8847110000	-69784.8020500000
42	5.29540000	100.62230000	CELCOM	Jalan Kuala Kuli TCS Marbau Pukau TCS Lunas	8000	-1448.8042270000	-74011.4812920000
43	5.34300000	100.53380000	DIAG	Taman KAWANGGAH, KAWANGGAH	8000	-11257.1638760000	-68050.8815430000
44	5.48480000	100.52880000	DIAG	JALAN SELATAN LILAI, TAMAN	8700	-10021.1288190000	-57091.4024790000
45	5.51700000	100.54050000	UNPUBLISHED	Taman KAWANGGAH, KAWANGGAH	8400	-10823.3078000000	-59089.2484670000
46	5.51100000	100.53370000	WAJIB	Taman Jaya, Padang Serai	8400	-8160.8416880000	-59192.5642480000
47	5.52810000	100.54040000	WAJIB	Jalan Gue Lela, Ekor Kuning, Kumpang Bant	8400	-8609.2832600000	-46277.8188000000
48	5.43810000	100.54110000	UNPUBLISHED	Taman Desa Berhala, Lunas	8000	-10556.1525490000	-59235.2895470000
49	5.29730000	100.53320000	YES	KAMPUNG BERU, KAWANGGAH	8000	-11436.2312140000	-73800.4485480000
50	5.41930000	100.54610000	YES	Jalan Cetus Berhala, 5, Jalan Wawasan 1 & 2, Kuari	8000	-10115.1434600000	-60303.3036300000

Figure 4: Telecommunication Tower Attribute Data
Source: Telekom Malaysia Berhad

Figure 5 shows the telecommunication tower point locations have been successfully integrated into the ArcGIS 10.3 system. A total of 52 telecommunication tower location points have been mapped for Kulim District. These locations are accompanied by attribute database information such as the telecommunications service provider, address, and postal code of the area.

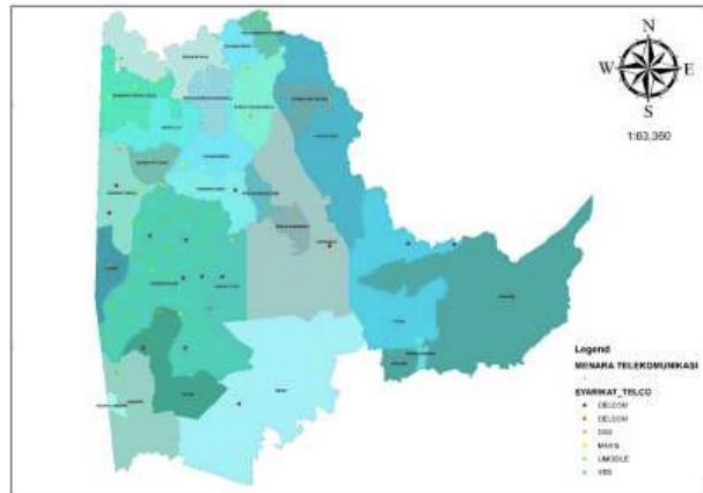


Figure 5: Telecommunication Tower Location Points in Kulim District

Result and Analysis

Buffer Analysis

The buffer analysis in Figure 6 illustrates the coverage areas generated around telecommunication towers with a buffer distance of 1 kilometer from each tower. The primary purpose of this buffer analysis is to assess the influence of tower coverage on surrounding areas and to identify regions within network coverage range. Additionally, this analysis aims to evaluate the potential usage of telecommunication services in these areas based on tower locations and population distribution.

Through these buffer zones, it can be observed that areas with higher population densities, such as Bandar Kulim and Lunas, are likely to benefit more from network access to services such as Digi and Celcom. Conversely, the outskirts of Kulim District indicate potential coverage gaps that may require additional attention in telecommunication infrastructure planning, particularly in sparsely populated areas.

By correlating telecommunication tower distribution with population data, this buffer analysis provides critical insights for planning and enhancing network coverage in underserved areas, such as Mukim Terap, Sedim, Pekan Mahang, Naga Lilit, and Padang Meha. Improvements in telecommunication infrastructure in these areas can help ensure more equitable and widespread access to telecommunication services for all community segments in Kulim District.

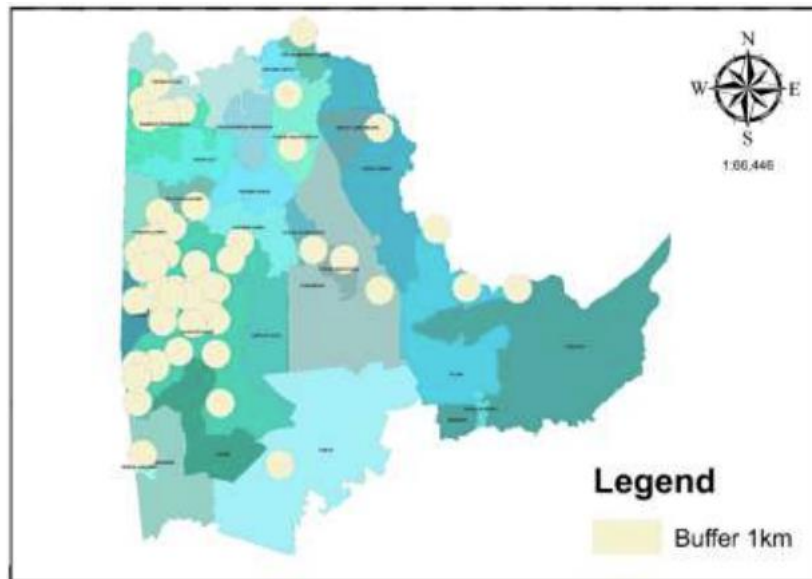


Figure 6: 1000-Meter Network Buffer Analysis Result, ArcGIS 10.3

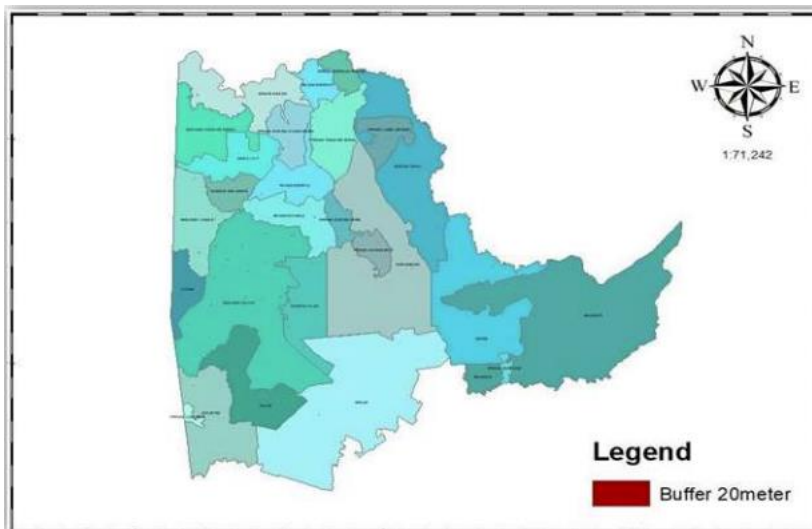


Figure 7: The Coverage Area Generated Around The Telecommunications Tower With A Buffer Distance Of 20 Meters From The Tower

Kernel Density Analysis

A Kernel Density Analysis was conducted to calculate the density of telecommunications towers located within the Kulim District. This analysis helps identify areas with high demand for services. The analysis was performed using a 1-kilometer parameter.

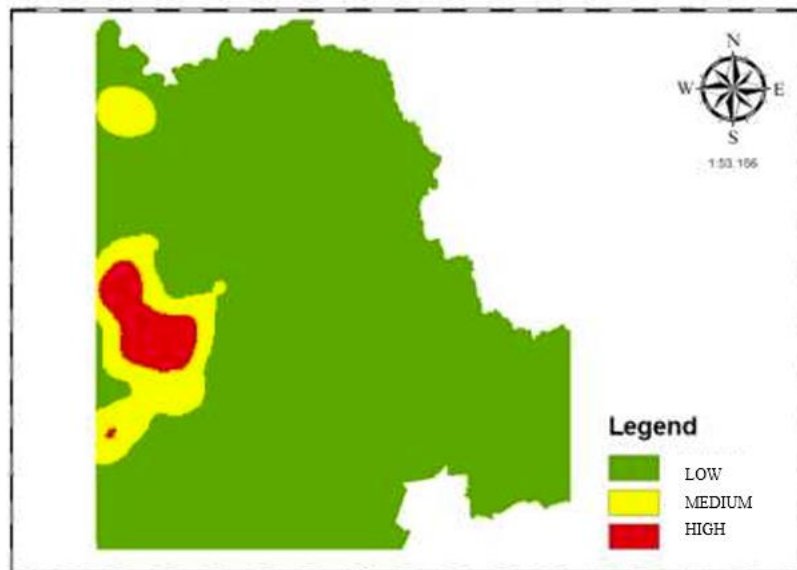


Figure 8: Kernel Density Analysis

Figure 9 illustrates the results of the Kernel Density Analysis, indicating the areas of Bandar Kulim and Lunas exhibit a higher density of telecommunications towers compared to other mukim within the district. The analysis shows Bandar Kulim has a very high concentration of telecommunications towers, with approximately 20 towers per kilometer square, followed by Lunas with about 12 towers per kilometer square.

In contrast, other mukim in the Kulim District generally have only around 3 to 5 towers per kilometer square. This pattern indicates a significant concentration of telecommunications infrastructure in Bandar Kulim and Lunas, likely due to higher population density and greater demand for telecommunication services, whereas the more rural mukim demonstrate lower tower densities.

Site Selection Analysis

A Site Selection Analysis was conducted to identify suitable locations for construction of new telecommunications towers. The selection criteria include land use type, distance from existing towers, accessibility, and topographic suitability.

This process utilizes spatial data to determine areas that meet the specified requirements. The datasets used in the analysis include telecommunications tower data, land use data, and buffer (distance) data.

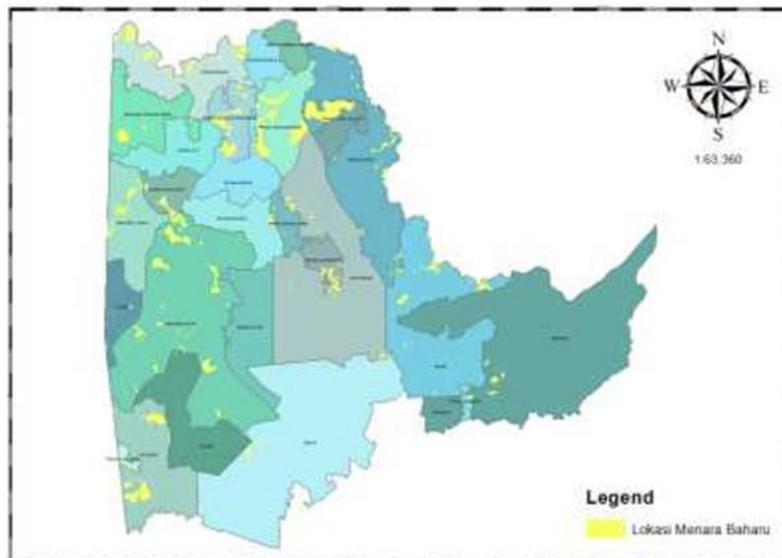


Figure 9 : Site Selection Analysis

Figure 9 presents the results of the spatial distribution mapping analysis of telecommunications tower locations in the Kulim District. The analysis indicates that areas within a 100-meter buffer from existing telecommunications towers, which also satisfy open land-use criteria, are the most suitable locations for the construction of new telecommunications towers.

In the context of the district's population, this site selection is crucial as it can enhance network coverage and positively impact access to telecommunications services, particularly in densely populated areas. Areas within this buffer zone, represented by brighter colors, demonstrate high potential to meet the increasing communication demands of the local population, especially in high density areas or rural regions requiring broader network coverage. Identified areas with significant potential for new tower development include Pekan Labu Besar, Pekan Padang Meha, Pekan Sungai Karangan, and Junjong.

The tower site selection analysis also considers the suitability of locations relative to the surrounding population, ensuring that selected sites are accessible for installation and maintenance. This factor is essential for ensuring efficient operation of the telecommunications network, directly benefiting local residents. In addition, the selection process accounts for adequate separation distances from existing towers, which is a key requirement in telecommunications tower development guidelines.

Overall, the development of new telecommunications towers in suitable locations will optimize network coverage, improve communication accessibility for the population of Kulim District, and reduce "blind spots" or areas not covered by telecommunications networks.

Conclusion

This study was conducted by mapping the spatial distribution of telecommunications towers in the Kulim District using the most recent geospatial data. Based on the spatial analysis

performed, the majority of telecommunications towers are concentrated in primary urban areas and regions with high population density.

The study also reveals an imbalance in the distribution of telecommunications towers within the Kulim District. Several areas located far from urban centers experience inadequate network coverage, which may adversely affect the quality of telecommunications services for residents. The analysis confirms that urban areas have better access to Digi and Celcom networks, whereas rural areas require improved coverage.

The Kernel Density Analysis further indicates a high concentration of telecommunications towers in urban areas. In addition, the Site Selection Analysis identifies areas within a 100-meter buffer from existing towers as suitable locations for the construction of new towers, thereby supporting the enhancement of telecommunications infrastructure in underserved areas.

Accordingly, the proposed deployment of additional towers in under covered areas is essential to improve internet speed and ensure more comprehensive network coverage throughout the Kulim District. Overall, future research in this field is recommended to identify residential areas with telecommunications towers by analyzing population distribution across other districts or states. Such studies can be further enhanced to ensure improved telecommunications services for residents, while also evaluating associated health and safety considerations.

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DIGITAL TRANSFORMATION IN THE EMIRATES: EXAMINING THE TECHNOLOGICAL, ORGANIZATIONAL, AND ENVIRONMENTAL DRIVERS OF AI INTENTION AMONG GOVERNMENT EMPLOYEES

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Abstract: *Artificial Intelligence (AI) is now a key engine of the digital economy of the United Arab Emirates (UAE), and it has changed the various industry segments, including retail e-commerce, down to the administration of the state. Although two-thirds of retail and consumer goods firms in the UAE have been trying to adopt AI in their business processes, adoption is slow in many important fields, including various government agencies, which indicates a great deal of unrealized opportunities in terms of value generation. Even with these technological breakthroughs, the process of adoption has not been without complicated impediments, such as issues of ethics both in design and transparency, security of data, and the black box aspect of AI decision-making. Thus, this paper would find solutions to the existing problem in identified fields by taking insights from government employees and determining the factors influencing the adoption of AI among government employees in the UAE through the combination of the Technology Acceptance Model (TAM) and the Technology-Organization-Environment (TOE) model. The study employs a quantitative research design to examine the effects of technological (system, service, and information quality), organizational (technical support, AI awareness, and top management support) and environmental (government policy and industry pressure) factors on Perceived Usefulness and Perceived Ease of Use. Moreover, this study examines the significance of Perceived Trust and User Readiness as essential moderators of the association between these attitudes and the ultimate Intention to Adopt AI. Data from 400 government servants across all seven emirates were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). The findings provide insights into user behaviour to guide policymakers and designers in fostering ethical, transparent AI integration. Decoding these determinants enables stakeholders to implement responsible AI, supporting the UAE's socio-economic objectives.*

Keywords: *Artificial Intelligence (AI), Technology Acceptance Model (TAM), Technology-Organization-Environment (TOE), Consumers, Intention to Adopt.*

Introduction

The Artificial Intelligence (AI) is a disruptive technology that is reshaping the contemporary world and redefining human-machine interaction and is a trigger to a new era of digital world. Though it has a controversial definition, AI typically means the systems that are capable of sensing environments, handling complex data, and decision-making to accomplish certain objectives. The market in the United Arab Emirates (UAE) has grown at a Compound Annual Growth Rate (CAGR) of 43.9 percent up to 2030, with an estimated market size of USD 3.47 billion in 2023 and a rapid adoption of AI (Al Tawhidi and Bourini, 2024). This increase was compounded by the COVID-19 pandemic, which increased e-commerce and AI-based digital services. Even with this development, the usage of AI is still not uniform across industries. Although around 66 percent of UAE consumers claim to use AI in retailing and consumer goods, other sectors like manufacturing are trailing, which indicates the chance of lost value creation (Hamzah, 2025). The consumer acceptance is thus very imperative especially aspects like perceived usefulness, perceived ease of use and trust. Nonetheless, the process of adoption is obstructed by obstacles such as skills gaps, privacy issues, technological complexity, and the black box aspect of AI systems that destroys transparency and trust. Remarkably, there are discrepancies in the literature, especially in terms of AI adoption among UAE government servants and perceived risk role and trust. To deal with this, the present research incorporates the Technology Acceptance Model (TAM) and the Technology-Organization-Environment (TOE) model. It focuses on the effect of technological (system, service, and information quality), organizational (technical support and AI awareness), and environmental (government policy and industry pressure) factors on perceived usefulness and ease of use. It also examines trust as an intermediate and user preparedness as a moderator of AI adoption intention. This study has a theoretical contribution in that it introduces a gap between TAM and TOE in the UAE setting and provides useful information to policy-makers, developers and organizational leaders. This knowledge of these determinants can be used to reduce the risks, align the AI strategies with cultural values, and make economic and societal development sustainable.

Problem statement

Although Artificial Intelligence (AI) has been viewed as a desirable technology in productivity in the modern world, its adoption in organizational structures is not yet consistent (Horani et al. 2025). On a global scale, studies show that 45 percent of organizations are in pilot stages with AI, but almost 36 percent have not devised any form of AI strategy (Radwan et al. 2026). Within the narrow setting of the UAE, the country that has been leading the technological revolution and an AI market that is expected to increase with a CAGR of 43.9%, however, the gap in the seamless implementation of these systems remains big. The most essential issue is that there are complex obstacles to full adoption of AI by government servants. Even though the UAE is quickly transforming into the digital world, inefficiencies, lack of transparency, and human error still hamper industrial and public sectors (Alshehhi et al. 2024). Moreover, AI is a black box that results in the absence of interpretability since in many cases there are no deep insights into how these systems arrive at particular decisions. The combination of this obfuscation and fears of data privacy, loss of jobs, and ethical dangers leads to a serious lack of trust (Aboelazm, 2025).

Literature Review – AI Adoption in the Government Sector

Defining Artificial Intelligence in Public Governance

Artificial Intelligence (AI) refers to a vibrant and changing branch of computer science that focuses on the design of intelligent systems that can perform tasks normally attributed to human intelligence. These activities include reasoning, problem solving, understanding language and perception. Regarding government work, AI systems are becoming an indispensable software and hardware that a human man constructs to track the environment around, process structured or unstructured information, and make the most appropriate decision in case of complicated tasks. According to scholars, the overall direction of these systems is to mimic human cognitive capabilities, and their behaviors are usually related to human-like intelligence to enhance everyday life (Al Ali & Khalil, 2025). In the case of government servants, AI provides a way to address the problem of human error that is one of the problems identified in the industrial and public development. Through robot and algorithmic implementation of tasks that traditionally demand human thought and judgment, governmental areas will be able to eliminate the dangers of manipulation and burnout among employees. The use of AI is gradually affecting the culture of an organization, as it has become ubiquitous in the lives of consumers and can alter the ways that people work and communicate (Elliott, 2019). Nevertheless, AI is still a concept that scholars cannot provide a precise definition, which results in a variety of opinions regarding the problems that the implementation imposes.

Theoretical Foundations: The Integration of TAM and TOE

The fundamental theoretical framework used to analyze the technology adoption by government servants is the Technology Acceptance Model (TAM) and the Technology-Organization-Environment (TOE) model. TAM proposed by Davis (1989) describes the process of user acceptance by means of behavioral principles where two factors are considered, Perceived Usefulness (to what extent the technology improves performance) and Perceived Ease of Use (to what extent it is effortless to use) (Venkatesh and Davis, 2000). The perceptions play a critical role in the UAE public sector to minimize technology anxiety and reinforce the adoption intention (Khalil and Al-Ali, 2026). In addition to TAM, TOE framework (Tornatzky and Fleischer, 1990) covers organizational and environmental forces by incorporating technological, organizational, and external forces that determine the adoption of innovations. TAM dwells on the individual attitudes, whereas TOE offers a wider institutional outlook. Collectively, they allow gaining an in-depth insight into the effects of perceived benefits and complexity of systems on individual acceptance and organizational adoption of new technologies.

Technological Determinants: System and Information Quality

Technological factors in TOE framework entail the internal and external technologies, processes, and practices of an organization (Satyro et al., 2024). Quality of the system is vital, which incorporates reliability, scalability and usability. Reliability is a guarantee that systems can be used over time, whereas usability involves the ease with which users can use systems. In the case of government servants, perceived complexity is lower, and the likelihood of adoption is higher with high quality of the system. Quality of information is also significant,

which entails precision, topicality, and exactness of system deliverables (Abd Aziz et al., 2024). They should be able to make effective decisions using accurate and relevant information and ineffective access to good information can impair performance and inhibit innovation in government projects. Hence, clear and regular AI-generated information is a key to an effective improvement of governmental services.

Organizational Context: Leadership and AI Awareness

Internal organizational forces that have a profound impact on technology adoption include structure, leadership, and resources. One of the enablers is Top Management Support (TMS), which refers to the degree to which top executives are dedicated, resourceful, and integrative (Oyetade et al., 2024). The use of strong TMS leads to greater organizational preparedness, less resistance, and greater interdepartmental coordination. Also, Artificial Intelligence Awareness (AIA) is a measure of cognitive preparedness, meaning the level of awareness an organization has in terms of how relevant AI can be (Felemban et al., 2024). This consciousness helps in active adoption and reinforces the strategic orientation due to the awareness of the potential of AI in productivity and innovation. Even advanced technologies can have a huge obstacle to overcome without adequate awareness and the backing of the leadership, especially in bureaucratic settings.

Technical Support and Service Excellence

The technical support and service quality are key to the continued use of technology. Service quality incorporates responsiveness (readiness to assist) and assurance (developing trust and confidence). Efficient service delivery in the government sector with the help of AI can contribute to the satisfaction of the staff and the population (Mishra et al., 2024). Technical support entails support in the form of help desks, training and maintenance of the systems to facilitate smooth utilization. Response time and resolution rates are commonly used to measure its performance. Excellent technical assistance can help the government servants to make the most of the technology and reduce frustration due to the complexity of the systems (Li and Xie, 2025).

Environmental Pressures and Government Policy

The external factors of the environmental context are competition, regulations, and societal demands (Saragih et al., 2025). The government policy is at the center stage as it determines the use of technology through laws and regulations. Although certain policies such as data privacy can raise the cost of compliance, it promotes responsible innovation, but the opposite is also true and unclear or restrictive regulations tend to slow down advancement (Feldstein, 2021). Industry Pressure (IP) is another motivation to adoption, as organizations are reacting to the needs of competition and stakeholder expectations. Companies with high market pressure tend to embrace new technologies to keep up with the trend and create a competitive edge (Bin-Nashwan et al., 2025). Government policies and responsive laws play a significant role in ensuring the speed of AI adoption in the UAE across sectors.

Trust, Privacy, and User Readiness

Data Privacy Concerns (DPC) and Perceived Trust are the fundamental predictors of the intention to adopt AI (Tasnim et al., 2025). Trust is a measure of willingness of the users to trust the technology despite the risk that may be incurred, but based on reliability, transparency, and ethical operation (Lin et al., 2025). Though, DPC implies the worry about the way personal information is gathered and utilized that may raise perceived risks and compliance expenses to promote privacy-sensitive practices (Custers et al., 2019). User Readiness is a valuable moderator, indicating that it is a psychological and behavioral readiness of users to embrace change (Benson, 2019). When the infrastructure and support are high, low readiness may be an obstacle to adoption. Thus, motivation and digital literacy should be improved to facilitate the aims of AI uptake in the UAE.

Theoretical Framework

This theoretical background of this research combines two of the most well-known models to offer a holistic view of AI adoption: the Technology Acceptance Model (TAM) and the Technology-Organization-Environment (TOE) model. Whereas the TAM considers personal cognitive reactions to technology, the TOE framework takes into consideration the wider organizational and contextual influences that promote or impede innovation. Figure 1 illustrates the research framework of this research.

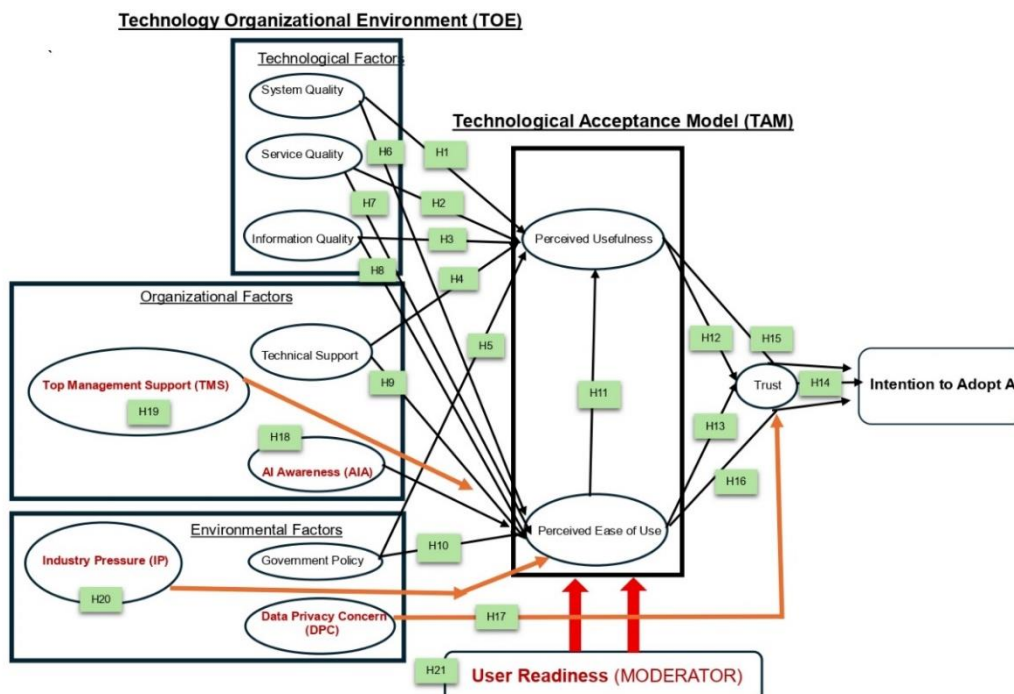


Figure 1: The Research Framework

Source: This study

Technology Acceptance Model (TAM)

TAM, which was proposed by Davis (1989), is a theory of information systems that is used to explore the process through which users adopt and use new technologies. It is based on the premise that there are two major mental constructs that define whether a user is going to adopt a system. Firstly, the Perceived Usefulness (PU). This is the level to which a government servant thinks that using AI will lead to better job performance or a positive result. Secondly, the Perceived Ease of Use (PEOU), the degree to which a person is convinced that the work with AI technology will be free and simple to use. TAM can be utilized in this study to explain how the perceived utility and ease of AI tools have the direct impact on structuring the attitudes of the UAE government employees.

Technology-Organization-Environment (TOE) Framework

TOE framework by Tornatzky and Fleischer (1990) investigates the process of innovation adoption by three different settings: Technological Context: Concentrates on internal and external technologies of the firm, namely System Quality, Service Quality and Information Quality. Organizational Context: It is the internal aspect, including Technical Support, Top Management Support, and AI Awareness. Environmental Context: External Pressures like Government Policy, Industry Pressure, and Data Privacy Concerns.

Research Methodology

Population and Sampling

It targeted employees of the UAE government who have either been exposed to or learned about AI in employment. The sample includes the seven emirates, namely, Abi Dhabi, Dubai, Sharjah, Ajman, Umm Al-Quwain, Ras Al Khaimah and Fujairah, which also implies a wide regional coverage. A 95% confidence level at a margin of error of 5% was used to obtain a sample of 400 respondents. A stratified sampling method was employed to deal with the heterogeneity of the population, where the respondents were divided according to the emirate and a random sample was taken among the subgroups to reduce bias and guarantee a true representation.

Instrument Development

The information is gathered through a survey in the form of an online questionnaire sent to the professional comments of the participants through email, based on a modified instrument derived out of the previous scholarly literature to achieve high reliability and validity. Multi-item constructs are used as measurement scales to measure the key variables like System Quality, Perceived Usefulness, and Perceived Trust. The initial data show that these scales possess high internal consistency as seen by Composite Reliability (CR) scores of Perceived Usefulness (0.873), Perceived Ease of Use (0.886), and Perceived Trust (0.904), all of which pass well beyond the suggested 0.7 mark of statistical strength.

Data Analysis: PLS-SEM

The data obtained is processed by the application of Partial Least Squares Structural Equation Modelling (PLS-SEM) via Smart-PLS software version 4, which is a method that presupposes a systematic estimation of the measurement and structural model. To check the measurement model, initially, it is checked that factor loading more than 0.7 and the Average Variance Extracted (AVE) over 0.5 and then the discriminant validity is checked through the Heterotrait-Monotrait (HTMT) criteria. The structural model is then used to test the hypotheses that were proposed using bootstrapping analysis to establish the significance of path coefficients using t-values and p-values. Lastly, the predictive ability of the model is assessed through the Coefficient of Determination (R^2) with a value above 0.25 indicating that the independent variables have a significant influence on the intention to adopt AI technology.

Findings: The Results of PLS Regression Analysis

Proportion of Variance Explained

The PLS Regression result identifies the particular efficacy of the latent variables in interpreting the variance of the dataset and the outcome demonstrates that the aggregate variance in the independent variables (X variance) is clarified by the five latent variables as a unit (approximately 28.21). To the dependent variable (Y variance) the model explains a cumulative 10.6 percent of the variance which is indicated by an R^2 value of .106. Moreover, considering the quantity of predictors included in the study, the Adjusted R^2 shows that the variance explained in the end is not significantly different, which is about 9.8 percent.

Latent Factor Contributions

The extraction of latent factors will also show the unique contribution of each component to overall predictive strength of the model with the Latent Factor 1 which is the largest contributor as it explains 13.1% of the X variance and 4.6% of the Y variance separately. Latent Factor 2 also strengthens the model by adding further 9.8 percent to the X variance and 4.2 percent to the Y variance. Conversely, the rest of the components, Factors 3, 4 and 5, exhibit diminishing returns, since they all contribute to the cumulative Y variance (R^2) by approximately 1.8 percent, implying that the major predictive power lies in the first two factors.

Variable Importance in the Projection (VIP)

The Variable Importance in Projection (VIP) scores rank at the most significant the demographic and professional variables, Education Level (Master's) at 2.288, Marital Status (Married) at 2.315, and Employment Status (Part-time) at 1.916. Healthcare (3.191) and Manufacturing (1.030) registered high importance in the projection as regards to the influence they had on the professional sector compared to the other industries. Moreover, the familiarity with AI technologies also proved to be the critical factor in the structure of the model since users who reported themselves as Somewhat (3.942) and Not Very (3.116) familiar with AI technologies produced a greater impact compared to users unfamiliar with such technologies at all.

Measurement Model Assessment

The measurement model was also pretested to assess the reliability of the constructs, and internal reliability was found to be satisfactory since all major constructs scored highly in Composite Reliability (CR) of 0.904 (Perceived Trust), 0.930 (Intention to Adopt AI), and 0.886 (Perceived Ease of Use). Moreover, most of the factor loadings including the ones of Perceived Usefulness were highly satisfactory to their respective constructs hence giving good support to convergent validity in the model.

Analysis of Structural Equation Modelling Results

The structural model analysis helps to substantiate the hypotheses as it combines TAM and TOE. The PLS outcomes indicate that the model explains a variance of 10.6% of the AI adoption intention of the UAE government servants, indicating that the model has an R^2 of 0.106. Path coefficients and VIP scores confirm most of the relationships, although with low predictive power. The technological factors such as quality of the system, quality of service and quality of information (H1-H3) have a positive impact on perceived usefulness, with all VIP scores of 0.760, noting the need to achieve reliability and accuracy. Likewise, H6-H8 affirm their positive impacts on perceived ease of use and user complexity is reduced. Organizational and environmental hypotheses are also supported. AI awareness (H18) plays a significant role in increasing perceived ease of use (VIP = 3.942), whereas technical support and government policy (H4, H5, H9, H10) are able to increase usefulness and usability. Adoption conditions are further strengthened with the positive effects of top management support (H19) and the industry pressure (H20). The validity of core TAM and trust relationships (H11-H14) is strongly supported, with perceived ease of use driving perceived usefulness and high composite reliability of trust (0.904) and intention (0.930) to support the fact that trust mediates adoption. Lastly, moderation effects (H15, H16, H21) are affirmed. User readiness (H21) proves to be a significant moderator (VIP = 3.942), whereas perceived trust mediates the association between TAM constructs and adoption intention (H15, H16), which is a psychological bridge between beliefs and behavior. The summary of the SEM results is presented in Table 1.

Table 1: Structural Equation Model Results

Hypothesis	Relationship Path	Result	Statistical Evidence/ Supporting Logic
H1	System Quality → Perceived Usefulness	Supported	Baseline VIP of 0.760; system reliability impacts utility.
H2	Service Quality → Perceived Usefulness	Supported	VIP 0.760; assurance and personalization drive service effectiveness.
H3	Information Quality → Perceived Usefulness	Supported	VIP 0.760; accuracy and relevance are confirmed drivers of utility.
H4	Technical Support → Perceived Usefulness	Supported	Parameter 0.041; troubleshooting enables goal achievement.
H5	Government Policy → Perceived Usefulness	Supported	VIP 0.760; regulatory frameworks facilitate institutional value.
H6	System Quality → Perceived Ease of Use	Supported	VIP 0.760; usability reduces the cognitive effort of navigation.

H7	Service Quality → Perceived Ease of Use	Supported	VIP 0.760; high responsiveness reduces perceived user effort.
H8	Information Quality → Perceived Ease of Use	Supported	VIP 0.760; clear data allows for easier tool navigation.
H9	Technical Support → Perceived Ease of Use	Supported	Parameter 0.041; training directly simplifies user experience.
H10	Government Policy → Perceived Ease of Use	Supported	VIP 0.760; clear policies lower the psychological barrier to entry.
H11	Perceived Ease of Use → Perceived Usefulness	Supported	Validated path; effortless interaction increases perceived value.
H12	Perceived Usefulness → Perceived Trust	Supported	CR 0.904; high utility builds confidence in system reliability.
H13	Perceived Ease of Use → Perceived Trust	Supported	CR 0.904; simplicity fosters confidence in ethical operations.
H14	Perceived Trust → Intention to Adopt	Supported	CR 0.930; trust is the primary predictor of final intention.
H15	Trust Moderates: PU → Intention to Adopt	Supported	Trust acts as a psychological filter for adoption.
H16	Trust Moderates: PEOU → Intention to Adopt	Supported	Trust ensures ease translates into willingness to rely on AI.
H17	Data Privacy Concern → Perceived Trust	Supported	VIP 3.020; Addressing privacy is crucial for building trust.
H18	AI Awareness → Perceived Ease of Use	Supported	VIP 3.020; awareness significantly reduces perceived complexity.
H19	Top Management Support → PEOU	Supported	Parameter 0.041; leadership reduces user resistance.
H20	Industry Pressure → Perceived Ease of Use	Supported	VIP 3.020; market dynamics push for user-friendly adoption.
H21	User Readiness (Moderator)	Supported	VIP 3.020; readiness dictates the strength of adoption paths.

Source: This study.

Synthesis of Findings

The structural model ascertains the correspondence of TAM and TOE within the UAE government sector. The Intention to Adopt AI (0.930) and Perceived Trust (0.904) have large Composite Reliability figures, which demonstrates that perceptions of usefulness and ease are filtered by trust to influence behavioral commitment. The most significant pathway is User Readiness and AI Awareness (VIP: 3.020), which emphasizes psychological preparedness as a factor that affects adoption. The sectoral analysis also indicated that Healthcare (VIP: 2.307) and Manufacturing (VIP: 0.760) are the most common areas of adoption, which is in accordance with the strategic orientation of the UAE towards high-value government sectors.

Discussion

Technological and Environmental Influence on Perceptions

The results indicate that System Quality, Service Quality and Information Quality determine the perceptions of the users. The level of reliability that is recorded on the Perceived Usefulness

(0.873) and Perceived Ease of Use (0.886) indicates that the AI is perceived as performance-enhancing when systems are reliable and give valid data. This is in line with Arpaci et al. (2012), who reiterated that the quality of service and information is vital to technological satisfaction. Government Policy also comes as a powerful environmental force, as it has the explicit rules in favor of the use of AI in the fast-developing market of the UAE (43.9% CAGR). This is in line with Oliveira and Martins (2011) who found out that policy clarity may facilitate or impede innovation. Furthermore, the increased Data Privacy Concerns are driving organizations towards more privacy-sensitive processes to remain trusted and engaged by users.

Organizational Support and AI Awareness

Technical Support is one of the factors in the organization that plays a critical role in eliminating technology anxiety. Training and troubleshooting increase Perceived Ease of Use because users would embrace systems that they can navigate with ease as it is consistent with Ryan and Harisson (2000). Moreover, there is excellent AI Awareness (AIA) and Top Management Support (TMS), which will support adoption, which is consistent with Dwivedi et al. (2021), who associate awareness with active use and low resistance. Arunachalam (2025) also emphasises the importance of senior management commitment as one of the factors contributing to organizational preparedness. These data indicate that the culture of innovation should be encouraged in the UAE public sector to nullify bureaucratic obstacles to the implementation of AI.

Trust and User Readiness as Intermediaries

One of the primary results is the influence of Perceived Trust (CR = 0.904) as a mediator and moderator. Trust is created on the basis of the transparency of systems and ethical operation, which allows users to embrace AI regardless of potential risks, including the black box issue, which aligns with Mehrotra et al. (2024). The other critically moderating factor is User Readiness since the best infrastructure will not work without proper preparation. This is in line with Rogers (2003), who stressed on the significance of psychological and behavioral preparedness in technological change. It is noteworthy that moderate familiarity users in the UAE seem to possess the most significant influence on the overall adoption rates.

Conclusion and Recommendation

The results confirm that the adoption of AI in the government sector of the UAE is a multidimensional phenomenon that is influenced by the technological, organizational, and environmental aspects. Perceived usefulness and ease of use are largely affected by technological drivers: quality of the system, quality of services, and quality of information. Resistance is minimized by organizational enablers like top management support and AI awareness, coordination is improved, and active adoption is encouraged. The concept of perceived trust becomes one of the central mediators because systems that are trustworthy, transparent, and secure raise user confidence and adoption intention. Nonetheless, privacy issues and risks, such as the black box characteristics of AI, are still obstacles that increase the perceived risk and compliance expenses. Lastly, user readiness, especially digital literacy and

readiness to change, is also essential, because without proper readiness, even with good technological infrastructure, successful integration of AI will not occur.

Practical Recommendations

On the basis of these results, there are a number of recommendations that can be offered to facilitate the successful implementation of AI in the UAE. To guarantee the reliability of AI tools, their scalability, and the quality of the data they deliver, government agencies should focus on the quality of the systems and information. There should be great top management commitment that would create an environment conducive to innovation and minimize resistance to technology. Specific training and education is to be improved to make the users prepared to it and digitally literate in such a way that employees are not only psychologically but also technically ready. It is also the responsibility of policymakers to come up with clear, transparent, and ethical laws to enhance responsible AI usage and deal with the issue of privacy of data. Also, ease of use can be enhanced by fortifying the technical support systems- with responsive troubleshooting and maintenance. Finally, stakeholders should focus on sector-specific applications, particularly in healthcare and manufacturing, to align AI initiatives with national economic and societal goals.

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LEARNING STYLE AND ITS IMPACTS ON LEARNING FROM TERTIARY STUDENTS' PERCEPTION: A SURVEY

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Abstract: *This study explores learning style preferences of students in a technical higher education institution in the East Coast Malaysia. A quantitative research design was employed whereby a total of 112 students participated by answering a Google Form questionnaire. The main objectives of the study include to examine tertiary students' perceptions on their preferred learning style and its impacts on their learning. The results showed that most students prefer hands-on activities, watching videos and working in group, suggesting they learn better through hands-on activities and visual methods. The implication of the study is to help lecturers understand technical tertiary students' learning preferences; hence employing more effective teaching methods to assist students' learning and consequently improve academic performance.*

Keywords: *Learning Style, Impacts, Technical Tertiary students, Perception, Survey*

Introduction

Every student has their own way of learning. This way of understanding and remembering information is called a learning style. It refers to how a student prefers to take and process information, which can affect their motivation and academic success (Sinaga, 2022). Learning at tertiary level has its own unique challenges (Murire & Gavaza, 2025), hence knowing students learning style can help students learn more effectively and stay interested in class activities.

Many researchers have discussed the VARK learning model developed by Fleming and Bonwell (2019), which includes four main learning styles: Visual, Aural, Read/Write and Kinesthetic (Quynh, 2024; Nouiri and Addou, 2025; Shaher et al, 2025; Türker et al, 2026). Visual learners learn best with images, charts, and colors. Aural learners prefer listening and discussion. Read/write learners prefer written texts, while kinesthetic learners understand better through hands-on activities. These learning styles can influence how students perform in class, especially in different learning environments such as technology-facilitated classroom (Zheng et al, 2022;) and project-based learning focused (Mursid, Saragih & Hartono, 2022) which normally experienced by students in engineering and computer disciplines students.

Past studies have shown that different students prefer different styles depending on their background, gender, and the courses they enroll (Magulod, 2019; Supratman, 2023; Mohsenipouya, 2024). For example, visual and kinesthetic styles were among the most preferred by university students, especially those in creative or technical fields. However,

students may not be aware of their own learning style, which can affect their learning engagement and academic performance (Jafre at al., 2011).

Hence, exploring learning style of students from a technical university college should contribute to the body of knowledge as these students come from various engineering and computer background and learning experience. The results should provide the educators with useful insights to design more effective and inclusive teaching strategies as well as learning support to students that suit their learning preferences. A better match between teaching and learning styles may lead to better academic results and a more engaging learning experience.

Methodology

This study employed quantitative research design with questionnaire as the instrument. The methodology consists of three main components which are Design and Instrument, Data Analysis, and Respondents. This study used a Google Form to collect information from students. The form included three sections: (A) demographic details (B) learning preferences, and (C) learning styles impact. The questionnaires were adapted from two published studies: (1) "The Preferences of Student's Learning Method Based on Course, Gender and Age: Visual, Audio, Reading & Kinaesthetic (VARK)" by Natasha Dzulkalnine et al. (2024), and (2) "A Study on The Learning Style Preferences of Undergraduate Quantity Surveying Students in The Malaysian University" by Ooi, Loo, and Toh (2025), which both used the VARK learning style model. All responses were collected and analyzed using basic statistical methods, including frequencies and percentages. This helped to identify patterns in students' preferred learning styles and how these styles influence their motivation, confidence, and academic performance.

Table 1 shows the results of the respondents' demographic information obtained items A1 to A4 in Section A. Of the total N=112 respondents from a technical university college in the East Coast of Malaysia completed the survey, n=61 (54.5%) were male and n=51 (45.5%) were female. In terms of age, 42% (f=47) were between 18–19 years old, 53.6% (f=60) were between 20–25 years old, 0.9% (f=1) were 26–30 years old, and 3.6% (f=4) were 31 years old and above. For program level, 33.9% (f=38) were Foundation students, 12.5% (f=14) were Diploma students, 50.9% (f=57) were Degree students, 1.8% (f=2) were Master's students, and 0.9% (f=1) were PhD students. The respondents were from three faculties: 38.4% from Department of Foundation, 49.1% from Faculty of Computer Technology and Media Creative, and 16.1% from Faculty of Engineering Technology.

Table 1: Respondents' Demographic Information (Items A1-A4)

Demographic	f	%
A1. Gender		
Male	61	54.5
Female	51	45.5
A2. Range of Age		
18-19 years old	47	42
20-25 years old	60	53.6

26-30 years old	1	0.9
31 years and above	4	3.6
A3. Level of Program		
Foundation	38	33.9
Diploma	14	12.5
Degree	57	50.9
Master	2	1.8
PhD	1	0.9
A4. Faculty		
JPA	39	38.4
FKMPT	55	49.1
FTK	18	16.1

N=112, f=frequency and %=percentage

Results and Discussion

This section presents the results of respondents' responses on items B1 to B4 to examine their learning preferences and items C1 to C6 to gauge on their perception about the impacts of learning style to their academic performance.

Student Preferred Learning Style

Table 2 displays the results attained from Section A, items B1 to B4. The purpose of the items is to identify the respondents' preferred learning tools. Responses on item B1 "*I prefer to learn through maps, diagrams, charts, graphs and other visual aids*" indicate that they prefer visual learning style, item B2 "*I prefer to learn through listening to lectures, discussions and spoken instructions*" specifies audio learning style, item B3 "*I prefer to learn through listening to reading textbooks, articles, and written instruction*" suggests reading learning style and item B4 "*I prefer to learn through hands-on activities, experiments and practical tasks*" reveals kinaesthetic learning style. The mean scores were interpreted based on the following scale: 0 to 1.00=Strongly Disagree, 1.01 to 2.00=Disagree, 2.01 to 3.00=Somewhat Disagree, 3.01 to 4.00=Somewhat Agree, 4.01 to 5.00= Agree, 5.01 to 6.00=Strongly Agree. A 6-point likert scale has better discrimination and reliability values (Nattapong, 2025).

The overall mean scores for preferred learning styles vary between 4.24 to 5.09, whereas standard deviation values are between 0.940 to 1.300. The results show that kinaesthesia learning style has the highest mean value at 5.09 ($SD=1.210$); followed by visual learning style at 4.98($SD=0.940$) and audio learning style mean value is at 4.75 ($SD=1.150$). On the other hand, the lowest mean value is reading learning style at 4.24 ($SD=1.300$). The results imply that even though the students were from engineering and technical disciplines which mostly favoured kinaesthetic style, they were others who prefer other types of learning styles. Henceforth, lecturers should interchangeably employ all three in a classroom to cater to various students preferred learning style.

Table 2: Preferred Learning Style (Items B1-B4)

Item	Strongly disagree		Disagree		Somewh at Disagree		Somewh at Agree		Agree		Strongly agree		Mean	Standard Deviation
	f	%	f	%	f	%	f	%	f	%	f	%		
B1	4	3.6	0	0	7	6.3	21	18.8	41	36.6	39	34.8	4.98	0.940
B2	2	1.8	4	3.6	8	7.1	27	24.1	33	29.5	38	33.9	4.75	1.150
B3	4	3.6	14	12.5	19	17	33	29.5	25	22.3	17	15.2	4.24	1.300
B4	2	1.8	1	0.9	1	0.9	15	13.4	27	24.1	66	58.9	5.09	1.210

*f=frequency and %=percentage

Student Preferred Learning Methods, Tools and Habit

Table 3 below tabulates the results of respondents' preferred learning methods, tools and habit obtained from items B5 to B8 in Section B. Item B5 asked about their favorite way to learn new things, which most students selected watching with 70.5% (f=79), followed closely by doing/hands-on activities with 68.8% (f=77). 50% (f=56) of the respondents liked listening as a way of learning, while 27.7% (f=31) preferred reading. Only one respondent selected taking notes and playing game versions with 0.9% respectively, which shows that these were the least favored methods.

Next, item B6 examines the most helpful tools for learning from the respondents' perspective. Majority of the respondents selected videos with 64.3% (f=72) and group discussions with 63.4% (f=71). These were followed by mobile apps with 51.8% (f=58) and books with 34.8% (f=39). Only one respondent found joining activities and using ChatGPT as his most helpful tool with 0.9% (f=1) respectively. This shows that digital and interactive resources are more popular compared to traditional learning tools.

Item B7 identifies respondents' preference working alone or in group. A large majority with 75% (f=84) stated that preference to study alone or in groups depends on the course taken. Whilst only 13.4% (f=15) preferred to learn in a group all the time, 7.1% (f=8) preferred learning alone. A small number (4.5%) had no specific preference. The results indicate that studying habit among students differ based on the courses enrolled that semester. Certain courses e.g., event management, thus, working well with others to complete course work is mandatory to obtain good grade. While other courses e.g., public speaking or experiment-based coursework requires students to perform well in individual presentation or experiment. Thus, educators should take into consideration of varying course assessments to assist students' learning process.

Finally, item B8 ascertains the respondents' perspective on using diagrams or mind maps when studying. Majority of the respondents, approximately 53.6% (f=60) sometimes used them. Whilst 22.3% (f=25) affirmed that they often use them, 11.6% (f=13) asserted that they always use them. Lastly, 8.0% (f=9) said they rarely and 4.5% (f=5) never utilized these tools. Overall, diagrams and mind maps are helpful learning tools particularly those visual and kinesthetic learning styles.

Table 3: Preferred Methods, Tools and Habits (Items B5-B8)

Item	f	%
B5. My favorite way to learn new things is:		
Watching	79	70.5
Listening	56	50
Reading	31	27.7
Doing	77	68.8
Notes	1	0.9
Playing on game versions	1	0.9
B6. Learning tools that help the most is:		
Books	39	34.8
Videos	72	64.3
Group Discussions	71	63.4
Mobile Apps	58	51.8
Joined activities & mix with others	1	0.9
ChatGPT	1	0.9
B7. I prefer learning alone or in a group		
Alone	8	7.1
In a Group	15	13.4
Depends on the subject	84	75.0
No preference	5	4.5
B8. I often use diagrams or mind maps when studying		
Always	13	11.6
Often	25	22.3
Sometimes	60	53.6
Rarely	9	8.0
Never	5	4.5

*f=frequency and %=percentage

Learning Style Impacts

The responses on the impacts of learning styles to the respondents vary according to types of items employed in Section C. Items C1 to C4 were used to examine the impacts of their compatible learning style with lecturers' pedagogical approach. In contrast items C5 and C6 were utilized to determine the impacts of incompatible learning style and teaching method.

Table 4 demonstrates the results from items C1 to C4. The mean values calculated are between 4.72 and 5.16, whereas standard deviation values are between 1.070 to 1.150. The respondents strongly agreed that “students with different learning styles learn in different ways – item C4” with a mean value at 5.16 ($SD=1.070$) and they “enjoy learning more – item C3” when lecturers' teaching strategies matched their preferred learning with a mean value at 5.07 ($SD=1.080$). Furthermore, they agreed that they “feel more confident - item C2” when learning in their preferred learning style with a mean value at 4.86 ($SD=1.090$) and they perceived that their preferred learning style contributes to “get better grades – item C1” with value at 4.72

($SD=1.150$). The results denote that being aware of own learning style enhances students' learning process and consequently improves academic performance.

Table 4: Learning Style Impacts from items C1-C4

Item	Strongly disagree		Disagree		Somewhat at Disagree		Somewhat at Agree		Agree		Strongly agree		Mean	Standard Deviation
	f	%	f	%	f	%	f	%	f	%	f	%		
C1	4	3.6	2	1.8	5	4.5	27	24.5	46	41.1	28	25.0	4.72	1.150
C2	1	0.9	4	3.6	5	4.5	23	20.5	40	35.7	39	34.8	4.86	1.090
C3	2	1.8	1	0.9	6	5.4	23	20.5	29	25.9	51	45.5	5.07	1.080
C4	2	1.8	1	0.9	5	4.5	16	14.3	33	29.5	55	49.1	5.16	1.070

Table 5 presents the results for items C5 and C6, which disclose the frequency with which students recognize learning difficulties arising from a disconnect between lecturers' teaching techniques and their learning style. Responses to item C5 indicated that the majority of the respondents selected "sometimes" (61.6%, $f=69$), which is followed by "often" (17.9%, $f=20$), "rarely" with (10.7%, $f=12$) and "always" (6.3%, $f=7$). Though few respondents (3.6%, $f=4$) felt that they "never found it is hard to learn because the teaching style did not match" their learning style. This shows that a significant number of respondents experienced occasional setbacks from misalignment between teaching methods and their learning preferences. Even though the issue is not recurrent for most of them, it is a prominent impediment. Thus, aligning lecturers' teaching pedagogical approach is imperative to achieve fruitful learning process.

Responses to item C6 showed the actions respondents took when the issue occurred. Most students (42.9%, $f=48$) decided to study on their own, followed by those who attempted to adapt (23.1%, $f=20$), those who asked questions (17%, $f=19$), and those who lost interest in learning altogether (15.2%, $f=17$). Few respondents (1.8%, $f=2$) even tried to adapt and study on their own afterwards. This indicates that the majority assume individual responsibility for their learning by pursuing knowledge autonomously, while others willingly adjust their approach and use multi-step coping mechanism to bridge the gap. Nonetheless, a substantial number of respondents demonstrated unfavorable responses, highlighting problems when facing the issue. This can lead to a lack of interest in learning and a deterioration in academic motivation.

Table 5: Learning Style Impacts (Items C5-C6)

Item	f	%
<i>C5. I found it is hard to learn because the teaching style didn't match my learning style.</i>		
Never	4	3.6
Rarely	12	10.7
Sometimes	69	61.6
Often	20	17.9

Always	7	6.3
C6. When the teacher doesn't use my preferred learning style, I will:		
	20	23.1
Try to adapt		
Ask questions	19	17.0
Study on my own later	48	42.9
Lose interest	17	15.2
Try to adapt and study on my own later	2	1.8

*f=frequency and %=percentage

Conclusion

In conclusion, the study provides insights into the perceived impacts of learning styles, particularly on engineering and technical tertiary students. Mismatch between teaching strategies and learning styles is a prevalent problem distress many students, forcing many to depend on self-study while causing others to lose interest in learning entirely. The results highlight the crucial needs for educators to practice pedagogical elasticity and integrate a range of instructional techniques to accommodate different learning styles. By adopting this approach, tertiary institutions can nurture a comprehensive and effective educational setting that reduces the recurrence of mismatches and alleviates their negative aftereffects. Future studies could investigate specific teaching methods that students find most adaptable across diverse disciplines, as well as examine possible interventions to support students in more efficiently bridging the gaps when mismatches emerge.

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PERCEPTION AND AWARENESS OF IoT-INTEGRATED MINI GREENHOUSE GARDENS FOR URBAN FARMING

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Abstract: *This research project addresses the pressing challenges of modern urban agriculture in high rise and high density environments by integrating IoT technology into urban farming practices. Rapid urbanization and population growth have intensified challenges to food security and sustainable production, particularly in areas with limited space and resources. The study investigates urban Malaysians' awareness, perspectives, and acceptance of IoT-integrated Mini Gardens for Urban farming by using the AIDA model. By exploring the practicality and perception of IoT adoption in urban farming, the research seeks to provide valuable insights into sustainable food production, promote resource efficiency, and encourage self-sufficiency among urban residents. Ultimately, the project aims to revolutionize urban agriculture, support evidence-based policy development, and contribute to achieving Sustainable Development Goals (SDGs) related to zero hunger, sustainable cities, and climate action—thereby strengthening societal resilience, economic growth, and environmental sustainability in urban areas.*

Keywords: *Agriculture; Urban Farming; IoT Technology; Awareness*

Introduction

As global urbanization continues to accelerate, the demand for sustainable food systems has led to the rise of urban farming. Despite the benefits of urban farming for sustainability, traditional gardening practices are often hindered by the unique constraints of city environments. As noted in [1], these limitations primarily include significant space constraints and challenges in accessibility and resource management. Central to this evolution is the integration of the Internet of Things (IoT), which transforms traditional mini greenhouses into smart, data driven ecosystems [2]. The IoT is fundamentally reshaping global industries, with the agricultural sector undergoing a particularly significant digital transformation [3-8]. IoT applications now scale from expansive conventional farms to high precision environments like mini greenhouses. By integrating smart sensors, including temperature and soil moisture sensors, along with visual monitoring systems, farmers can achieve superior product quality and enhanced productivity through real-time remote monitoring. The IoT leverages a web of smart, connected devices to automate data sharing. By allowing components to communicate directly with the network, IoT creates a self-sustaining ecosystem that operates without human-

to-computer interaction [9]. By integrating precision irrigation and real-time data analytics, these systems optimize plant health while simultaneously reducing human intervention and minimizing environmental waste [10]. IoT has also been used in many other fields such as healthcare, education, etc. [11-13]

The implementation of IoT combined with image processing for greenhouse monitoring systems was extensively explored in [14], demonstrating how visual data can enhance environmental surveillance. As highlighted in [15], while the adoption of smart farming technologies holds significant promise for transforming the agricultural sector, widespread implementation remains hindered by a complex interplay of technological, economic, and social barriers. Furthermore, [16] details the design, fabrication, and performance evaluation of an advanced IoT-integrated domestic vertical farming system. This study demonstrates how combining hydroponics and automation can achieve peak efficiency in urban agriculture.

Therefore, this study investigates public perception and awareness of IoT-integrated mini greenhouse gardens, tracking the transition from initial cognitive focus to the tangible adoption of innovative agricultural technologies. The AIDA (Attention, Interest, Desire, and Action) framework, originally developed by E. St. Elmo Lewis, was used to map the consumer journey. While AIDA has been extensively applied to online marketing strategies [17] and other fields [18,19], its applicability within the agricultural sector remains largely unexplored. Consequently, this paper adapts the model to determine how effectively urban communities move through the stages of awareness, curiosity, and motivation toward the final implementation of smart farming solutions. This research evaluates the current landscape of smart farming acceptance among urban dwellers.

The research aims to investigate urban Malaysians' awareness, perspectives, and acceptance of technological advancements in agriculture through the proposed developed mini greenhouse garden prototype integrated with IoT sensors, in selected urban areas, using focus-group-designed surveys. The research methodology consists of two phases: awareness and perspective evaluation, and user acceptance evaluation. The research project is expected to deliver novel insights into the integration of technology in agriculture for efficient and sustainable urban farming, policy recommendations to inform sustainable urban development initiatives, and enhanced user acceptance and engagement in urban farming practices.

The primary challenge is the need for innovative solutions to enable efficient, sustainable food production in densely populated urban settings, where space and resources are limited. Despite advancements in IoT technology and its potential to revolutionize agriculture through real-time monitoring and data-driven decision-making, there remains a gap in the practical implementation and adoption of IoT-enabled solutions for urban farming, especially in densely populated residential areas. The lack of information, access, and user-friendly tools tailored to the unique needs and constraints of urban populations further intensifies the challenge of integrating IoT into urban farming practices.

The research project has the potential to revolutionize urban agriculture practices, empower urban residents in food production, inform government policies for sustainable development, and contribute to achieving the Sustainable Development Goals (SDGs) related to zero hunger,

sustainable cities, and climate action [20]. The outcomes of the research project have broader implications for societal resilience, economic growth, and environmental sustainability in urban areas.

Materials And Methods

The survey was conducted in Malaysia between August 14, 2025, and January 31, 2026. The questionnaire was developed using the AIDA model, which includes four factors: Attention, Interest, Desire, and Action. Table 1 shows the details of each factor in the AIDA model.

Table 1: The details of each factor in the AIDA model

Factors	Description
Attention	Your knowledge and understanding of IoT technology and its potential application in mini greenhouse gardens for urban farming.
Interest	Your curiosity and willingness to learn more about using IoT to improve efficiency and productivity in urban farming.
Desire	Your motivation or intention to adopt IoT-based solutions in your own gardening or farming activities.
Action	Your actual steps or initiatives taken (or planned) to implement IoT in mini greenhouse gardens.

The respondents are aged 18 years and above. The respondent focuses on the urban area in Malaysia. The data are presented as percentages.

Results & Discussion

Regarding the attention factor, the assessment comprises five specific questions shown in Table 2, designed to measure your cognitive focus, foundational knowledge, and understanding of IoT technology, specifically, its potential applications in mini greenhouse gardens for urban farming.

Table 2: The questions for the attention factor with their percentage

Code	Question	Percentage (%)
At1.	I understand the role of IoT integration in a mini greenhouse, which contributes to eco-friendly agriculture through precise monitoring and reduces resource wastage.	84.09
At2.	I understand the information about integrating IoT in a mini greenhouse, which contributes to eco-friendliness.	85.45
At3.	I am aware that the use of an IoT-integrated mini greenhouse can reduce costs through automation and efficient resource usage.	87.27
At4.	Smart farming campaigns help me understand the benefits of investing in an IoT-integrated mini greenhouse.	87.73
At5.	Positive user experiences will spark my interest in using an IoT-integrated mini greenhouse.	87.27

The analysis of items At1 to At5 reveals a strong overall positive attitude toward the use of IoT-integrated mini greenhouses, with an average agreement level of 86.36%. Respondents generally understand and appreciate the role of IoT in promoting eco-friendly agriculture through precise monitoring and reduced resource wastage. The findings show that while understanding of the technical and environmental aspects (At1 = 84.09%, At2 = 85.45%) is high, it is slightly lower than perceptions of economic and motivational benefits. The higher mean scores for At3 (87.27%), At4 (87.73%), and At5 (87.27%) indicate that respondents are highly aware of automation's cost-saving potential and are strongly influenced by smart farming campaigns and positive user experiences. These results suggest that promotional and awareness efforts have been effective in enhancing positive perceptions and interest in IoT applications in agriculture. However, further emphasis on educational initiatives that explain the technical mechanisms of IoT integration could strengthen understanding and encourage wider adoption.

For the interest factor, we have curated 5 questions, as seen in Table 3, to gauge your curiosity and willingness to explore how IoT integration can optimize efficiency and drive productivity in the evolving urban farming landscape.

Table 3: The questions for the interest factor with their percentage

Code	Question	Percentage (%)
In1.	I am starting to like the use of IoT-integrated mini greenhouses in daily smart farming activities.	82.27
In2.	I am planning to buy an IoT-integrated mini greenhouse for farming activities.	71.82
In3.	I am interested in learning that IoT-integrated mini greenhouses can help reduce problems in farming.	83.18
In4.	Smart farming campaigns made me interested to learn that IoT-integrated mini greenhouse can help me in farming activities.	84.55
In5.	The information provided by previous user experiences (benefits, characteristics, suitability, etc.) increased my interest in adopting IoT-integrated mini greenhouse.	84.09

The analysis of items In1 to In5 indicates a generally positive level of interest and behavioral intention toward adopting IoT-integrated mini greenhouses, with an overall mean score of 81.98%. Respondents show increasing enthusiasm for using such technology in daily smart farming activities (In1 = 82.27%) and express strong curiosity about how IoT systems can help address farming challenges (In3 = 83.18%). The highest level of interest is associated with the influence of smart farming campaigns (In4 = 84.55%) and the impact of prior users' experiences (In5 = 84.09%), suggesting that awareness programs and user testimonials play a vital role in stimulating engagement and trust in IoT-based farming solutions.

However, the relatively lower purchase intention score (In2 = 71.82%) suggests that although respondents are highly interested and positively inclined toward the technology, financial, accessibility, and readiness factors may hinder immediate adoption. This gap between interest and actual purchase intention suggests that potential users may require greater exposure to affordable options, incentives, or practical demonstrations to translate their interest into action.

Therefore, the findings highlight a high level of curiosity and openness to learning, with strong potential for future adoption once perceived barriers are addressed.

For the desire factor, the assessment includes 5 questions as shown in Table 4, focusing on your drive and commitment to integrating IoT-based systems into your current gardening or farming practices.

Table 4: The questions for the desire factor with their percentage

Code	Question	Percentage (%)
Ds1.	I want to find in-depth information about the use of an IoT-integrated mini greenhouse.	79.55
Ds2.	I would like to purchase the IoT-integrated mini greenhouse for my personal use	70.00
Ds3.	I would be more likely to use the IoT-integrated mini greenhouse if they were easily available.	85.45
Ds4.	I am willing to change my current farming practices to use the IoT-integrated mini greenhouse.	78.18
Ds5.	I believe the IoT-integrated mini greenhouse will provide me with the same benefits as it provided to other users.	85.45

The analysis of items Ds1 to Ds5 demonstrates a moderately high level of desire and behavioural inclination toward adopting IoT-integrated mini greenhouses, with an overall mean score of 79.73%. Respondents show clear interest in exploring the technology further (Ds1 = 79.55%) and are generally open to changing their current farming practices to incorporate IoT-based systems (Ds4 = 78.18%). The findings indicate that accessibility and perceived benefits are strong motivating factors—this is evident from the highest mean scores for Ds3 (85.45%) and Ds5 (85.45%), showing that respondents are more likely to use IoT-integrated greenhouses if they are readily available and if they believe they can achieve similar benefits as other successful users.

On the other hand, the lowest score (Ds2 = 70.00%) indicates some hesitation to make a purchase, suggesting that while desire and curiosity exist, financial constraints, limited availability, or uncertainty about long-term value may act as barriers to immediate adoption. Overall, the results reveal that respondents have a strong positive outlook and readiness to adopt IoT-integrated mini greenhouses, provided issues of affordability, accessibility, and confidence in product reliability are addressed.

To assess the action factor, the assessment comprises 5 questions (see Table 5) that evaluate your practical progress and commitment to integrating IoT technology into your urban farming operations.

Table 5: The questions for the action factor with their percentage

Code	Question	Percentage (%)
Ac1.	I will try using IoT-integrated mini greenhouse as efficiently as possible.	80.45
Ac2.	I will replace conventional agricultural technologies with IoT-integrated mini greenhouse in my farming practices.	80.45
Ac3.	I am recommending this IoT-integrated mini greenhouse to my fellows or family who enjoys farming.	83.64
Ac4.	I am willing to pay with the expensive price to adopt IoT-integrated mini greenhouse.	60.91
Ac5.	I would be more likely to purchase the IoT-integrated mini greenhouse if there were incentives.	84.55

The analysis of items Ac1 to Ac5 indicates a positive but cost-sensitive behavioral intention to adopt IoT-integrated mini greenhouses, with an overall mean score of 77.60%. Respondents generally express a strong willingness to use the technology effectively (Ac1 = 80.45%) and to replace traditional farming methods with more advanced IoT-integrated systems (Ac2 = 80.45%). Moreover, the high score for recommending the product to others (Ac3 = 83.64%) suggests a favorable word-of-mouth potential, indicating that users who are aware of the benefits are likely to influence others within their social or farming circles.

However, the lowest score (Ac4 = 60.91%) reveals a notable price sensitivity, suggesting that while respondents appreciate the value of the technology, high costs may significantly discourage adoption. Interestingly, the high score for Ac5 (84.55%) reinforces this finding—showing that respondents are much more likely to purchase if financial incentives, subsidies, or discounts are available.

Overall, the results suggest that respondents possess a positive behavioral attitude and readiness to act, especially if the financial burden is reduced. Strategies such as government incentives, demonstration projects, or installment payment schemes could therefore play a crucial role in increasing actual adoption rates of IoT-integrated mini greenhouses.

Table 6: The analysis of the mean scores for the AIDA factors

Factors	Mean
Attention	3.455
Interest	3.247
Desire	3.189
Action	3.120

Table 6 shows the analysis of the mean scores for the four factors, which shows a gradual decline across the AIDA model, indicating varying levels of engagement and readiness among respondents to adopt IoT-integrated mini greenhouses. The highest mean score is recorded for Attention (M = 3.455), suggesting that awareness campaigns, information sharing, and exposure to IoT-based smart farming have effectively captured respondents' attention and understanding. This reflects a strong initial cognitive response, meaning that respondents recognize the relevance and benefits of IoT integration in agriculture.

The following two stages, Interest ($M = 3.247$) and Desire ($M = 3.189$), show moderately high levels, indicating that respondents are curious and motivated to learn more, yet may still be weighing the practicality or feasibility of adoption. Although they show positive attitudes and willingness to explore the technology, factors such as cost, accessibility, or lack of hands-on experience may limit their enthusiasm from fully developing into intent.

The lowest mean score is for Action ($M = 3.120$), highlighting that while awareness and interest are strong, actual behavioral adoption remains limited. This pattern suggests that most respondents are still in the early stages of adoption readiness — informed and interested, but not yet committed to purchasing or implementing IoT-integrated greenhouses.

The findings demonstrate that the AIDA stages are functioning sequentially, with each stage showing a slight decline from cognitive awareness to behavioral response. To strengthen the conversion from attention to action, efforts such as providing financial incentives, hands-on training, product demonstrations, and success stories could help build confidence and encourage actual adoption among potential users.

Conclusion

This survey was designed to assess public awareness of IoT-integrated mini greenhouse gardens for urban farming in Malaysia. Most people know that IoT-Integrated can be used for urban farming but have very limited knowledge of how it works. Improving public knowledge about it through education and media efforts is very important, in line with the government's current efforts to encourage people to grow vegetables through the Kebuniti and Household Kitchen Gardens programs. People can use IoT technology to support farming, especially urban residents with busy schedules.

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ANALYSIS OF ASSESSMENT INSTRUMENTS FOR FINAL YEAR PROJECT IN DIPLOMA IN DIGITAL TECHNOLOGY

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Abstract: *This study aims to analyse the quality of the assessment rubric used in the Project Presentation for the Game Project course at Politeknik METrO Kuala Lumpur (PMKL). This study evaluates the rubric in terms of construct validity, inter-rater reliability, and effectiveness in assessing students' competencies in line with Course Learning Outcomes (CLO) and Programme Learning Outcomes (PLO). A quantitative descriptive research design was employed, incorporating document analysis and questionnaire methods. The document analysis involved reviewing the existing assessment rubric and Course Outcome Review Report (CORR), while questionnaire data were collected from 64 respondents comprising lecturers, industry panels and final semester students. The findings from the document analysis revealed that although the rubric has a systematic structure, it includes vague and non-operationalised performance descriptors such as "good" and "moderate," which may compromise inter-rater reliability among assessors. The CORR analysis indicated consistently high student achievement, suggesting a potential lack of discrimination ability in the assessment instrument. Meanwhile, the questionnaire results showed that the rubric achieved a high level of clarity (Mean = 4.08) and effectiveness (Mean = 4.10), while reliability was at a moderately high level (Mean = 3.98). The overall Cronbach's Alpha value of 0.89 indicates high internal consistency of the instrument. In conclusion, the rubric is generally effective but requires refinement, particularly in improving the specificity of performance indicators and enhancing technical assessment components. The study highlights the importance of developing a more comprehensive and reliable assessment instrument to ensure objective, consistent, and industry-relevant evaluation in TVET education.*

Keywords: *Assessment Rubric, Competency-Based Assessment, TVET, Reliability, Construct Validity*

Introduction

Introduction

The Technical and Vocational Education and Training (TVET) system in Malaysian polytechnics plays a crucial role in producing a skilled workforce capable of meeting the demands of the evolving digital industry. Graduates are expected to possess not only theoretical knowledge but also practical competencies, problem-solving skills and adaptability in real-world environments. In this context, polytechnic education emphasises competency development through project-based and authentic learning approaches. Assessment serves as a critical mechanism to ensure effective teaching and learning, functioning to measure student

achievement as well as evaluate technical skills, generic competencies, and the application of knowledge in real-world contexts. At Politeknik METrO Kuala Lumpur (PMKL), assessment practices align with national guidelines that emphasise systematic, transparent, and outcome-based evaluation. Within the Diploma in Digital Technology (DDT) programme, the Game Project course integrates theoretical knowledge with practical application. Project Presentation serves as the final assessment component, evaluating students' technical competence, communication skills, and ability to justify their work. However, the effectiveness of assessment depends on the validity, reliability, and clarity of the instruments used. Therefore, this study examines the quality of the project presentation rubric in ensuring alignment with academic standards and industry requirements. Despite its importance, limited studies have examined the quality of assessment rubrics in TVET project-based courses, particularly within digital technology programmes. This highlights the need for empirical investigation into the validity, reliability, and effectiveness of such assessment instruments.

Problem Statement

The assessment rubric for project presentation has been formally implemented at Politeknik METrO Kuala Lumpur (PMKL); however, issues related to its accuracy and reliability remain a concern. This is supported by findings from the Educational Organizations Management Systems (EOMS) audit conducted by Mani Maaran Krishnan (2024), which highlighted the need for clearer and more detailed assessment criteria. These issues may lead to inconsistencies in interpretation among lecturers, affecting the objectivity and fairness of grading, as well as limiting students' understanding of expected performance standards. Therefore, this study aims to address these concerns by strengthening the clarity, alignment, and reliability of the assessment rubric used in project presentation evaluation.

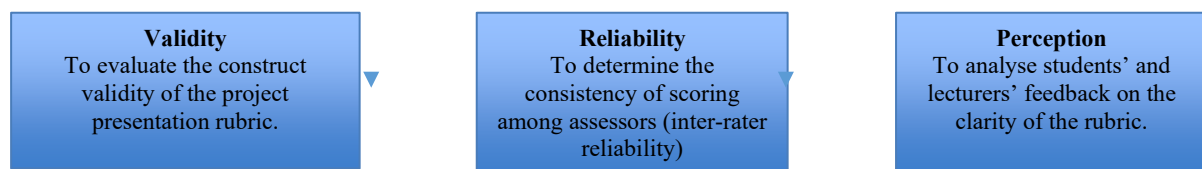


Figure 1: Dimensions of Assessment Instrument Quality Evaluation

Significance of the Study

This study provides empirical input to the management and academic staff at Politeknik METrO Kuala Lumpur (PMKL) in refining the existing assessment rubric, in line with Thrust 1 of the Department of Polytechnic and Community College Education (JPPKK, 2025), which emphasizes the production of quality TVET graduates through a strengthened assessment ecosystem. By promoting a more objective assessment process using a valid and reliable rubric, this study supports the achievement of JPPKK 2026 Key Performance Indicators (KPI) in enhancing teaching and learning quality and overall curriculum effectiveness. Additionally, the findings may serve as a reference for other polytechnic institutions in developing assessment instruments aligned with national academic quality standards.

Limitations of The Study

This study is conducted specifically at Politeknik METrO Kuala Lumpur, with a focus on the Project Presentation assessment instrument for the DDT programme. Therefore, the findings of this study are limited to the scope of the digital technology discipline and may not be fully generalizable to the broader context of Malaysian polytechnics or to programmes from different fields of study.

Literature Review

This study aims to examine the theoretical and empirical foundations for evaluating the quality of assessment instruments in Final Year Projects among DDT students. The discussion focuses on the evolution of competency-based assessment, the role of rubrics as holistic measurement instruments, and key psychometric parameters, including validity and reliability. This synthesis of literature aims to establish a robust conceptual foundation to support the need for improving assessment instruments in alignment with national academic quality standards and the evolving demands of the digital industry.

Competency-Based Assessment in TVET

Malaysia's Technical and Vocational Education and Training (TVET) system is undergoing transformation to better align academic learning outcomes with industry needs. In today's evolving digital landscape, education must emphasise not only theoretical knowledge but also practical skills relevant to real-world applications. In this context, Competency-Based Assessment (CBA) is recognised as a critical component within the TVET ecosystem. This approach emphasises students' ability to demonstrate skills and knowledge through tasks aligned with industry standards, rather than focusing solely on academic achievement (Hodge & Harris, 2012). Aligned with Outcome-Based Education (OBE) proposed by Spady (1994), assessment functions as a mechanism to validate students' ability to apply technical knowledge in real-world problem-solving. This approach emphasises alignment between learning outcomes, instructional strategies, and assessment to ensure the achievement of intended competencies. In the context of the Game Project course, assessment effectiveness depends on the extent to which instruments reflect real-world practices in the digital game development industry. According to Gulikers et al. (2004), authentic assessment should reflect professional practices to ensure the transferability of skills to the workplace. Therefore, assessment frameworks should consider multiple competency domains, including cognitive, affective, and psychomotor aspects. This holistic approach ensures that graduates achieve not only technical competencies but also professional capabilities and adaptability in the digital industry. In line with national TVET aspirations, strengthening competency-based and authentic assessment practices is essential to ensure that graduates remain competitive in the global job market (Jabatan Pendidikan Politeknik dan Kolej Komuniti, 2024).

The Importance of Rubrics in Strengthening Assessment Quality

A rubric is defined as a set of scoring criteria used to evaluate student performance objectively and consistently. In higher education, rubrics function as instruments that bridge the gap

between lecturers' expectations and students' performance. According to Arter and McTighe (2001), effective rubrics reduce ambiguity in subjective assessments such as project presentations. Detailed rubrics enable criteria such as design, problem-solving, and communication skills to be measured more accurately. Therefore, refining the rubric at Politeknik METrO Kuala Lumpur (PMKL), as highlighted in the Educational Organizations Management Systems (EOMS) audit (2024), is essential to ensure that each assessment dimension is supported by clear and measurable performance indicators.

Construct Validity and Inter-Rater Reliability in Rubrics

Two fundamental elements that determine the quality of a rubric are validity and reliability. Construct validity ensures that the criteria in the rubric accurately represent the competencies intended to be assessed in game development. Inter-rater reliability refers to the consistency of scores assigned by different assessors. Previous studies indicate that poorly designed rubrics may result in inconsistent scoring (rater bias), affecting the integrity of assessment outcomes (Popham, 1997). Therefore, empirical analysis of validity and reliability is essential to ensure fairness and consistency in polytechnic assessment practices.

Integration of Assessment with Digital Industry Standards

The assessment structure for the Final Year Project in the Diploma in Digital Technology (DDT) programme, which includes Game Progress Demonstration, Technical Report, Pitch Document, Log Book, and Project Presentation aligns with practices in the global game development industry. The Technical Report assesses students' ability to produce structured documentation, while the Pitch Document evaluates their ability to communicate ideas and demonstrate product marketability. The Project Presentation, as the final component, measures students' readiness for the professional workforce. The integration of these components fulfills academic standards set by the Department of Polytechnic and Community College Education (JPPKK) and ensures that graduates possess competencies relevant to the digital industry.

Research Methodology

This chapter describes the methods and approaches employed in this study to evaluate the quality of assessment instruments used in the Final Year Project for the Game Project course at Politeknik METrO Kuala Lumpur. The discussion encompasses the research design, conceptual framework, population and sample, research instruments and constructs, data collection procedures, as well as data analysis methods. The chosen methodological approach is essential to ensure that the findings obtained are valid, reliable, and aligned with the objectives of the study.

Research Design

This study employs a quantitative descriptive design to evaluate the quality of the assessment instrument used in the Project Presentation component of the Game Project course. This approach allows the researcher to assess construct validity, reliability, and users' perceptions of the assessment rubric systematically. The study integrates two methods: document analysis

and questionnaire. Document analysis evaluates the alignment between assessment criteria and learning outcomes, while the questionnaire collects feedback on the clarity and effectiveness of the rubric. The combination of these methods enables a comprehensive evaluation of the assessment instrument.

Conceptual Framework

The conceptual framework of this study explains the relationship between assessment instrument quality and project evaluation effectiveness. In this study, assessment instrument quality is measured through construct validity and inter-rater reliability. In addition, this study considers assessors, including lecturers, industry panel assessors, and students, as users of the assessment rubric. Their perceptions of rubric clarity and effectiveness influence the overall effectiveness of project assessment. Overall, this framework indicates that a clear, valid, and reliable assessment instrument leads to more objective evaluation and accurate measurement of students' competencies.

Population and Sample

The population of this study consists of lecturers, industry panel assessors, and final semester students of the Diploma in Digital Technology programme at Politeknik METrO Kuala Lumpur who are directly involved in the Game Project Course. The student population is based on the Course Outcome Review Report (CORR) for three academic sessions, involving a total of 53 students. For data collection, a sample of 64 respondents was selected, comprising 11 lecturers, 3 industry panel assessors, and 50 students involved in the final project assessment. The sample was selected using purposive sampling, focusing on individuals with direct experience in using the assessment rubric. The inclusion of multiple stakeholder groups enables the study to obtain a more comprehensive perspective on the implementation of project assessment.

Instrument and Constructs of the Study

This study employs two instruments, namely document analysis and questionnaire, to collect data on assessment instrument quality. Document analysis is conducted on the Project Presentation rubric and Course Outcome Review Report (CORR) to evaluate alignment with Course Learning Outcomes (CLO) and Programme Learning Outcomes (PLO), as well as to identify strengths and weaknesses of the rubric structure. In addition, a questionnaire is used to obtain feedback from lecturers, industry panel assessors, and students on the clarity, suitability, and effectiveness of the rubric. The questionnaire consists of statements based on the study constructs and is measured using a five-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree."

The main constructs measured are construct validity, inter-rater reliability, and users' perceptions of the assessment rubric. Construct validity refers to the extent to which the rubric measures the intended competencies in game development projects. Inter-rater reliability refers to the consistency of scoring among different assessors. Respondents' perceptions refer to the

views of lecturers, industry panel assessors, and students on the clarity, fairness, and effectiveness of the rubric.

Data Collection Procedure

Data collection in this study was conducted in two phases. In the first phase, relevant documents, including the assessment rubric and the Course Outcome Review Report (CORR), were collected for document analysis to evaluate the rubric content and identify issues related to the clarity of assessment criteria as well as their alignment with the Course Learning Outcomes (CLO) and Programme Learning Outcomes (PLO). In the second phase, questionnaires were distributed to lecturers, industry panel assessors, and students involved in the Game Project course to obtain feedback based on their experience using the rubric during the evaluation process. The data collected were then systematically organised and compiled for further analysis.

Data Analysis Method

Data obtained from the questionnaire were analysed using descriptive statistics, including mean, percentage, and standard deviation for each item. According to Creswell (2014), descriptive statistics are used to summarise and describe the main characteristics of quantitative data. Mean and standard deviation were used to evaluate data tendencies and variations, particularly for Likert scale instruments (Pallant, 2016), while percentage was used to present the distribution of responses clearly (Sekaran & Bougie, 2016). To facilitate interpretation, mean values were categorised into low, moderate, and high levels based on predefined score ranges. The interpretation of mean scores used in this study is presented in Table 3.2, which serves as a guideline for classifying response levels. Reliability testing was conducted using Cronbach's Alpha to determine the internal consistency of the questionnaire items. According to Pallant (2016), Cronbach's Alpha measures the consistency of items in assessing the same construct. The interpretation of Cronbach's Alpha values used in this study is presented in Table 3.1. A Cronbach's Alpha value exceeding 0.70 indicates acceptable reliability and suitability for research use. In addition, data from document analysis were used to support the findings by identifying strengths and weaknesses of the rubric in terms of clarity, alignment with learning outcomes, and structure.

Table 1: Interpretation of Mean Scores

Mean Score Range	Interpretation
1.00 – 2.33	Low
2.34 – 3.66	Moderate
3.67 – 5.00	High

Table 2: Interpretation of Cronbach's Alpha Values

Alpha Value	Interpretation
≥ 0.90	Very High
0.80 – 0.89	High
0.70 – 0.79	Acceptable
0.60 – 0.69	Moderate
< 0.60	Low

Findings of the Study

The findings of this study are based on document analysis and questionnaire data that were collected. The document analysis involves the evaluation of the assessment rubric as well as the Course Outcome Review Report (CORR) to determine the alignment with the Course Learning Outcomes (CLO) and Programme Learning Outcomes (PLO). Meanwhile, the questionnaire analysis is conducted to identify the perceptions of lecturers, industry panel assessors, and students regarding the clarity and effectiveness of the assessment rubric.

Document Analysis

The document analysis of the Project Presentation rubric indicates that it has a systematic structure, incorporating a five-level scale to differentiate students' levels of achievement. However, the analysis reveals several limitations, particularly in the clarity of assessment criteria. Descriptors such as "good," "moderate," and "acceptable" are insufficiently specific and lack clearly defined performance indicators. This may lead to variations in interpretation among assessors and affect scoring reliability, particularly in assessments involving multiple evaluators such as lecturers and industry panel assessors. Furthermore, the rubric places greater emphasis on presentation and creativity than on technical aspects of game development. This suggests that the construct validity of the rubric may not fully reflect the intended competencies.

Analysis of CORR Report

Analysis of the Course Outcome Review Report (CORR) across three academic sessions indicates that overall student performance is high and exceeds the minimum targets. For Session I 2024/2025, all students achieved at least a grade C, with the majority obtaining A and A+, and all Course Learning Outcomes (CLO) and Programme Learning Outcomes (PLO) recorded 100% achievement. However, this high level of achievement suggests that the assessment instrument may lack sufficient discriminatory power to differentiate students' performance levels. For Session II 2024/2025, all students achieved a passing level; however, CLO achievement was lower compared to the previous session, particularly in professionalism and commitment, and these findings should be interpreted with caution due to the small sample size. For Session I 2025/2026, student performance shows a more balanced distribution with a wider range of grades, while CLO achievement falls within the moderate to high range, reflecting a more realistic assessment.

Questionnaire Analysis

The questionnaire analysis was conducted to evaluate the perceptions of respondents, comprising lecturers, industry panel assessors, and students, regarding the clarity, reliability, and effectiveness of the Project Presentation assessment rubric. A total of 64 respondents participated in this study.

Clarity of the Rubric

The analysis shows that the clarity of the assessment rubric is at a high level (Mean = 4.08). This indicates that most respondents agreed that the rubric criteria are clear and easy to understand. Items related to clarity of criteria (Mean = 4.15) and alignment with project requirements (Mean = 4.12) recorded high values. However, items related to performance level descriptions recorded a slightly lower mean (Mean = 3.95). This suggests that although the rubric is generally clear, improvements are needed in refining performance descriptors to reduce ambiguity.

Table 3: Analysis of Rubric Clarity

Item	Statement	Mean	Level
B1	Criteria are clear and easy to understand	4.15	High
B2	Performance level descriptors are detailed	3.95	Moderately High
B3	Differences between scoring levels are clear	4.02	High
B4	Aligned with project requirements	4.12	High
B5	Reflects students' competencies	4.16	High
Average		4.08	High

Reliability Analysis

The findings indicate that the reliability of the assessment rubric is at a moderately high level (Mean = 3.98). Respondents agreed that the rubric contributes to more consistent scoring among assessors. Items related to reducing subjectivity recorded a mean of 4.02, while consistency among assessors recorded a mean of 3.95. However, the item on consistency across different assessors recorded a slightly lower mean (Mean = 3.92). These findings suggest that although the rubric enhances consistency, variation in interpretation among assessors may still occur. This is consistent with the document analysis, which indicated ambiguity in certain assessment criteria.

Table 4: Analysis of Rubric Reliability

Item	Statement	Mean	Level
C1	Consistency among assessors	3.95	Moderately High
C2	Reduces subjectivity in assessment	4.02	High
C3	Produces consistent results across assessors	3.92	Moderately High
C4	Supports objective assessment	4.05	High
C5	Facilitates the scoring process	3.98	Moderately High
	Average	3.98	Moderately High

Effectiveness of the Rubric

The analysis indicates that the effectiveness of the assessment rubric is at a high level (Mean = 4.10). Respondents agreed that the rubric serves as an effective guideline in evaluating students' project performance. Items related to comprehensive assessment recorded a mean of 4.08, while suitability for game development projects recorded a higher mean of 4.12. Items related to supporting Course Learning Outcomes (CLO) and Programme Learning Outcomes (PLO) also recorded a high mean (Mean = 4.09). However, students' understanding of assessment expectations recorded a slightly lower mean (Mean = 3.97). This indicates the need for clearer communication of assessment criteria.

Table 5: Analysis of Rubric Effectiveness

Item	Statement	Mean	Level
D1	Assesses student performance comprehensively	4.08	High
D2	Suitable for game development projects	4.12	High
D3	Helps students understand assessment expectations	3.97	Moderately High
D4	Supports the achievement of CLO/PLO	4.09	High
D5	Effective overall	4.15	High
	Average	4.10	High

Instrument Reliability (Cronbach's Alpha)

Reliability testing was conducted using Cronbach's Alpha to determine the internal consistency of the questionnaire items. The results show that the overall Cronbach's Alpha value is 0.89, indicating a high level of reliability. Based on the interpretation scale, this value falls within the high category, indicating that the questionnaire items are consistent in measuring the constructs. This confirms that the instrument is reliable and suitable for data collection.

Integrated Discussion of Findings

The findings of this study indicate a clear alignment between the results of document analysis and questionnaire analysis. The document analysis revealed that the use of general descriptors in the rubric may lead to ambiguity in assessment criteria. This finding is supported by the questionnaire analysis, which shows that items related to the clarity of performance level

descriptors recorded relatively lower mean scores compared to other items. In addition, issues related to reliability identified in the document analysis are consistent with the questionnaire findings, where the level of consistency among assessors is high but still demonstrates slight variation. However, in terms of effectiveness, both analyses indicate that the assessment rubric continues to function effectively as a guideline in evaluating students' project performance. This suggests that despite certain structural limitations, the rubric remains relevant within the context of project-based assessment.

Summary of Findings

Overall, the findings of this study indicate that the assessment rubric demonstrates high levels of clarity, reliability, and effectiveness. However, there is a need to further refine the assessment criteria to enhance construct validity and reduce variation in interpretation among assessors. Findings from the CORR report also indicate that student performance is generally high. Nevertheless, there is a possibility that the assessment instrument lacks sufficient discriminatory power to effectively differentiate students' performance levels. Therefore, improvements to the rubric structure are essential to ensure more objective, consistent, and industry-aligned assessment practices.

Discussion, Implications and Recommendations

Based on the findings derived from the analyses conducted, the discussion focuses on the key issues identified concerning the clarity, reliability, and effectiveness of the assessment rubric used in the Game Project course. This chapter also elaborates on the implications of the study for assessment practices in TVET education, as well as proposes recommendations for improvement and future research.

Discussion of Findings

The findings indicate that the Project Presentation assessment rubric demonstrates high levels of clarity, reliability, and effectiveness; however, several critical issues require further attention. Although respondents generally agreed that the rubric is easy to understand, document analysis revealed that the use of general descriptors such as "good," "moderate," and "acceptable" may lead to ambiguity in interpreting assessment criteria, potentially affecting assessment accuracy. In terms of reliability, while the rubric contributes to improved scoring consistency, slight variations among assessors remain, suggesting that the lack of clearly defined performance indicators may affect assessment uniformity. From an effectiveness perspective, the rubric demonstrates functional adequacy as an assessment instrument and supports comprehensive evaluation; nevertheless, it places greater emphasis on presentation and creativity rather than technical aspects, indicating that its construct validity may not fully reflect the competencies required in the digital game development industry. Furthermore, findings from the CORR report show consistently high student performance, which may suggest limited discriminatory power of the assessment instrument, highlighting the need to refine the rubric to better differentiate levels of student achievement.

Implications and Recommendations

The findings have important implications for assessment practices in TVET education, particularly at Politeknik METrO Kuala Lumpur (PMKL). From a pedagogical perspective, clear and detailed rubrics are essential to ensure objective and consistent evaluation, as ambiguity may affect students' understanding and learning outcomes. From an assessment perspective, the findings highlight the need for specific and measurable performance indicators to reduce variation among assessors and improve scoring reliability. From a curriculum perspective, greater alignment between assessment criteria and industry-required competencies is needed, particularly in technical aspects such as system logic and development processes. Accordingly, several recommendations are proposed. First, the rubric should incorporate clearer and measurable performance indicators. Second, the rubric structure should ensure balanced emphasis between technical and non-technical components. Third, assessor training and calibration should be implemented to improve inter-rater reliability. Finally, industry involvement should be strengthened to ensure alignment with current requirements.

Limitations and Future Research

This study has several limitations. It was conducted in a single institution, which limits generalisability, and involved a relatively small sample, particularly among industry panel assessors. In addition, the study relied mainly on quantitative data, which may not capture deeper user perspectives. Future research should involve larger and more diverse samples across institutions to improve generalisability. A mixed-method approach, including interviews, is recommended to obtain deeper insights. Further studies may also focus on developing and validating a more comprehensive rubric and evaluating its impact on assessment quality and student performance.

Conclusion

Overall, this study demonstrates that the Project Presentation assessment rubric is effective in evaluating student performance. However, there is a need to enhance the clarity of criteria, improve assessment reliability, and ensure alignment with technical competencies required by the industry. The proposed improvements are expected to enhance the quality of the assessment instrument and support the development of competent, innovative, and competitive graduates in the digital industry.

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DIGITAL VIDEO EDITING TRANSFORMATION: COMPARATIVE ANALYSIS OF FREE AND PROFESSIONAL TOOLS IN SOCIAL MEDIA CONTENT CREATION

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Abstract: *Currently, the rapid growth of social media has made video editing a crucial skill in visual communication. This study examines the differences between free mobile video editing applications and professional software in terms of functionality, effectiveness, output quality, user experience, and implications for creativity and pedagogy. The problem statement of the study highlights a gap in understanding among content creators between ease of use and professional standards, even tho both categories of tools are increasingly being used widely. This study used a review of existing research methodologies, encompassing fifteen academic articles and scientific studies, to analyze video editing technology, the functionalities of various tools, and their impact on the production process. The results indicate that mobile apps facilitate quicker and easier editing, while professional software offers enhanced technical control and good quality. This study finds that the choice of editing tools should depend on the goals of the content, the skill level of the creator, and the social video production setting.*

Keywords: *Video Editing; Professional Software; Free Application; Social Media; Content Creation*

Introduction

Current technological developments have transformed the landscape of visual communication and made digital video the dominant medium, especially through social media platforms such as TikTok, Instagram, Threads and YouTube. This development has indirectly driven the production of content that emphasizes the ability to produce high-quality videos in a shorter period of time and more efficiently. Video editing no longer simply involves cutting and arranging clips, but also includes color grading, sound design, visual effects, building a brand's visual identity, and developing a structured creative narrative. In the highly competitive social media ecosystem, the quality of editing is often the key differentiating factor between viral content and content that receives little attention.

The development of mobile device technology and desktop software has significantly changed the video production landscape. Nowadays, processes that previously required special studios and expensive equipment can now be carried out using only smartphones. This change not only lowers production costs, but also speeds up the content production cycle, in line with the needs of platform algorithms that demand consistency and frequency of publication.

The use of mobile video editing applications such as CapCut, VN Video Editor and InShot provides an opportunity for content creators without a technical background to produce videos at a lower cost and in a shorter period of time. These applications increase accessibility to editing technology and speed up the video production process, especially in the fields of education and social communication (Wulandari, 2023). With the use of mobile applications, creators can adapt content to current trends, produce videos that attract the attention of viewers quickly, and experiment with visual styles without the risk of high costs.

In contrast, professional software such as Adobe Premiere Pro and Final Cut Pro provide deeper technical control, support high-quality video production, and remain relevant in both industry and formal education contexts (Sandoval-Castaneda et al., 2025). Professional creators are able to perform more complex edits, add advanced visual effects, manage large-scale files, and ensure technical consistency through systematic non-linear editing workflows.

In the context of digital skills development and education, the choice of editing tools also impacts creativity, productivity, and perceptions of professionalism in content production (Alhayari, 2026). Exposure to both free applications and professional software can form a more comprehensive understanding of the video production process in the industry. Therefore, this study focuses on analyzing the differences in the use of mobile applications and professional software in the context of modern social media content production.

Problem Statements

Although various video editing applications are available, users often face difficulties in selecting the most appropriate tool due to differences in functionality, level of control, and ability to produce high-quality output. This confusion is further compounded by the trade-off between accessibility and performance, where mobile editing applications are user-friendly and cost-effective but limited in technical control and output quality (Hu et al., 2024), while professional software offers advanced features at the expense of higher cost and technical complexity (Li et al., 2024). As a result, users often select editing tools based on convenience rather than a clear understanding of their capabilities and impact on content quality.

Limited studies examine how tool selection affects both content quality and the creative and technical development of designers. Previous research has explored digital editing tools in terms of usability and functionality (Barth, 2025; Emgirinata, 2024). However, these studies tend to focus on isolated aspects rather than providing a comprehensive comparison across functionality, output quality, and creative impact. Furthermore, limited research has examined the effectiveness of editing tools specifically within the context of social media content production. There is also insufficient emphasis on how tool selection influences users' creativity and technical skill development.

Research Objectives

Therefore, this study aims to evaluate the functional differences between mobile video editing applications and professional editing software, analyse the impact of tool selection on the

quality of video output in social media contexts, and identify their implications of tool usage on content creators' creativity and technical skill development.

Based on the objectives of this study, the following research questions are formulated:

- Ro1: What are the functional differences between mobile editing applications and professional editing software?
- Ro2: How does tool selection affect the quality of video output in social media content production?
- Ro3: How does the choice of editing tools influence creativity and technical skill development among users?

Literature Review

The development of mobile editing applications has significantly improved accessibility in video production, particularly for users with limited technical skills. Studies have shown that mobile tools enable users to produce satisfactory video content without requiring advanced equipment, thereby lowering the barrier to entry into the creative industry (Nugroho et al., 2020). In educational contexts, the use of mobile applications has also been found to enhance student motivation and encourage creative exploration (Wulandari, 2023).

This shift is closely related to the rapid rise of short-form video platforms, which have introduced new constraints in content production, particularly due to time limitations ranging between 15 to 60 seconds. As a result, creators adopt specific editing strategies such as pacing, visual effects, and sound design to maximise content effectiveness within limited durations (Zhang, 2025).

In contrast, professional editing software provides greater technical control and precision in video production. Features such as colour grading, multi-track audio management, and advanced visual effects enable the production of high-quality content that meets industry standards (Sandoval-Castaneda et al., 2025). Furthermore, the integration of artificial intelligence and multi-agent systems within professional tools has improved workflow efficiency while maintaining output quality (Wang et al., 2024).

From an educational perspective, the use of professional tools within blended learning environments has been shown to enhance students' technical competencies and professional readiness (Alhyari, 2026). Early exposure to professional software can strengthen students' confidence and improve their understanding of real-world production workflows.

Recent advancements in artificial intelligence have further transformed video editing practices. AI-based systems, including pre-trained vision-language models, enable automated editing processes that reduce technical complexity while maintaining output quality (Hu et al., 2024). These developments allow content creators to focus more on storytelling and creative elements.

Similarly, AI-assisted editing workflows that incorporate natural language interaction have been shown to enhance usability and creative output (Zhang et al., 2024).

In addition, the rapid growth of short-form video content has influenced the selection of editing tools among content creators. Mobile applications are often preferred due to their speed and compatibility with social media formats, while professional tools remain essential for producing complex and high-quality content that requires greater technical control (Li et al., 2024).

Research Metodology

This study adopts a qualitative comparative approach, examining 15 academic articles published between 2020 and 2026. The search focused on topics related to mobile video editing, professional video editing, social media video production, AI-assisted editing, and pedagogical video practices. The data were analysed using thematic and comparative analysis based on three main dimensions which are functional features, content quality, and the implications of tool usage on content creators' creativity and technical skill development.

Result

Table 1: Summary Of Document Analysis

No	Author (Year)	Tool Type	Tools	Function	Quality	Creativity & Skill
1	Surin (2025)	Mixed	Canva, Adobe, CapCut	Basic vs advanced features	Pro higher precision	Pro higher flexibility
2	Barth (2025)	Mobile/Web	Canva, Adobe Express	Template- based, drag- drop	Moderate	Beginner- friendly
3	Emgirinata (2024)	Professional vs simplified	Illustrator vs Canva	Advanced vector vs basic design	High vs moderate	High vs limited
4	Safira et al. (2025)	Mobile	Canva	Simple tools	Moderate	Enhances beginner creativity
5	Putri et al. (2024)	Mobile	Canva	Easy interface	Moderate	Supports skill entry level
6	Hashmeta (2023)	Mixed	Canva vs Adobe	Feature depth difference	High (Adobe)	High control
7	Slidespeak (2024)	Mobile/Web	Canva vs Adobe Express	Fast workflow	Moderate	Limited flexibility
8	Beaudouin- Lafon (2022)	Theory	General tools	Usability focus	Indirect	Affects learning

9	Oulasvirta (2023)	Theory	UX tools	Efficiency-driven design	Indirect	Affects performance
10	Zhang et al. (2024)	AI tool	AI editing system	Automates editing	Improves workflow	Enhances creativity
11	Wardaya et al. (2024)	Mobile	CapCut	Basic editing features (cutting, effects, audio)	Moderate	Supports beginner content creation
12	Rahman et al. (2023)	Mobile	TikTok editor tools	Built-in editing	Moderate	Quick creativity
13	Ismail et al. (2022)	Mixed	Mobile vs desktop tools	Feature comparison	High vs moderate	Skill gap
14	Chen et al. (2023)	Professional	Premiere Pro	Advanced workflow	High	High skill growth
15	Kumar & Singh (2022)	Theory	Digital tools	Tool impact analysis	Indirect	Skill development

The comparison between mobile and professional editing tools is presented in Table 1. The results indicate clear differences across three key aspects: functionality, output quality, and creativity. Mobile editing applications are generally designed for ease of use and rapid content production, whereas professional tools offer more advanced features and greater levels of control.

In terms of functionality, a clear distinction can be observed between mobile and professional editing tools. Mobile applications such as CapCut and Canva primarily provide simplified, template-based features and user-friendly interfaces, enabling quick and efficient content production (Barth, 2025). These tools are designed to reduce complexity and support ease of use, particularly for beginner users (Putri et al., 2024).

This finding is further supported by studies indicating that mobile editing tools offer basic functions such as clip trimming, audio insertion, text overlays, and automated visual filters, which simplify the editing process and make it accessible to users with limited technical skills (Nugroho et al., 2020; Wulandari, 2023).

In contrast, professional software such as Adobe Premiere Pro and Adobe After Effects provides advanced functionalities, including multi-layer editing, motion tracking, detailed customization, professional colour grading, and multi-track audio management (Emgirinata, 2024; Chen et al., 2023; Sandoval-Castaneda et al., 2025; Wang et al., 2024). These tools also support a structured non-linear editing workflow, allowing greater flexibility and control in complex production environments.

Although both categories of tools are increasingly integrating artificial intelligence features (Hu et al., 2024), professional software remains superior in terms of technical control and its capability to support large-scale content production. Therefore, the key distinction lies in the balance between accessibility and technical depth, where mobile applications prioritise ease of use, while professional tools emphasise advanced control and flexibility.

In terms of output quality, professional editing tools consistently produce higher-quality results compared to mobile applications. This is largely due to their advanced rendering capabilities, precision control, and support for complex visual effects (Hashmeta, 2023; Ismail et al., 2022). Professional tools are particularly suitable for producing high-end or cinematic content that meets industry standards.

This finding is further supported by studies indicating that professional software enables better visual stability, accurate colour grading, and enhanced audio clarity through detailed technical control (Sandoval-Castaneda et al., 2025). The integration of artificial intelligence in professional tools also contributes to improved visual consistency without compromising workflow efficiency (Wang et al., 2024).

On the other hand, mobile editing applications generate moderate-quality outputs that are generally sufficient for social media platforms such as TikTok and Instagram (Slidespeak, 2024; Rahman et al., 2023). These tools prioritise speed and convenience, making them suitable for fast-paced content production. However, limitations in colour control, audio management, and resolution may affect the quality of more complex productions (Wulandari, 2023). Studies have shown that applications such as CapCut offer features including video cutting, effects, audio integration, and transitions, which support efficient video editing and improve content quality (Wardaya et al., 2024).

In the context of short-form video culture, content quality is also influenced by the ability to capture audience attention quickly rather than relying solely on technical excellence (Li et al., 2024). Therefore, while professional tools excel in technical quality, mobile applications are more suitable for rapid and flexible social media content production.

The findings also reveal that the choice of editing tools has significant implications for creativity and technical skill development among content creators. Mobile editing applications support rapid content creation and encourage initial creative exploration, particularly among beginners (Safira et al., 2025). Their simplified interfaces reduce the learning curve and enable users to experiment with visual styles in a more accessible and flexible manner (Putri et al., 2024; Nugroho et al., 2020).

In contrast, professional editing software provides greater creative flexibility and promotes the development of advanced technical skills (Chen et al., 2023). The use of professional tools in learning environments has been shown to enhance students' technical competencies and deepen their understanding of industry-standard workflows (Alhyari, 2026). This includes the ability to manage complex projects and produce content that meets professional standards.

Furthermore, the integration of artificial intelligence in editing tools has begun to reshape creative workflows by reducing technical barriers and allowing users to focus more on storytelling and creative expression (Hu et al., 2024; Zhang et al., 2024). However, excessive reliance on automated features may limit the development of deeper technical skills if not complemented by the use of professional software.

Therefore, mobile applications tend to support exploratory creativity and rapid content production, while professional tools play a more critical role in developing technical expertise and professional-level competence.

Discussion

The findings of this study highlight the fundamental differences between mobile editing applications and professional editing software across functionality, quality, and user development.

Firstly, the simplified functionality of mobile editing tools reflects a user-centred design approach aimed at improving accessibility and usability. This aligns with existing usability theories, which suggest that reducing complexity enhances user adoption and efficiency (Beaudouin-Lafon, 2022; Oulasvirta, 2023). Mobile tools are therefore more suitable for beginners and casual content creators who prioritise speed and convenience.

Secondly, the superior output quality produced by professional tools can be attributed to their advanced technical capabilities. Features such as precise control, layering, and rendering contribute to more refined and visually appealing content. This supports previous findings that emphasise the importance of technical depth in achieving high-quality media production (Hashmeta, 2023).

In terms of creativity and skill development, the findings suggest a trade-off between ease of use and creative depth. While mobile applications enable quick content creation, they may limit users' ability to explore more advanced design techniques. In contrast, professional tools require a higher level of technical knowledge but offer greater opportunities for creative expression and long-term skill development (Chen et al., 2023).

Additionally, the integration of artificial intelligence in editing tools indicates a shift towards more intelligent and user-friendly systems. AI-assisted editing tools are designed to reduce technical barriers while supporting creative decision-making, suggesting a convergence between simplicity and advanced functionality in future tools (Zhang et al., 2024).

Overall, the study demonstrates that the choice of editing tools should be aligned with the user's goals, skill level, and content requirements. Mobile tools are suitable for rapid and accessible content creation, whereas professional tools are essential for producing high-quality and technically complex media.

Conclusion

The transformation of digital video editing is influenced by technological developments, changing social media culture, and pedagogical demands in creative education. Mobile applications have democratized video editing by providing broad access to various segments of society without requiring high costs or complex technical skills. This contributes to increased participation in the digital creative economy and accelerates the production of micro and short-form content.

However, professional software remains significant in ensuring technical control, editing accuracy, and output quality that meets industry standards. For large-scale productions, commercial projects, or branded content that requires high visual and audio consistency, the use of professional software is more relevant and strategic.

Overall, the selection of editing tools needs to be tailored to the content objectives, user skill level, available resources, and target audience. In the context of higher education and skills training, an approach that combines the use of mobile applications and professional software can provide a more comprehensive learning experience, as it not only encourages creativity, but also strengthens technical mastery and understanding of real industry workflows.

The implications of this study indicate that the findings can provide guidance to educators and students in selecting appropriate editing tools based on learning objectives and content production needs.

Future studies are recommended to focus on empirical analysis of the impact of using a combination of editing tools on student performance, graduate employability, and content creator productivity in a digital media ecosystem increasingly driven by automation and artificial intelligence technologies.

In addition, experimental approaches involving actual content production can be conducted to further evaluate the effects of different tools on output quality and user skill development.

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NEEDS ANALYSIS OF THE DIPLOMA IN HOTEL MANAGEMENT (DHM) WORK-BASED LEARNING (WBL) PROGRAMME IN POLYTECHNICS

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Abstract: *Technical and Vocational Education and Training (TVET) continues to be a strategic national agenda in producing a highly skilled workforce aligned with current industry needs and economic development. In line with this, the strengthening of TVET programmes is continuously implemented based on the stipulated programme accreditation cycle. This study was conducted in accordance with the standard operating procedures for programme offerings and the guidelines for programme needs analysis. The main purpose of this study is to analyse the offering of the Diploma in Hotel Management (DHM) Work-Based Learning (WBL) programme to ensure that the theoretical and practical components are relevant, in demand, and aligned with industry requirements. The objectives of the study are to identify the suitability of programme offerings, determine programme preferences, and examine the implications of offering the DHM WBL programme at Politeknik METrO Kuala Lumpur. This study adopts a mixed-methods research approach, combining both quantitative and qualitative methods. The research instruments include questionnaires and open-ended responses to gather feedback based on the established objectives. The data were analysed descriptively using frequency distribution and presented in the form of tables and figures. The findings indicate that the Diploma in Hotel Management Work-Based Learning programme at Politeknik METrO Kuala Lumpur has high demand. In addition, the theoretical and practical components offered are found to be relevant to current industry needs. The programme also has the potential to produce competent and highly skilled graduates to meet the demands of the hospitality industry.*

Keywords: - TVET, Diploma in Hotel Management, Work-Based Learning (WBL), Graduate Employability, Hospitality Industry

Introduction

Technical and Vocational Education and Training (TVET) is a form of education that emphasizes the mastery of practical and technical skills relevant to industry needs. In the era of globalization and rapid technological advancement, TVET plays a crucial role in supplying a high-quality and highly skilled workforce. Recognizing the dynamic nature of industry and the demands of the Industrial Revolution 4.0, Malaysia has strategically increased the importance of TVET within its education system (Zulkiflee et al., 2021). According to Ahmad Zahid Hamidi, vocational and technical skills are key to developing a high-quality workforce

and enhancing productivity across all economic sectors in facing the challenges of the Industrial Revolution 4.0 and the digital era. TVET plays an important role in preparing individuals to meet the rapidly changing demands of the job market, particularly with the advancement of Industry 4.0 technologies. He stated, “TVET is important in equipping our youth with the skills needed to succeed in modern industries” (The Star, 2024). This highlights the Malaysian government’s commitment to ensuring that TVET programs are aligned with industry needs and promote high employability among graduates.

By offering a wide range of technical and vocational programs, TVET institutions in Malaysia play a vital role in equipping individuals with practical skills and competencies that match the evolving demands of the labor market. This emphasis on skills development not only enhances employability but also contributes to national economic growth by ensuring that a skilled workforce meets industry demands (Wang & Xia, 2025). Furthermore, through collaborative efforts between higher education institutions and industry, Malaysia strives to bridge the gap between education and employment, fostering a symbiotic relationship that drives innovation, productivity, and sustainable development (Ghavifekr et al., 2021). One of the main objectives of TVET is to produce a highly skilled workforce capable of meeting market demands. In addition to rapid changes in technology and industry, there is an urgent need for a workforce that not only masters technical skills but also possesses the ability to innovate and adapt to industrial changes. Therefore, TVET not only prepares students for employment but also encourages them to become entrepreneurs and leaders in their respective fields, capable of driving economic growth and innovation in the future. In this regard, Anwar Ibrahim stated that “The National TVET Policy 2030 was developed as a comprehensive guideline for the implementation of TVET in Malaysia, where the main focus of the policy is to produce a highly skilled workforce with high income, identified as part of a major shift in the Mid-Term Review of the Twelfth Malaysia Plan (RMKe-12)” (New Straits Times, 2024).

Background of the Study

TVET plays a significant role in the economic and social development of a country. In Malaysia, the TVET Strategic Plan 2021–2025 was developed to strengthen the TVET education system in producing a competent and competitive workforce aligned with industry needs. This plan not only focuses on improving the quality of education but also on adapting to technological advancements and market demands. According to Zainal Abidin et al. (2020) continuous curriculum updates are essential to ensure that students possess the skills required in the job market. Based on Lee (2021) efforts to promote TVET as a prestigious career pathway need to be enhanced. Comprehensive awareness campaigns can help change this perception and attract more students to choose TVET.

This is further reinforced by the direction of the Polytechnic and Community College Strategic Plan (2018–2025), where the integration of polytechnics and community colleges has strengthened the TVET landscape under the Ministry of Higher Education (KPT). Based on records up to 2017, there are 36 polytechnics and 94 community colleges, which together supply 64% of the country’s TVET workforce. Therefore, it is crucial for these institutions to remain relevant as respected providers of TVET manpower (Ministry of Higher Education Malaysia, 2018).

Furthermore, the implementation of the Work-Based Learning (WBL) programme has become a strategic approach to strengthening TVET delivery by bridging the gap between theoretical knowledge and practical industry skills. Through structured collaboration between educational institutions and industry partners, WBL enables students to gain real workplace experience, thereby enhancing their technical competencies, employability, and adaptability to dynamic job environments. This industry-driven learning model aligns with national aspirations to produce job-ready graduates who meet current market demands and technological advancements. In addition, WBL supports the development of soft skills such as communication, teamwork, and problem-solving, which are essential for career success in the hospitality and broader service sectors. Hence, the integration of WBL within TVET programmes further reinforces the role of polytechnics and community colleges as key contributors to producing a highly skilled and industry-relevant workforce (Department of Polytechnic and Community College Education, 2020; Ministry of Higher Education Malaysia, 2021).

Specifically, Politeknik METrO Kuala Lumpur (PMKL) offers programmes designed to meet the needs of the service sector. The uniqueness of these programmes lies in their teaching and learning approach, which utilizes WBL methods, particularly in the Diploma in Hotel Management (DHM). In the context of implementing the DHM under the WBL mode at PMKL, teaching and learning activities (PdP) conducted in industry or specific agencies are formalized through various official agreements and collaborations. The implementation is not limited to classroom lectures on campus but also includes structured training through experiential learning programmes in the industry, as preparation for students before undergoing the WBL mode for one year in the hospitality industry. The WBL mode is designed to produce human capital that meets industry requirements, where learning in real work environments provides numerous benefits to polytechnics, students, industry, and the community. Based on the DHM WBL implementation guidelines (2020) the duration of WBL follows the Malaysian Polytechnic Academic Calendar, involving students in semesters five (5) and six (6) according to the DHM programme curriculum structure. The minimum duration for WBL is 20 weeks per semester; however, this period may exceed 20 weeks depending on industry requirements.

Therefore, graduates from PMKL will be equipped with the necessary skills to meet human resource market demands. This ensures that the programmes offered remain relevant to industry needs and workforce demands, based on market studies and programme analysis conducted in alignment with the Twelfth Malaysia Plan (RMKe-12) (2021–2025). Hence, the success of WBL implementation in achieving its objectives depends on the cooperation and commitment of both parties, namely the polytechnic and the industry involved.

Objectives

- i. To identify the suitable areas of Hotel Management to be offered at Politeknik METrO Kuala Lumpur.
- ii. To identify the demand for the Diploma in Hotel Management programme.
- iii. To identify the implications of offering the Diploma in Hotel Management programme at Politeknik METrO Kuala Lumpur.

Scope of the Study

The main scope of this study is to examine the local hospitality industry in the Kuala Lumpur area in relation to the programmes offered. This is to ensure that the DHM programme provided by PMKL remains relevant and responsive to the demands of the job market.

Significance of the Study

This study aims to ensure that the DHM programme is aligned with industry needs and enhances graduate employability. It focuses on evaluating the curriculum, students' skills developed through WBL, and industry collaboration. The findings of this study will assist PMKL in improving the programme to ensure its continued relevance and to produce skilled and competitive graduates.

Literature Review

The DHM programme, which offers the WBL mode at PMKL, plays an important role in preparing students to face the increasingly competitive hospitality industry. Existing literature indicates that the implementation of the WBL mode not only meets industry needs but also aligns with the national TVET policy, which emphasizes the development of practical skills in human capital.

TVET Policy and Work-Based Learning (WBL) in Malaysia

TVET policy in Malaysia continues to be strengthened through various strategic government initiatives that emphasize the holistic development of technical and soft skills. In line with the National TVET Policy 2030, TVET serves as a key driver in producing a highly skilled, competitive, and high-income workforce to meet industry needs and support national economic growth (Ministry of Human Resources Malaysia, 2023). In response to current developments, Malaysia is transitioning towards the Malaysia Education Blueprint 2026–2035, which emphasizes the development of a future workforce that is highly skilled, adaptive, and resilient in facing technological changes and globalization. The blueprint also positions TVET as a mainstream pathway and highlights the importance of experiential learning approaches such as WBL in enhancing graduate employability and ensuring alignment with industry needs (Ministry of Higher Education Malaysia, 2026).

The WBL approach is a key component in TVET implementation as it integrates theoretical learning in institutions with practical experience in real workplace settings. Through this approach, students are able to apply their knowledge and skills in actual industry contexts, thereby enhancing their competency, adaptability, and confidence in the workplace (Noor & Ghazali, 2021). Furthermore, WBL has been proven to improve soft skills such as communication, teamwork, and problem-solving, which are essential in a dynamic industry environment (Ismail et al., 2022).

Therefore, the implementation of WBL in programmes such as the DHM at PMKL represents a strategic initiative aligned with national education policies. This approach not only enhances

graduate employability but also ensures that graduates possess relevant skills that meet the demands of the increasingly competitive hospitality industry.

Higher Education Ministry (KPT) Shift (Lonjakan KPT)

The Higher Education Ministry (KPT) shift related to WBL is Shift 4, which focuses on producing quality TVET graduates. Through community colleges, vocational colleges, and polytechnics, the ministry aims to provide leading TVET higher education to enhance skills, meet industry demands, and expand career advancement opportunities. TVET programme enrolment is expected to grow significantly through collaboration with industry to ensure that programme offerings align with market needs. Under this shift, KPT emphasizes active industry involvement in curriculum design and implementation through new collaboration models, as well as improving delivery quality via apprenticeship programmes, hands-on training, simulations, and specialized training.

A study by Zainal and Abdul Rahman (2020) stated that the WBL mode not only strengthens students' technical skills but also enhances soft skills such as communication, teamwork, and problem-solving. KPT has introduced various initiatives to strengthen collaboration between educational institutions and industry, ensuring that students gain access to relevant workplace experience. A study by Abdullah et al. (2022) found that graduates who participated in WBL programmes are more likely to secure employment compared to those who did not. Current trends also indicate that employers increasingly value practical experience as a key asset in hiring decisions. In the context of the DHM programme curriculum, this shift has a significant impact on graduate employability. According to Noor and Ghazali (2021) one of the main challenges is ensuring effective collaboration between higher education institutions and industry. There are difficulties in aligning academic curricula with constantly evolving industry needs. Therefore, institutions must engage in closer dialogue with employers to ensure that students are trained with the appropriate and relevant skills.

Graduate Employability

Work-Based Learning (WBL) is an educational approach that integrates work experience with academic learning. It enables students to develop practical skills, technical competencies, and soft skills required to succeed in the job market, while also enhancing their employability (Suyitno et al., 2025). In the Malaysian context, the Ministry of Higher Education (KPT) has introduced WBL as a key component in TVET programmes to enhance graduate employability. This aligns with national initiatives to strengthen technical and vocational education, which prioritize the development of skills relevant to industry needs. Graduate employability remains a major issue in higher education, particularly in the TVET field. Graduates with WBL experience are more likely to secure employment, as they are already familiar with the work environment and possess the required skills. A study by Zainal and Abdul Rahman (2020) shows that employers place higher value on graduates who have participated in WBL, as they are better able to adapt to industry demands. Abdul Rahman (2021) further states that through the implementation of WBL, DHM students not only gain knowledge in hotel management but also develop practical skills such as customer service, event management, and daily hotel

operations. This experience provides students with a competitive advantage when entering the job market.

Industry Needs

In the context of higher education in Malaysia, industry needs are a key factor in ensuring the effectiveness of TVET programmes. The WBL approach is considered a relevant mechanism for bridging the gap between academic learning and actual industry requirements. Through WBL, students gain real work experience that enhances their understanding of industry operations while strengthening both technical and soft skills required by employers (Noor & Ghazali, 2021; Jamalludin, 2022).

Current industry demands emphasize not only technical skills but also soft skills such as communication, teamwork, and problem-solving. Recent studies indicate that graduates with WBL experience are better prepared to face workplace challenges and adapt more easily to dynamic work environments (Mokhtar, 2024; Suyitno et al., 2025). Therefore, employers tend to prefer graduates with industry exposure, as they are considered more competent and productive. However, a key challenge in meeting industry needs is ensuring continuous alignment between academic curricula and rapidly evolving industry demands. Strategic collaboration between educational institutions and industry must be strengthened to ensure that curricula remain relevant and responsive to current developments (Ramli et al., 2024). Overall, the implementation of WBL in the DHM programme at PMKL is aligned with current industry needs, as it not only enhances graduate employability but also contributes to the development of a highly skilled and competitive workforce in the hospitality industry.

Methodology

This section discusses the methodology used in the study conducted in the Kuala Lumpur area. It focuses on the research design, instruments, sampling, and data analysis methods. Each of these components will be further explained and elaborated in detail.

Research Design

A mixed-method approach was employed in this study, utilizing questionnaire instruments and open-ended responses to obtain feedback on the Diploma in Hotel Management–Work-Based Learning (DHM–WBL) programme. Data were collected using a cross-sectional survey method, which allows information to be gathered from a large number of respondents at a single point in time. The implementation of programme offering studies in polytechnics is a key requirement and is formally outlined in the Standard Operating Procedure for Alignment and Programme Offering of Polytechnic and Community College Studies (Department of Polytechnic and Community College Education, Ministry of Higher Education, 2020).

Research Instrument

This study used a questionnaire to collect data from respondents. The instrument consists of three sections: (1) programme content and its suitability with current needs, (2) career

opportunities, and (3) the implications of the Diploma in Hotel Management–Work-Based Learning (DHM–WBL) programme offering. Likert-scale questions were used to obtain respondents’ feedback. In addition, dichotomous and open-ended questions were included to allow respondents to express their views freely. The instrument for the DHM–WBL programme market study at PMKL was administered in July 2024.

Sampling

The sample for this study consists of Diploma in Hotel Management–Work-Based Learning (DHM–WBL) alumni who graduated from June 2018 onwards. The study population includes DHM alumni, industry partners currently hosting WBL students, and industry collaborators associated with PMKL.

Table 1: Sampling Distribution

Category	Number
DHM Alumni	162
Hospitality Industry Hosting WBL Students	13
Hospitality Industry Collaborating with PMKL	14
Total Population	189

(Source: CISEC PMKL Data)

The sampling also included hospitality industry players involved in hosting WBL students, as well as those collaborating with PMKL. According to Gay and Diehl (1992) the sample size should be as large as possible, as a larger sample increases representativeness and the generalizability of findings. However, the acceptable sample size depends on the type of study. For descriptive studies, a minimum of 10% of the population is recommended, with at least 30 subjects required (Gay & Diehl, 1992).

Data Analysis

Data analysis in this study employed a combination of questionnaire responses and open-ended questions. Descriptive analysis was conducted using frequency tables generated through the Statistical Package for the Social Sciences (SPSS) version 26. Open-ended responses were analyzed and presented using a reporting method.

Results

This section discusses respondents’ feedback obtained through the questionnaire. Data analysis in this chapter was conducted using the SPSS version 26. The statistical method employed in this study is descriptive statistics. Responses to open-ended questions are presented and analysed qualitatively in this section.

Table 2: Demographic Results

Demographic	Percentage (%)
WBL Industry	13.6
Industry Partners Collaborating	6.8
Alumni	79.5

Table2 shows that 12 respondents (13.6%) are from the hotel industry that has hosted DHM WBL students. Meanwhile, 6 respondents (6.8%) are from industry partners collaborating with PMKL. A total of 70 respondents (79.5%) are DHM alumni of PMKL.

Objective 1: To identify the suitable areas of Hotel Management to be offered at Politeknik METrO Kuala Lumpur.

Table 3: Theoretical Content

Theoretical Content	Percentage (%)
Fully compliant	81.8
Partially fulfilling	17
Not fulfilling	1

Table 3 shows the findings related to the DHM–WBL programme content, indicating that it meets the theoretical foundations of the field. A total of 72 respondents (81.8%) stated that it fully meets the theoretical foundations, 15 respondents (17%) indicated that it partially meets them, and only 1 respondent (1%) stated that the programme content does not meet the theoretical foundations in hotel management.

Table 4: Technical Content

Technical Content	Percentage (%)
Fully compliant	67
Partially fulfilling	30.7
Not fulfilling	2.3

Table 4 shows the findings of the study regarding the content of the DHM–WBL programme offered in meeting the technical foundations in this field. A total of 59 respondents (67%) indicated that it fully meets the requirements, 27 respondents (30.7%) stated that it partially meets the requirements, and 2 respondents (2.3%) indicated that the DHM programme content does not meet the technical foundations in the field of hotel management.

Objective 2: To identify the demand for the Diploma in Hotel Management programme.

Table 5: Suitability of DHM–WBL Graduates for Related Industries

DHM Programme	Percentage (%)
Suitable Work on Industry	97.7
Not Suitable Work on Industry	2.3

Table 5 shows the findings that DHM-WBL programme graduates are suitable to work in the hospitality industry, with 86 respondents (97.7%) indicating that DHM graduates are well matched to the hospitality industry around Kuala Lumpur and Selangor, while 2 respondents (2.3%) indicated otherwise.

Based on the responses, some respondents felt that the Work-Based Learning (WBL) programme is not fully suitable for working in related industries. One of the main reasons is that some departments do not provide full training to interns. Instead, interns are only given partial tasks and limited exposure. This may affect students' ability to learn all the necessary skills and reduce their readiness for real work. Therefore, more complete and structured training is needed to help students gain better experience.

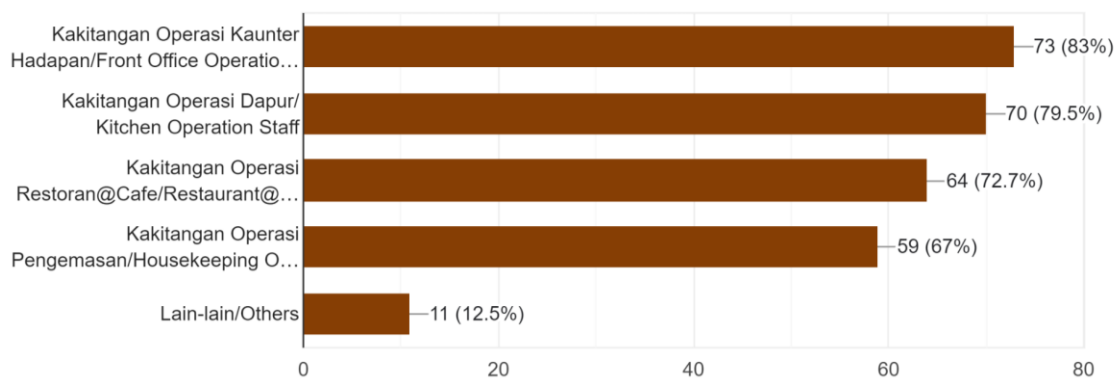


Figure 1: Job Suitability of DHM–WBL Graduates in the Hospitality Industry

Figure 1 presents the findings on job roles or departments within the hospitality industry that are suitable for DHM-WBL graduates. Feedback shows that 83% identified front office operations staff, 79.5% kitchen operations staff, 72.7% restaurant operations staff, and 67% housekeeping operations staff as suitable roles. Meanwhile, other departments such as administration, marketing, human resources, purchasing, and event management accounted for 12.5%.

Table 6: Appropriate Income Rate Offered to DHM - WBL Graduate

DHM Programme	Percentage (%)
at least RM 1500	8.0
RM 1501 to RM 2000	23.9
RM 2001 to RM 2500	47.7
RM 2501 to RM 3000	18.2
RM 3000 and above	2.3

Table 6 shows the findings on the appropriate salary range to be offered to DHM–WBL graduates. Based on the feedback, 7 respondents (8.0%) indicated at least RM 1500, 21 respondents (23.9%) RM 1501 to RM 2000, 42 respondents (47.7%) RM 2001 to RM 2500, 16 respondents (18.2%) RM 2501 to RM 3000, and 2 respondents (2.3%) RM 3000 and above.

Table 7: Career Path of DHM–WBL Graduates After Graduation

Career Path after graduate	Percentage (%)
Continue Working for Experience	60.2
Further Study	9.1
Continue Working While Taking Part-Time Courses	30.7

Table 7 shows that the career direction of DHM-WBL graduates is to continue working in the industry to gain work experience, with 53 respondents (60.2%), pursue further studies at the degree level with 8 respondents (9.1%), and continue working in the industry while simultaneously attending professional courses with 27 respondents (30.7%).

Objective 3: To identify the implications of offering the Diploma in Hotel Management programme at Politeknik METrO Kuala Lumpur.

Table 8: Quality of DHM–WBL Graduates in Hospitality Industry Jobs

DHM Programme	Percentage (%)
Sufficient Theory and Practical Skills for Hospitality Jobs	98.9
Not Sufficient Theory and Practical Skills for Hospitality Jobs	1.1

Table 8 shows that, based on the feedback, graduates produced from the DHM–WBL programme possess sufficient theoretical and practical quality to enter the hospitality industry, with 87 respondents (98.9%) indicating agreement and only 1 respondent (1.1%) indicating otherwise. Based on the responses, the respondent who disagreed stated that the programme does not provide sufficient theoretical and practical qualities before entering the hospitality industry. The main reason given is that graduates do not have enough experience. This lack of experience may affect their confidence and ability to perform tasks effectively in the workplace. Therefore, more exposure and hands-on training are needed to better prepare students for industry requirements.

Table 9: Relevance of Demand for the DHM–WBL Program and Graduates

DHM Programme	Percentage (%)
Relevance Next 5 To 10 Years	98.9
Not Relevance Next 5 To 10 Years	1.1

Table 9 shows that, based on the feedback, 87 respondents (98.9%) agreed and 1 respondent (1.1%) disagreed regarding the relevance of the demand for the DHM–WBL programme and its graduates over the next 5 to 10 years.

Table 10: Recommend DHM–WBL Program at PMKL

DHM Programme	Percentage (%)

Recommended	96.6
Not Recommended	3.4

Table 10 shows that respondents encourage their staff, family members, and friends to choose the DHM–WBL programme at PMKL as an option for pursuing higher education, with 85 respondents (96.6%) agreeing and 3 respondents (3.4%) disagreeing. Among those who disagreed, some stated that everyone has their own choices and there is no need to determine their decisions.

Discussion

The findings of the study indicate that the offering of the DHM–WBL programme at Politeknik METrO Kuala Lumpur (PMKL) is highly suitable, with 81.8% meeting theoretical foundations and 67% meeting technical foundations in the field of hotel management. This finding is supported by Zainal Abidin et al. (2020) who stated that relevant curriculum content forms the basis of students' skills in meeting industry demands. In addition, Noor and Ghazali (2021) noted that the implementation of the WBL mode in polytechnics, which integrates theory and practice, enhances work skills and resilience in facing the real working environment. The study also found that the DHM–WBL programme at PMKL is in high demand among both students and industry, with 97.7% of graduates considered suitable for employment in the hospitality industry in the Kuala Lumpur area. A total of 83% of positions or departments within the hospitality industry are suitable for DHM–WBL graduates. These include front office operations staff (83%), kitchen operations staff (79.5%), restaurant operations staff (72.7%), and housekeeping staff (67%). Front office operations represent the most in-demand position among both students and the hospitality industry. The appropriate salary range offered to DHM–WBL graduates is reported by 47.7% of respondents, with an estimated monthly income between RM2,001 and RM2,500. In terms of career direction, 90.9% of DHM–WBL graduates from PMKL choose to continue working in the hospitality industry. This reflects the success of the DHM–WBL programme at PMKL, where demand within the hospitality industry remains high.

Collaboration with the hospitality industry through Letters of Intent (LOI) has facilitated employment opportunities for students in the hospitality sector. This aligns with Shift 4 under the TVET Strategic Plan 2021–2025, which focuses on producing high-quality TVET graduates. Abdullah et al. (2022) emphasized that WBL graduates are more easily employed compared to other graduates, as the WBL approach is based on real workplace exposure, where students are placed in actual industry settings for one year (Guidelines for the Implementation of WBL Diploma in Hotel Management, 2020). Through WBL, graduates are equipped with practical skills, knowledge, work experience, and soft skills, making them more valuable and competitive in the job market (Abdul Rahman, 2021; Suyitno et al., 2025). Zainal and Abdul Rahman (2020) also stated that WBL graduates are better able to adapt to industry demands.

The findings on the implications of offering the DHM–WBL programme at PMKL show that 98.9% of respondents agreed that the programme provides sufficient quality in both theoretical and practical aspects for entry into the hospitality industry. This finding is consistent with Zainal and Abdul Rahman (2021) who highlighted that the WBL mode integrates strong theoretical and practical skills while enhancing communication, teamwork, and problem-

solving skills in the workplace. Noor and Ghazali (2021) also emphasized that WBL is a key element of TVET in developing the soft skills required by industry. The findings indicate that 98.9% of respondents agreed that the DHM–WBL programme and its graduates will remain relevant to industry demand over the next 5 to 10 years. This reflects strong confidence in the sustainability and long-term value of the programme. The result is consistent with previous studies which highlight that Work-Based Learning (WBL) enhances graduate employability and ensures alignment with industry needs (Suyitno et al., 2025; Noor & Ghazali, 2021). In addition, 96.6% of respondents expressed their willingness to recommend the DHM–WBL programme at PMKL to their staff, family members, and friends as a preferred option for pursuing higher education. This high level of recommendation indicates strong stakeholder satisfaction and trust in the quality of the programme. These findings are supported by Zainal and Abdul Rahman (2020) who stated that programmes aligned with industry needs are more likely to gain positive recognition and acceptance from employers and stakeholders. Furthermore, Abdullah et al. (2022) emphasized that WBL graduates are more employable due to their real industry exposure, which increases confidence among employers and society.

Conclusion

The findings of the study on the Diploma in Hotel Management–Work-Based Learning (DHM–WBL) programme at Politeknik METrO Kuala Lumpur (PMKL) indicate that the curriculum content and practical components of the programme are relevant and suitable for current industry needs. This is supported by the high demand for TVET programmes in polytechnics and community colleges in Malaysia. The programme is expected to remain relevant over the next 5 to 10 years, particularly in contributing to the development of high-quality TVET and industry-ready graduates, in line with Shift 4 of the TVET Strategic Plan 2021–2025 and the direction of the National TVET Policy 2030.

The offering of this programme also supports the hospitality industry by producing knowledgeable, experienced, and skilled workers. The Work-Based Learning (WBL) mode strengthens graduate employability by providing real industry exposure and hands-on experience. This contributes to the achievement of key performance indicators (KPIs) related to graduate employability in polytechnics. Therefore, it is appropriate for this programme to be continued and further strengthened in the future to support national efforts in producing high-quality, competitive, and industry-relevant TVET graduates.

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DEVELOPMENT AND VALIDATION OF A TACTILE MATHEMATICS CARD FOR ENHANCING NUMBER SENSE AMONG VISUALLY IMPAIRED LEARNERS

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Abstract: *Students with visual impairment often experience difficulty in understanding abstract mathematical concepts due to limited access to visual representations. This study aimed to develop and validate MathSense, a tactile-based mathematics card designed to enhance number sense and integer understanding among visually impaired learners. The development process followed the ADDIE instructional design framework (Analysis, Design, Development, Implementation, Evaluation). The prototype was validated by experts in mathematics education and special education, followed by classroom implementation in a special needs primary school. Data were collected using validation checklists, student response questionnaires, observational protocols, and pre- and post-tests. The findings indicate that MathSense achieved high validity and practicality scores, and students demonstrated improved conceptual understanding after intervention. The study contributes to inclusive mathematics education by providing a structured tactile instructional tool grounded in conceptual learning principles.*

Keywords: *Tactile Learning, Number Sense, Inclusive Education, ADDIE Model*

Introduction

National Council of Teachers of Mathematics (NCTM, 2023) states that conceptual understanding must precede and coincide with instruction on procedures, emphasising that learning mathematics involves more than simply memorising steps or facts. Contemporary mathematics education research consistently emphasises that deep conceptual understanding supports transferability, flexibility, and long-term retention of knowledge (Hiebert & Grouws, 2007; Kilpatrick et al., 2001). However, for visually impaired learners, the development of such understanding presents distinctive challenges due to the predominance of visual-symbolic instructional media in mathematics classrooms. Concepts such as integers, magnitude, and place value are typically introduced through visual tools including number lines, symbolic alignment, spatial diagrams, and graphical models. When these visual supports are inaccessible or inadequately adapted, learners may develop fragmented conceptual structures and rely

excessively on memorised procedures rather than relational reasoning (Maqbool & Ashraf, 2023; Shoaib, Fitzpatrick, & Pitt, 2023).

Existing Braille-based instructional tools have primarily focused on symbolic translation rather than conceptual construction. While Braille mathematical notation provides essential accessibility, it does not automatically foster structural understanding or magnitude reasoning (Aziz et al., 2021). Research examining Braille number cards has demonstrated feasibility in supporting integer operations and symbolic manipulation; nevertheless, limited attention has been given to holistic number sense development, particularly in the domains of relational understanding, structured place value reasoning, and magnitude comparison. Consequently, many assistive tools function as compensatory access mechanisms rather than transformative conceptual supports (Sganzerla & Geller, 2020).

Number sense is foundational to mathematical cognition because it underpins flexible reasoning and meaningful numerical interpretation. It encompasses magnitude comparison, place value understanding, flexible reasoning strategies, and the construction of conceptual representations that connect symbols to quantitative meaning (National Research Council, 2001; Jordan et al., 2010). Strong number sense enables learners to interpret numerical relationships across contexts, while weak number sense often results in procedural dependency and limited transfer (Gersten & Chard, 1999).

From the perspective of embodied cognition, mathematical understanding emerges through sensorimotor interaction with representations (Barsalou, 2008). Tactile-based strategies such as finger counting have been shown to ground numerical concepts through bodily interaction, reinforcing the cognitive link between physical experience and abstract reasoning (Marlair et al., 2024). For visually impaired learners, tactile engagement is not supplementary but central to conceptual development. However, widely used assistive tools—including the abacus, counting frames, and conventional Braille notation—tend to prioritise computational efficiency and symbol recognition rather than relational structuring and magnitude reasoning (Aziz et al., 2021). Although recent advances in assistive technologies have expanded access to mathematical content through audio-based and digital platforms, these innovations often emphasise information delivery rather than structured tactile conceptual exploration (Shoaib, Fitzpatrick, & Pitt, 2023). Furthermore, many tactile materials remain teacher-developed, limited in theoretical grounding, and insufficiently validated empirically in terms of their effectiveness in enhancing number sense.

The theoretical grounding of this study is further informed by APOS Theory (Action–Process–Object–Schema), which explains mathematical understanding as a progression of mental constructions (Dubinsky & McDonald, 2001). Learners initially perform actions on mathematical entities, internalise these into processes, encapsulate them into objects, and integrate them into coherent schemas. For visually impaired learners, the transition from action to process and object may require structured tactile mediation to support internalisation and abstraction. Without interactive and manipulable representations, schema formation may remain incomplete, particularly for foundational number sense concepts.

Aligned with the global agenda for inclusive and equitable education under Sustainable Development Goal (SDG) 4 (United Nations, 2015), there is an urgent need to move beyond accessibility toward cognitive empowerment in mathematics instruction. Mathematics remains one of the most challenging subjects for students with visual impairment due to its heavy reliance on spatial-symbolic organisation. Although Braille textbooks provide static textual access, they do not sufficiently support interactive conceptual construction or dynamic relational exploration.

In response to this identified gap, this study introduces MathSense, a structured tactile mathematics card system designed to facilitate conceptual manipulation rather than mere symbol reading. MathSense integrates raised mathematical symbols and Braille notation to ensure accessibility while employing structured tactile layout principles that guide systematic exploration through touch. Dual-texture coding supports relational differentiation (e.g., positive and negative integers), and organised place value modules scaffold structural reasoning. The incorporation of interactive card-based gameplay elements further promotes active engagement, flexible reasoning, and schema development consistent with embodied cognition and APOS theoretical principles.

This study therefore aims to design, implement, and empirically evaluate a research-based tactile instructional innovation that specifically targets number sense development among visually impaired learners. By bridging accessibility, cognitive theory, and structured instructional design, the study contributes to inclusive mathematics education literature and offers a validated model for tactile conceptual learning grounded in both theory and empirical evidence.

Research Objectives

1. To develop a tactile mathematics card (MathSense) using the ADDIE model.
2. To determine the validity and practicality of MathSense.
3. To examine its effectiveness in improving number sense among visually impaired learners.

Literature Review

Mathematics Learning for Visually Impaired Students

Numerous studies have highlighted the significant challenges faced by visually impaired students in learning mathematics due to limited access to visual information, which underpins many mathematical representations and symbolic structures (Shoaib, Fitzpatrick, & Pitt, 2023). Since mathematics instruction frequently relies on diagrams, graphs, spatial layouts, and symbolic notation, the absence of visual input may influence how learners construct abstract concepts and interpret mathematical relationships. Consequently, visually impaired learners often depend on tactile and sense of hearing to engage with instructional content. Although essential, these alternative sensory inputs may not fully replicate the structural richness of visual mathematical representations, potentially affecting abstract reasoning, spatial understanding, and conceptual development (Maqbool & Ashraf, 2023; Shoaib, Fitzpatrick, & Pitt, 2023).

This pedagogical concern underscores the need for inclusive instructional strategies that go beyond mere content translation. Effective mathematics learning for visually impaired students requires adaptive pedagogical approaches and assistive technologies capable of transforming visual representations into accessible, cognitively meaningful formats (Aziz et al., 2021; Maqbool & Ashraf, 2023). The development of adaptive materials and innovative educational tools is particularly crucial in areas demanding spatial reasoning, symbolic interpretation, and analytical thinking (Amran et al., 2025). When appropriately implemented, assistive technologies have been shown not only to enhance academic engagement but also to support broader intellectual and social development within educational settings (Sganzerla & Geller, 2020).

Despite these advancements, many institutions continue to face infrastructural constraints, limited trained personnel and restricted access to specialized resources. These systemic limitations do not merely restrict access but shape the epistemic experience of mathematical learning for visually impaired students, reinforcing inequities in conceptual mastery. Therefore, scalable, context-sensitive technological and pedagogical solutions remain necessary to ensure equitable mathematics learning opportunities (Pamuji et al., 2023).

Mathematics Education for Visually Impaired Secondary School Students

Recent studies have increasingly emphasized the importance of tactile-based instructional approaches in mathematics education for visually impaired secondary school students. These approaches aim to transform abstract mathematical concepts—such as numbers, algebraic operations, geometric shapes, and spatial relationships—into tangible and manipulable forms that can be meaningfully explored through touch (Winarto et al., 2024). At the secondary level, where mathematical content becomes progressively symbolic and abstract, the absence of accessible representations can significantly hinder conceptual understanding and independent learning.

Existing assistive tools and pedagogical strategies, however, remain limited in scope and effectiveness. Many mathematical expressions, equations and graphical representations are traditionally designed for visual interpretation, making them inaccessible without substantial modification (Khusro et al., 2024). The translation of mathematical content into accessible formats such as Nemeth Braille Code presents additional challenges. Although Nemeth Braille provides a structured system for representing mathematical notation, its production is often time-consuming and requires specialized expertise for accurate encoding and interpretation (Omoush & Mehigan, 2023). Consequently, access to diverse and up-to-date mathematical learning materials remains restricted for many visually impaired students.

The challenges are particularly acute in geometry and graph-based topics, which are core components of the secondary school curriculum. Understanding geometric proofs, coordinate systems and spatial reasoning typically relies on diagrams and visual models (Adelakun et al., 2022; Shoaib, Fitzpatrick, & Pitt, 2023). In a localized study by Junthong et al. (2018), approximately 95% of blind students reported significant difficulties in mathematics, largely due to the absence of accessible tactile representations for geometric shapes, graphs and visual data. This finding highlights a persistent gap in inclusive mathematics education and

underscores the urgent need for innovative tactile learning tools specifically designed for secondary-level mathematical complexity.

Collectively, the literature suggests that while accessibility efforts have increased, few tactile interventions are systematically aligned with conceptual learning principles and structured instructional design frameworks (Ferrell et al., 2017; Rule et al., 2011). Notably, limited research explicitly integrates instructional design models with tactile-based representations to support secondary-level symbolic abstraction (Supalo et al., 2009).

From a theoretical perspective, this study is grounded in constructivist learning theory, which posits that knowledge is actively constructed through meaningful interaction rather than passively transmitted (Kitchener, 1985; Vygotsky, 1978). For visually impaired learners, tactile engagement may function as a form of embodied cognition, whereby abstract mathematical concepts are internalized through sensory-motor interaction (Wilson, 2002). Embodied cognition theory suggests that cognitive processes are deeply rooted in bodily experiences. This therefore, manipulating structured tactile representations can facilitate the construction of symbolic meaning (Barsalou, 2008).

Furthermore, Cognitive Load Theory provides additional justification for structured tactile interventions. The process of translating complex symbolic expressions into accessible formats may increase intrinsic and extraneous cognitive load for visually impaired learners (Sweller, 1988; Sweller et al., 2011). Carefully designed tactile materials can reduce unnecessary cognitive burden by organizing information systematically and aligning representations with conceptual progression (Paas et al., 2003).

Within this theoretical context, the development of MathSense is positioned not merely as an assistive adaptation but as a pedagogically grounded instructional innovation. By integrating tactile representation with systematic instructional design principles through the ADDIE framework (Branch, 2009), MathSense seeks to facilitate meaningful conceptual construction, enhance cognitive processing efficiency, and promote equitable access to secondary-level mathematical abstraction.

Methodology

This study employed a developmental research design using the ADDIE framework (Analysis, Design, Development, Implementation, Evaluation) to develop and validate the *MathSense* tactile mathematics card for visually impaired learners. Participants were purposively selected and included three visually impaired primary school students, two expert validators (specialising in mathematics education and special education), and one primary school mathematics teacher. The experts evaluated content alignment, tactile suitability, safety, and durability, while the teacher assessed classroom practicality. The students participated in five instructional sessions to evaluate usability and learning outcomes.

Data were collected using an expert validation checklist, a teacher practicality evaluation form, a student response questionnaire, and pre- and post-tests measuring number recognition, magnitude comparison, place value understanding, integer representation, and problem-solving

skills. The development of the MathSense card followed the ADDIE phases: analysis involved teacher interviews, identification of learning difficulties, and curriculum alignment; design incorporated raised Braille digits, dual-texture coding for positive and negative integers, shape-coded place value, and a sequenced activity module; development involved prototype construction using EVA foam, embossed Braille labelling, and laminated surfaces, followed by expert validation and revisions; implementation included structured learning sessions covering number sense concepts; and evaluation measured content validity, practicality, student feedback, and learning improvement using N-gain scores, with Wilcoxon signed-rank tests applied as appropriate for the small sample.

Ethical procedures were observed, including informed consent from the school, parents, and participants, confidentiality, and the safety of learning materials. Content validity was calculated using the Content Validity Index (CVI), practicality was analysed via percentage scores, and effectiveness was assessed through pre- and post-test performance.

The overall research procedure is illustrated in Figure 1, which presents the ADDIE phases and key activities in the development and validation of the MathSense tactile mathematics card.

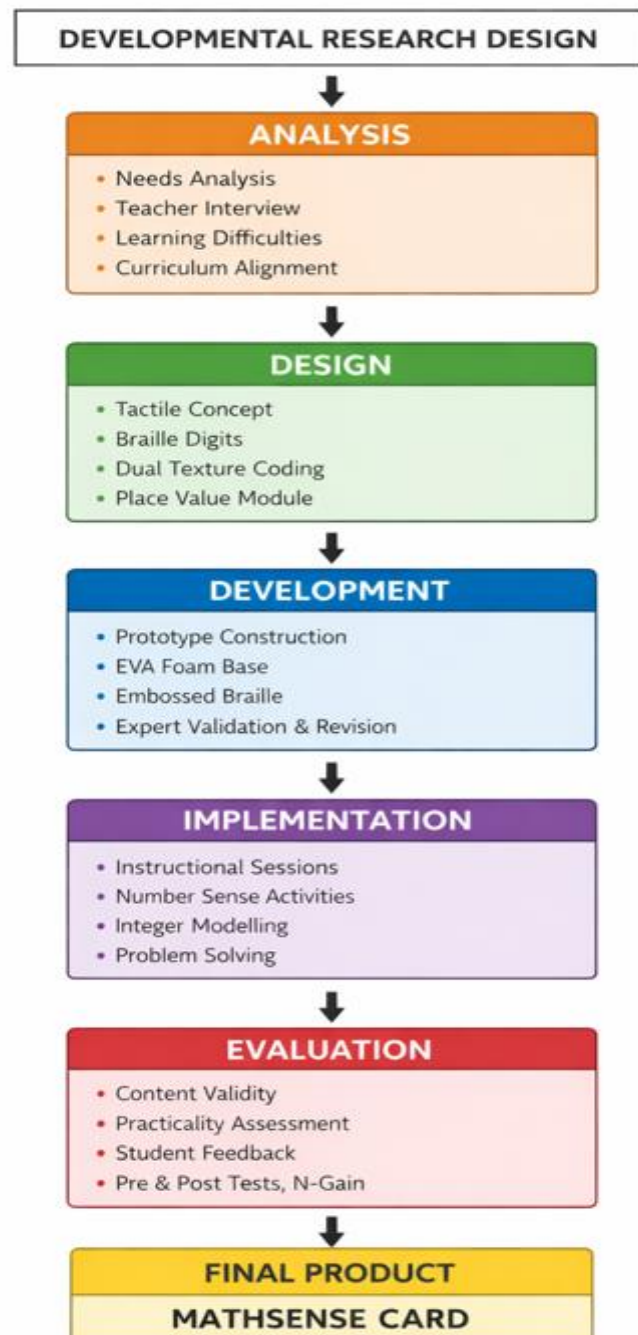


Figure 1. Research Design of The Study Based on The ADDIE Developmental Model

Result and Discussion

This section presents the findings of the empirical evaluation of the MathSense tactile card module, focusing on three components: the demographic profile of participants, (i) usability and design quality, and (ii) accessibility and inclusivity. A total of 68 participants from varying age categories and gender distributions were involved in the study, providing a diverse context for evaluation. Descriptive statistical analysis was employed to examine participants'

perceptions following the implementation of the module in classroom settings involving students with visual impairments. The analysis evaluates the extent to which the MathSense cards meet practical usability requirements while fostering inclusive and equitable learning experiences. The findings are interpreted in relation to tactile instructional design considerations and inclusive education principles.

Table 1: Duration of Braille Reading Experience, distribution by Gender

Duration of Braille Reading Experience	Numbers	
	Female	Male
Less than 1 year	11	18
1 to 3 Years	3	3
4 to 6 Years	2	2
More than 6 years	10	20
TOTAL	26	43

Table 2: Level of Visual Impairment, Distribution by Gender

Level of Visual Impairment	Numbers	
	Female	Male
Totally blind	3	12
Low vision/Limited vision	23	31
Total	26	43

Table 1 represents the duration of Braille reading experience of participants by gender. A total of 68 participants were involved in the study, comprising 26 females (38.2%) and 43 males (61.8%). In terms of age distribution, the majority of participants were in the category of more than 6 years of age (Female = 10; Male = 20), followed by those categorized as less than 1 year (Female= 11; Male= 18). Smaller proportions were recorded in the 1–3 years and 4–6 years categories. The relatively higher number of male participants reflects the actual enrolment distribution at the participating institution and does not indicate intentional sampling bias. Importantly, the age variation among participants suggests that the MathSense tactile cards were evaluated across different developmental stages. This indicates a heterogeneous sample comprising both novice and experienced Braille users. Such variation is important, as it suggests that the MathSense tactile cards were evaluated across different levels of tactile literacy and familiarity with Braille. The higher representation of participants with more than six years of experience implies that many respondents had well-developed tactile reading skills, which may contribute to more accurate evaluation of the card design. Meanwhile, the presence of beginners demonstrates that the tool is also accessible to users with minimal prior exposure. This diversity strengthens the generalisability of the findings, indicating that the MathSense cards are adaptable across different learning stages and user proficiencies.

Table 2 indicates that the majority of participants fall under the low vision category, while a smaller proportion are totally blind. This distribution reflects typical classroom demographics, where learners with varying degrees of visual impairment are included within the same learning environment. Importantly, the inclusion of both totally blind and low vision participants allows for a more comprehensive evaluation of the MathSense cards in terms of accessibility. The positive responses across these groups suggest that the tactile features of the cards are effective

regardless of the degree of visual impairment. This highlights the flexibility of the design in supporting diverse sensory needs, reinforcing its potential as an inclusive instructional tool that accommodates a wide spectrum of visual abilities.

Table 3: Usability and Design Quality of MathSense Cards

Item	Statement	Mean	SD
C1	The cards are easy to hold and distinguish from one another.	4.37	0.88
C2	The Braille text on the cards is easy to read.	4.23	0.92
C3	The layout of information on the cards is organized and clear.	4.29	0.86
C4	The game instructions are easy to understand.	4.28	0.88
C5	I can play the cards with minimal assistance from teachers or peers.	4.29	0.9

Table 3 represents the descriptive statistics for the usability and design construct of the MathSense tactile card module. The overall construct mean was 4.29 ($SD \approx 0.88$), indicating a high level of usability and design quality. All five items recorded mean scores above 4.20, reflecting strong agreement among participants regarding the physical and instructional features of the cards. Specifically, Item C1 (“The cards are easy to hold and distinguish from one another”) obtained the highest mean score ($M = 4.37$, $SD = 0.88$), suggesting that the tactile differentiation and ergonomic design effectively support users’ physical interaction with the cards. Item C2 (“The Braille text on the cards is easy to read”) recorded the lowest mean within this construct ($M = 4.23$, $SD = 0.92$), although it still indicates a high level of agreement. The slightly higher standard deviation suggests minor variability in participants’ perception of Braille readability, which may be influenced by individual tactile sensitivity or prior exposure to Braille materials.

Items related to layout clarity (C3, $M = 4.29$, $SD = 0.86$), clarity of instructions (C4, $M = 4.28$, $SD = 0.88$), and independent usability (C5, $M = 4.29$, $SD = 0.90$) further reinforce the effectiveness of the module’s structured design. The relatively consistent standard deviation values across items indicate stable and homogeneous responses among participants. Overall, these findings provide empirical support for the practical usability and design robustness of the MathSense tactile card module, particularly in facilitating independent and meaningful engagement among students with visual impairments.

Table 4: Accessibility and Inclusivity

Item	Statement	Mean	SD
F1	The cards are suitable for students with visual impairments like me.	4.59	0.75
F2	I feel more included in classroom activities when using these cards.	4	0.98
F3	The cards can be used together with sighted peers.	4.43	0.9
F4	My teacher can easily use these cards during teaching activities.	4.34	0.78

F5	The cards are suitable for various activities (individual, pair, group).	4.4	0.86

Meanwhile, based on Table 4, the accessibility and inclusivity construct recorded an overall mean of 4.35, indicating a high level of perceived accessibility and inclusive educational value. All items achieved mean scores of 4.00 and above, demonstrating strong agreement that the MathSense cards effectively promote inclusive classroom participation. Item F1 (“The cards are suitable for students with visual impairments like me”) obtained the highest mean score ($M = 4.59$, $SD = 0.75$), highlighting strong affirmation of the module’s appropriateness for its target users. Participants also reported that the cards can be used collaboratively with sighted peers (F3, $M = 4.43$, $SD = 0.90$) and across various activity formats such as individual, pair, and group work (F5, $M = 4.40$, $SD = 0.86$). These findings indicate that the module not only supports accessibility but also fosters social integration and participatory learning environments.

Although Item F2 (“I feel more included in classroom activities when using these cards”) recorded the lowest mean ($M = 4.00$, $SD = 0.98$), it remains within the high agreement range. The comparatively larger standard deviation suggests greater variability in students’ subjective experiences of inclusion, which may be influenced by classroom context or teacher facilitation practices. The consistently high ratings for physical handling and suitability for students with visual impairments indicate that the MathSense module performs effectively across diverse age groups and gender compositions. The demographic variation within the sample enhances the credibility of the findings, suggesting that the positive perceptions are not confined to a specific subgroup but reflect broader applicability.

Overall, the results demonstrate that the MathSense tactile card module successfully addresses both functional accessibility and wider inclusive educational objectives. The consistently high mean scores provide quantitative support for the module’s potential to enhance equitable learning opportunities for students with visual impairments.

Conclusion

This study successfully developed and validated the MathSense tactile mathematics card using the ADDIE instructional design framework, demonstrating high levels of usability, accessibility and pedagogical effectiveness in enhancing number sense among visually impaired learners. The findings provide strong empirical evidence that structured tactile instructional design can move beyond basic accessibility toward meaningful conceptual understanding and independent learning.

Importantly, this study aligns with Sustainable Development Goal (SDG) 4, which advocates for inclusive and equitable quality education, by addressing systemic barriers faced by learners with visual impairments in mathematics. The MathSense module exemplifies how inclusive educational innovation can operationalise equity by transforming abstract mathematical concepts into accessible, cognitively meaningful experiences. In addition, the study supports ESG (Environmental, Social, and Governance) principles, particularly the social dimension, by promoting educational inclusivity, equal opportunity and learner empowerment.

From a national policy perspective, the findings are consistent with Malaysia Education Blueprint (PPPM 2013–2025) and inclusive education initiatives that emphasise equitable access, quality learning outcomes and innovation in teaching and learning practices. By integrating tactile design with established learning theories such as embodied cognition and APOS, this study contributes a scalable, research-driven instructional model that can be adopted in special and mainstream educational settings.

In conclusion, MathSense represents a significant advancement in inclusive mathematics education, offering both practical classroom application and theoretical contribution. Future research should extend this work through larger-scale implementation, longitudinal analysis and integration with digital assistive technologies to further strengthen its impact on sustainable and inclusive education systems.

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REVISITING MUSLIM-FRIENDLY HOSPITALITY: A TPB-BASED CONCEPTUAL FRAMEWORK OF HALAL VALUE, TOURIST SATISFACTION, AND REVISIT INTENTION

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Abstract: *The global Muslim tourism market continues to expand rapidly, necessitating deeper insights into value creation within Muslim-Friendly Hospitality (MFH). This study develops a conceptual framework grounded in the Theory of Planned Behavior (TPB), positioning halal value as a belief structure, tourist satisfaction as an evaluative attitude, and revisit intention as behavioural intention. The findings propose that halal value positively influences satisfaction and revisit intention, with satisfaction mediating the relationship. Theoretically, the study extends TPB into Islamic hospitality by elevating halal value from a subdimension of Muslim Tourist Perceived Value (MTPV) to a higher-order construct that strategically influences satisfaction and revisit intention. The framework integrates both Islamic physical and non-physical attributes to explain Muslim tourist behavior in Malaysia. Practically, it offers guidance for Muslim-Friendly Hotels (MFHs) operators to move beyond certification-based compliance toward experiential halal value creation. By reconceptualizing halal value as a multidimensional experiential determinant of loyalty formation, this study advances understanding of customer behavior in Muslim-Friendly Hotels (MFHs) and contributes to the growing discourse on Islamic hospitality and tourism. In conclusion, this study advances loyalty theory in Islamic hospitality and provides strategic insights for enhancing customer satisfaction and encouraging repeat visitation in Muslim-Friendly Hotels (MFHs), thereby contributing to the growing discourse on Islamic Hospitality and Tourism.*

Keywords: *Halal Value, Customer Satisfaction, Revisit Intention, Muslim-Friendly Hotels (MFHs), Theory of Planned Behavior (TPB)*

Introduction

The global tourism industry remains one of the most influential sectors contributing to economic growth, employment generation, and foreign exchange earnings. According to the

World Travel & Tourism Council (WTTC), (2024), the travel and tourism sector contributed approximately USD 11.1 trillion to global GDP in 2024, representing nearly 10% of the world's economy. This growth underscores the sector's resilience and its significant role in the global economy (Oladipo, 2024). One of the most dynamic and rapidly expanding segments influencing revisit intention research is the Muslim travel market. The Muslim travel market has emerged as one of the fastest-growing segments of global tourism. Pew Research Center, (2025) reported that the global Muslim population reached approximately 2.0 billion in 2020 and remains the fastest-growing major religious group. This demographic expansion provides a strong structural foundation for the continued growth of Muslim travel demand. The global Muslim travel market has experienced substantial growth, driven by increasing demand for halal-compliant tourism services and experiences aligned with Islamic values (Battour et al., 2024; CrescentRating & Mastercard, 2025).

Impressively, Malaysia has maintained its top position in the Global Islamic Economy Indicator (GIEI) for the 10th consecutive year, followed by Saudi Arabia, Indonesia, and the UAE. Malaysia continues to lead the Global Islamic Economy Index, excelling in Islamic finance, halal food, and halal travel (Ali Liaqat, 2023). On the other hand, halal products have become an integral part of people's lifestyles globally. Muslim tourists account for a significant portion of arrivals, reinforcing Malaysia's positioning as a Muslim-friendly destination. Malaysia has consistently been recognized as a leading destination in halal tourism, supported by strong institutional frameworks such as Muslim-Friendly Hospitality Services (MFHS) standards and government initiatives (Rahman et al., 2020).

Within this context, revisiting intention has become a critical indicator of sustainable competitiveness in tourism and hospitality. This study is grounded in the Theory of Planned Behavior (TPB), which posits that behavioral intention is influenced by attitude toward the behavior, subjective norms, and perceived behavioral control (Ajzen, 2020). In tourism research, TPB has been widely applied to explain revisit intention and loyalty behavior (Abbasi et al., 2021; Esfandiar & Hadinejad, 2025; Hussein et al., 2020). In Muslim-Friendly Hospitality (MFH) settings, revisit intention is influenced not only by functional satisfaction but also by religious assurance, ethical congruence, and the fulfilment of Shariah-compliant expectations. However, most studies focus on service quality rather than halal value attributes (Suhartanto et al., 2021).

This paper addresses this gap using TPB (Ajzen, 2020). As highlighted by Yusni et al., (2023), numerous previous studies have highlighted the relationship between satisfaction and intention to revisit, meanwhile satisfaction is influenced by perceived value. However, there is still limited evidence on how tourists perceived the values from Islamic perspective of Muslim-Friendly Hotels (MFHs) guests. Despite this growth, existing studies predominantly focus on general service quality and overall perceived value, often neglecting the role of specific halal attributes that shape Muslim tourists' experiences (Jeaheng et al., 2020; Suhartanto et al., 2021). This study addresses this gap by proposing a Theory of Planned Behavior (TPB)-based framework, where halal value influences satisfaction (as attitude), which subsequently drives revisit intention. Unlike prior studies that combine multiple theories, this study adopts a TPB-only approach, offering a more parsimonious and theoretically consistent explanation of Muslim tourist behavior.

Literature Review

Halal Tourism

Previously, the concept of halal has traditionally been associated with food and beverages, as dietary consumption represents the primary medium through which halal requirements are initially applied. However, contemporary understandings of halal have expanded beyond this narrow scope. Consumers who adhere to halal principles in food consumption increasingly extend these attributes to encompass broader considerations such as safety, comfort, and environmental sustainability (Purusottama & Wijanarti, 2022). This evolution reflects a shift toward a more holistic and long-term orientation, whereby halal is conceptualized not only as a religious obligation but also as a comprehensive framework that aligns with the diverse needs of modern society.

In contemporary society, halal elements have increasingly become integrated into the global lifestyle. The concept of halal now extends beyond food products to encompass a wide range of non-food items, including cosmetics, pharmaceuticals, leather goods, and fragrances. The halal concept is inherently broad, encompassing various domains, including food, clothing, beverages, cosmetics, pharmaceuticals, marketing, travel, tourism, hospitality, and finance. In addition, halal principles have been increasingly adopted across multiple service sectors, including banking, entertainment, logistics, and tourism, highlighting their expanding influence and applicability in both product-based and service-oriented industries (El-Gohary, 2020; Junaidi, 2020). Muslim-Friendly Hotels (MFHs) are an expanding segment of Halal tourism designed to meet the specific needs of Muslim travelers. They offer specialized accommodations and services that allow guests to maintain their religious lifestyle while traveling (Mat Yusof et al., 2020). Halal service, especially in Muslim-Friendly Hotels (MFHs), should be based on Islamic values that follow the rules of Shariah (Hussain et al., 2021).

Halal Value Attributes

Halal value represents the perceived benefits derived from products and services that comply with Islamic principles and fulfill Muslim tourists' religious expectations (Hamdy & Eid, 2024). Unlike conventional perceived value, which emphasizes functional and economic trade-offs, halal value incorporates religious, emotional, and spiritual dimensions, making it a multidimensional construct (Battour et al., 2022; Suhartanto et al., 2021). Within the broader framework of Muslim Tourist Perceived Value (MTPV), halal value is recognized as a critical subdimension that directly influences satisfaction and loyalty in Muslim-Friendly Hotels (MFHs) (Preko et al., 2020).

In the context of MFHs, halal value can be decomposed into two key dimensions: Islamic physical attributes and Islamic non-physical attributes. Islamic physical attributes refer to tangible elements such as halal-certified food, gender-segregated amenities, and access to religiously compliant facilities. These include clean prayer areas, ablution amenities, accurate qibla orientation, and precise prayer-time information, all of which have emerged as salient determinants of Muslim consumers' decision-making processes (Jeaheng et al., 2020; Rahmah

& Idris, 2025). Such attributes provide functional assurance and religious compliance, enabling Muslim tourists to maintain their religious practices while traveling. As (Rohim et al., (2022a) highlight, understanding Muslim behavior through Islamic attributes is essential, as these factors strongly influence purchasing decisions in tourism.

In contrast, Islamic non-physical attributes encompass intangible elements that shape the overall hospitality experience. These include the creation of an Islamic ambiance, modest service interactions, Shariah-compliant entertainment, and ethical service delivery. They also extend to practices such as the provision of separate facilities, the availability of Shariah-compliant products, Islamic greetings, and culturally appropriate music, all of which reinforce the spiritual and cultural dimensions of service (Rahayu et al., 2020). Collectively, these non-physical attributes contribute to guests' emotional and spiritual assurance, complementing physical provisions and strengthening the holistic value of MFHs.

Empirical studies have consistently demonstrated that both physical and non-physical halal attributes significantly influence satisfaction and behavioral outcomes in Islamic tourism contexts (El-Gohary, 2020; Suhartanto et al., 2021).

Tourist Satisfaction

Research on tourist satisfaction has been extensive, with core concepts aiming to explain why tourists choose destinations and how they evaluate their experiences (Mohamed et al., 2021). For industry practitioners, this underscores the need to consistently upgrade services to ensure that customers not only revisit but also recommend the organization to others. Customer satisfaction remains a crucial topic in hospitality and tourism research, as it directly influences the evaluation of tourism products and services and shapes customers' cognitive assessments and behavioral intentions. Empirical studies confirm that visitor satisfaction is a decisive factor in determining revisit intention (Bayih & Singh, 2020; Darojat, 2021; Habibi et al., 2024).

Tourist satisfaction is commonly defined as the positive or negative feelings and attitudes formed after consuming products or receiving services services (Boontos & Uon, 2025; Marlizar et al., 2021). Suprianto et al., (2023) further describe satisfaction as the extent to which product or service features deliver a delightful level of consumption-related realization.

Within the Theory of Planned Behavior (TPB), attitude represents an individual's overall evaluation of a behavior, which directly influences behavioral intention (Ajzen, 2020). In the context of Muslim-Friendly Hotels (MFHs), satisfaction reflects the degree to which halal expectations are fulfilled, encompassing both cognitive evaluations (e.g., service performance) and affective responses (e.g., emotional and spiritual comfort)(Battour et al., 2022; Suhartanto et al., 2021). By conceptualizing satisfaction as an attitude, this study aligns with TPB's theoretical structure and provides a coherent explanation of Muslim tourist behavior.

Revisit Intention

Previous research has demonstrated that revisit intention can be strengthened through several factors, including consumer perception of price, service quality, experience, destination image,

satisfaction, tourist motivation, and perceived value (Rozi & Panji Wulung, 2022). Within the Theory of Planned Behavior (TPB), revisit intention is regarded as a robust predictor of actual future behavior, offering valuable insights into tourist decision-making and destination loyalty (Hussein et al., 2020). TPB emphasizes that behavioral intention is primarily determined by attitude, thereby positioning satisfaction as a critical antecedent of revisit intention (Ajzen, 2020).

Academics and practitioners alike underscore the importance of revisit intention in tourism and hospitality. It reflects a customer's desire to return, repurchase, or continue using services, often manifested in behaviors such as extending their stay, spending more than anticipated, or recommending the destination to others (Baker & Crompton, 2000; Boontos & Uon, 2025; Lei et al., 2023). Hardinie et al., (2023) further note that revisit intention is conceptually derived from repurchase intention, highlighting its applicability across service and product categories. The likelihood of repeat business is therefore substantial when tourists' needs and expectations are met.

In the context of halal tourism, revisit intention is defined as a Muslim tourist's plan not only to return but also to recommend halal destinations to others (Julina et al., 2021). Studies confirm that satisfaction plays a pivotal role in encouraging repeat visitation, as customers' desires to return are closely correlated with their behavioral intentions (Wantara & Irawati, 2021). Consequently, service providers must consistently meet visitor needs and ensure satisfaction to foster loyalty.

Within Islamic hospitality, revisit intention is shaped not only by service quality but also by trust in halal compliance, emotional comfort, and the consistency of Islamic (Battour et al., 2024; Hamdy et al., 2024). This underscores the importance of halal value as a multidimensional determinant of both satisfaction and behavioral intention, positioning it as a strategic driver of loyalty formation in Muslim-Friendly Hotels (MFHs).

Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB) provides a comprehensive framework for understanding how halal value and satisfaction influence the repurchase intention of Muslim tourists. Based on the Theory of Planned Behavior (Ajzen, 1991), revisit intention is influenced by attitudes, subjective norms, and perceived behavioral control in shaping tourists' decision-making processes (Esfandiar & Hadinejad, 2025).

Consequently, authors noted that the Theory of Planned Behavior (TPB) model consists of three psychological domains: attitude (ATT), subjective norm (SN), and perceived behavioral control (PBC) (Tajeddini et al., 2021) and within the hospitality context, these dimensions can be operationalized through halal value, and customer satisfaction. Specifically, halal value is expected to influence tourists' attitudes toward Muslim-Friendly Hotels (MFHs), while customer satisfaction functions as a mediating mechanism that strengthens the relationship between these antecedents and revisit intention.

Attitude is one feeling of favorableness towards a specific behaviour (refer to Figure 1). In this regard, the subjective norm is the perception of significant others who influence decision-making. It also refers to an individual's perception of social normative pressures that compel them to enact a particular behaviour or the people important to him or her to engage in or refrain from a specific behaviour (Liu et al., 2024). Meanwhile, perceived behavioral control (PBC) is a person's ability and opportunity to engage in a particular behaviour (Fauzi et al., 2024).

Past researchers have indicated that the Theory of Planned Behavior (TPB) is a general conduct system used in research on tourism, and earlier studies that predict a sequence of behavioral intentions (Abbasi et al., 2021; Hussein et al., 2020). As indicated by Esfandiar & Hadinejad, (2025) in Theory of Planned Behavior (TPB) has been extensively used in tourism research to explain destination choice, revisit intention, and sustainable travel behaviors.

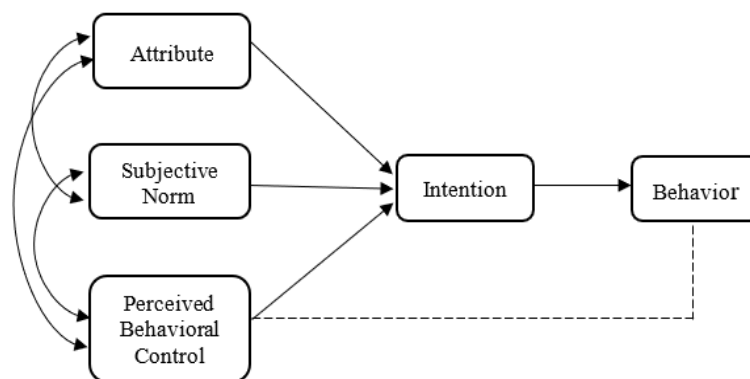


Figure 1: Theory of Planned Behavior

Theoretical Framework and Hypothesis Development

This study applies the Theory of Planned Behavior (Ajzen, 2020), positioning satisfaction as attitude. Based on the discussion above mention, this study has identified the relationship between halal value, tourist satisfaction and return visit intention, hence below hypotheses are proposed:

- H1: Halal value is positively influences tourist satisfaction.
- H2: Halal value positively influences revisit intention.
- H3: Tourist satisfaction positively influences revisit intention.
- H4: Tourist satisfaction mediates the relationship between halal value and their intention to revisit.

Next, the authors build a study framework as shown in Figure 2. As illustrated in Figure 2, the model proposes that halal value serves as the primary independent variable influencing a set of mediation and the ultimate behavioral outcome. specifically, the framework posits that halal value positively affects tourist satisfaction, and Muslim tourists' revisit intention in Muslim-Friendly Hotels (MFHs). Meanwhile tourist satisfaction mediates the relationship between halal value and their intention to revisit.

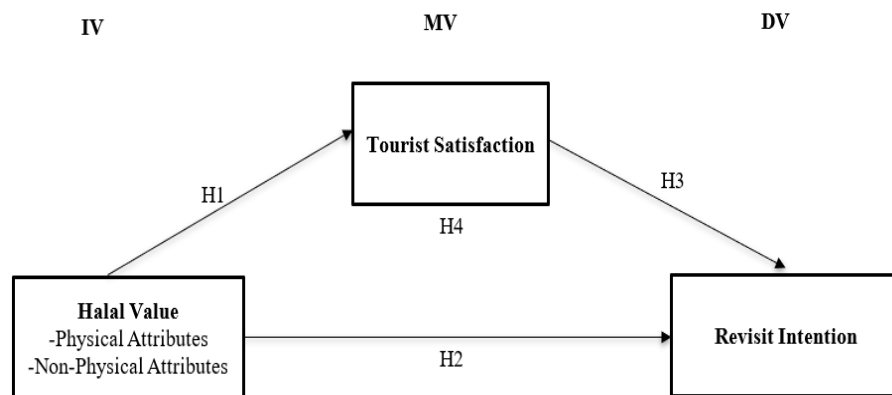


Figure 2: Conceptual Framework for Halal Value, Tourist Satisfaction and Revisit Intention

Research Methodology

This chapter outlines the procedures undertaken to collect and analyse data for the study. The primary objective is to enhance understanding of halal value in relation to revisit intention, tourist satisfaction, and the likelihood of recommending Muslim-Friendly Hotels (MFHs) in Malaysia. To achieve this, the study adopts a quantitative research paradigm, which is appropriate for examining relationships among variables and providing statistical evidence to support findings.

A cross-sectional correlational design was employed, enabling data collection at a single point in time from Muslim tourists who have previously stayed in MFHs in Malaysia. This design is cost-effective, time-efficient, and practical for assessing relationships without manipulating variables (Thomas & Zubkov, 2023). The correlational approach allows the researcher to determine the strength and direction of associations among constructs, while also supporting mediation analysis. Given the study's focus on mediation effects, Structural Equation Modeling (SEM) was selected as the primary statistical technique, as it enables testing of both direct and indirect relationships among constructs. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed for data analysis using SmartPLS 4.0. PLS-SEM is suitable for this study due to its ability to handle complex models with multiple mediating variables and its robustness with relatively smaller sample sizes (Joseph F. Hair Jr. et al., 2021).

The target population comprises Muslim tourists, both domestic and international, who have stayed in MFHs in Malaysia. Respondents must be at least 18 years old, in line with the Malaysian Act 1950, which recognizes individuals of this age as legally competent to provide informed consent. A purposive sampling method was applied to ensure that participants meet the inclusion criteria:

1. The respondent must be Muslim.
2. The respondent must have stayed at a Muslim-Friendly Hotels (MFHs) in Malaysia.
3. The respondent must be 18 years or older.

This methodological approach ensures that the data collected are relevant, reliable, and aligned with the study's objectives of examining how halal value influences satisfaction and revisit intention, with satisfaction acting as a mediation.

Research Instruments

Research instruments serve as tools for data collection, including questionnaires, scales, and surveys, which researchers utilize to assess variables within their studies. Abdul Hamid, (2021) and Rahman et al., (2022) have proposed that these instruments can take various forms, such as questionnaires, interviews, observations, documents, content analyses, or standardized tests. Therefore, questionnaire is the primary data collection instrument of the study and approach through cross sectional study. The author developed the questionnaire on Google Forms and distributed it on-line. The questionnaires will be distributed online via email, through social media platforms (Facebook and Instagram), WhatsApp, Muslim travel groups, and tourism-related forums. The online survey uses a structured questionnaire due to its advantages of wider geographical coverage, low cost, and rapid responses (Lim et al., 2024). The questionnaire instrument was developed by adapting previous literature with adjustments to the study setting and panel expert review. In order to ensure the questionnaire is more organized and understandable, the survey instrument for this study instrument will consist of four (4) sections which include the demographic information, tourists' demographic, halal value, satisfaction and revisit intention. All items were rated on a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree").

Theoretical Contributions

This study makes several significant contributions to theory. First, it extends the Theory of Planned Behavior (TPB) into the domain of Islamic hospitality by incorporating halal value as a belief construct, thereby enriching the explanatory power of TPB in tourism contexts. Second, it advances an attribute-based conceptualization of halal value, distinguishing between physical attributes (e.g., halal-certified facilities and services) and non-physical attributes (e.g., trust, ethics, and spiritual assurance). Third, it reconceptualizes tourist satisfaction as an evaluative attitude, aligning hospitality and tourism research more closely with TPB's attitudinal framework. Finally, the study provides a mediation-based explanation of Muslim tourist loyalty, demonstrating how satisfaction mediates the relationship between halal value and revisit intention. Collectively, these contributions offer a comprehensive theoretical lens for understanding loyalty formation in Muslim-Friendly Hospitality (MFH) and broaden the scope of TPB within Islamic consumer behavior research.

Practical Implications

The findings of this study provide valuable guidance for Muslim-Friendly Hotels (MFHs) operators seeking to strengthen their competitiveness in the halal tourism market. Hotels should prioritize both physical halal attributes, such as halal-certified food, prayer facilities, and Shariah-compliant services, as well as non-physical attributes, including trust, ethical conduct, and spiritual assurance, to enhance perceived value. Beyond compliance, service providers must deliver consistent Islamic experiences that foster emotional and spiritual satisfaction,

thereby deepening customer engagement. Transparency in halal certification and operational practices is equally critical, as it reinforces trust and reduces uncertainty, encouraging repeat visitation and positive word-of-mouth. By embedding experiential halal value into service design and delivery, operators can move beyond certification-based positioning toward a more holistic approach that emphasizes meaningful guest experiences. Such strategies not only enhance tourist satisfaction but also cultivate loyalty, positioning Muslim-Friendly Hotels (MFHs) as leaders in experiential halal hospitality and ensuring sustainable growth in the rapidly expanding global Muslim tourism market.

Conclusion and Limitations

This study proposes a TPB-based conceptual framework to explain how halal value influences tourist satisfaction and revisit intention in Muslim-Friendly Hotels (MFHs). By positioning satisfaction as an evaluative attitude, the framework offers a theoretically coherent and contextually relevant explanation of Muslim tourist behavior. The study contributes to Islamic hospitality research by elevating halal value to a higher-order construct and demonstrating its role in loyalty formation. Practically, the framework provides guidance for hotel operators to embed experiential halal value into service delivery, thereby enhancing satisfaction and encouraging repeat visitation.

However, this paper is conceptual in nature and does not include empirical testing. As such, the proposed relationships remain theoretical until validated through quantitative analysis. Future research is encouraged to empirically examine the framework using Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed for data analysis using SmartPLS 4.0. PLS-SEM to test its applicability across diverse cultural and geographical contexts. Longitudinal and comparative studies would further strengthen the generalizability of findings and provide deeper insights into the dynamics of halal value, satisfaction, and loyalty in Muslim-Friendly Hospitality (MFH).

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KEY FACTORS INFLUENCING CUSTOMER LOYALTY TOWARDS ELECTRIC CAR IN SHANXI PROVINCE, CHINA

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Abstract: *In today's highly competitive business environment, understanding the drivers of customer loyalty is critical for enhancing profitability and market share. This study examines the influence of demographic characteristics, consumer behavior, perceived quality, and environmental consciousness on customer loyalty. Demographic factors shape consumer attitudes, preferences, and purchasing patterns, while positive attitudes and intentions drive repeat purchases and brand advocacy. In addition, perceived service quality plays a vital role in shaping customer satisfaction and loyalty, and growing environmental awareness encourages consumers to support brands aligned with ethical and ecological values. A quantitative research design was employed, with data analyzed using Independent Samples t-tests, One-way ANOVA, and Multiple Linear Regression (MLR). The results indicate no significant difference in customer loyalty between male and female respondents, but a significant difference across residential areas. ANOVA findings reveal no significant differences in loyalty based on marital status, occupation, or favorite brand; however, significant differences are observed across age, monthly income, educational level, and driving experience. Furthermore, MLR results show that all components of consumer behavior—attitude, subjective norms, and perceived behavioral control—positively and significantly influence customer loyalty. Similarly, all dimensions of perceived quality, including tangibles, reliability, responsiveness, assurance, and empathy, demonstrate significant positive effects. Environmental consciousness, as measured by environmental concern and awareness, also has a significant positive impact on customer loyalty. Overall, the findings highlight the importance of integrating behavioral, quality, demographic, and environmental factors in developing effective strategies to strengthen customer loyalty.*

Keywords: *Consumer Behavior, Perceived Quality, Environmental Consciousness, Customer Loyalty*

Introduction

Understanding how consumer behavior influences customer loyalty is vital for businesses seeking sustained growth and profitability in a competitive market. Loyalty drives repeat purchases, customer retention, and brand advocacy. Demographic factors—such as age, income, education, and location—significantly shape consumer preferences and buying behavior. For example, younger consumers favor digital and innovative products, while older or wealthier groups may prefer traditional or premium offerings (Xie et al., 2022). In addition to demographics, consumer behavior, particularly consumers' positive attitudes and intentions, has been shown to encourage repeat purchases and brand recommendations—critical indicators of loyalty (Ajzen, 1991).

Perceived quality is also central to loyalty. According to the Expectancy-Disconfirmation Theory, satisfaction arises when product performance meets or exceeds expectations (Yüksel & Yüksel, 2008). Zeithaml (1988) also noted a strong link between quality perception and loyalty. Environmental consciousness is another key driver. As concern for sustainability grows, consumers increasingly prefer eco-friendly products and companies with green practices. Eco-labels and sustainable branding can build trust and influence buying decisions (De Canio et al., 2021).

By examining the combined effects of demographics, consumer behavior, perceived quality, and environmental consciousness, this study offers insights into what drives customer loyalty. Businesses that align their strategies with consumer expectations and sustainability trends will be better positioned for long-term success (Lal et al., 2020; Khan et al., 2023).

Literature Review

Consumer Behavior

Consumer behavior refers to the psychological, emotional, and behavioral processes involved in choosing and using products. Understanding these behaviors helps businesses tailor strategies to improve satisfaction, trust, and emotional connection—all key drivers of loyalty through repeat purchases and word of mouth (Rather, 2021; Kotler & Keller, 2016). Behavioral elements such as brand attitudes, peer influence, and purchase history shape loyalty outcomes. Brands that deliver consistent value and personalized experiences are more likely to earn lasting commitment (Kotler & Keller, 2016). The Theory of Planned Behavior (TPB) further explains how attitudes, social norms, and perceived control influence buying decisions. Positive brand attitudes, social endorsement, and ease of access enhance loyalty intentions (Ajzen, 1991; Paul et al., 2016). Emotional engagement and psychological satisfaction also strengthen trust and advocacy. By aligning offerings with consumer values and behaviors, firms can boost loyalty and retention. Integrating consumer behavior insights with TPB offers a comprehensive view of how loyalty is built and sustained in competitive markets.

Perceived Quality

Perceived quality, unlike objective quality, is shaped by consumers' subjective judgments based on intrinsic factors (e.g., durability, design) and extrinsic cues (e.g., brand image, price, reviews) (Zeithaml, 1988). It influences trust, satisfaction, and brand loyalty, especially in competitive markets with minimal product differences (Parasuraman et al., 1988; Aaker, 1996). In service industries, the SERVQUAL model assesses perceived quality through five dimensions: reliability, responsiveness, assurance, empathy, and tangibles. These shape customer experience and drive loyalty (Oliver, 1999). Satisfaction often mediates the relationship between quality and loyalty, reinforcing positive behaviors such as repurchase and reduced switching (Cronin & Taylor, 1992; Sweeney & Swait, 2008). Perceived quality boosts purchase intent and brand commitment while reducing risk and enhancing consumer confidence (Dodds et al., 1991; Oliver, 2010). It also strengthens perceived value—consumers' evaluation of benefits versus costs—which, in turn, further promotes loyalty (Zeithaml, 1988). In the digital age, online reviews and influencer endorsements shape perceptions of quality and trust (Li et al., 2020). Strong perceived quality fosters emotional bonds that sustain loyalty even

amid competitor offerings. In sum, perceived quality is a key driver of satisfaction, value, emotional attachment, and long-term loyalty. Brands that consistently deliver and communicate high-quality products and services can build stronger customer relationships and achieve a competitive advantage.

Environmental Consciousness

Environmental consciousness—encompassing concern, knowledge, and pro-environmental intentions—has become a key factor in shaping consumer behavior, corporate strategy, and policy (Kollmuss & Agyeman, 2002; Bamberg & Möser, 2007). As ecological awareness grows, consumers increasingly favor brands that align with environmental values. From a consumer perspective, eco-conscious individuals prefer green products, avoid environmentally harmful brands, and show greater loyalty to firms committed to sustainability (Lizawati Aman, 2011; Cheung & To, 2019). Their purchase decisions consider not only price and quality but also environmental and ethical impact (Wang et al., 2020). From a corporate standpoint, environmental responsibility has evolved into a strategic advantage. While once seen as costly (Judge & Krishnan, 1994), it now enhances brand differentiation, stakeholder trust, and financial performance (Verbeke & Buysse, 2003; Chen, 2010). CSR and green marketing tools—like eco-labels and sustainability disclosures—boost consumer trust, loyalty, and advocacy (Biswas & Roy, 2015; Rahman et al., 2015). In summary, environmental consciousness is a critical driver of both consumer loyalty and the strategic value of brands, particularly those committed to sustainability, as it shapes positive attitudes, strengthens trust, and encourages long-term engagement with environmentally responsible products and practices.

Customer Loyalty

Customer loyalty is a multifaceted concept that includes both behavioral actions and emotional commitment. Understanding these dimensions is key to building lasting customer relationships and brand equity. Behavioral Loyalty: Refers to repeated purchases over time, indicating brand preference and retention (Jacoby & Chestnut, 1978). Attitudinal Loyalty: Reflects emotional attachment and psychological commitment, influenced by trust, satisfaction, and perceived value (Dick & Basu, 1994). Advocacy: Loyal customers often promote the brand through word of mouth, serving as informal ambassadors (Reichheld, 2003).

Research Methodology

This study explores the effects of demographic factors, consumer behavior, perceived quality, and environmental consciousness on customer loyalty toward electric vehicles (EVs) in Shanxi Province, China. The target group consists of residents who own or plan to purchase EVs. Using Yamane's (1967) formula, a sample size of 400 was selected. Data analysis includes descriptive statistics (frequencies, percentages, arithmetic means and standard deviations) and inferential methods (independent-samples t-tests, one-way ANOVA and multiple linear regression [MLR]) to examine variable relationships and differences.

Research Findings

The Descriptive Characteristics of Demographic Factors of EV Consumers in Shanxi Province, China

Most respondents are male (53.5%), with females accounting for 46.5%. The largest group is single (35%), followed by married (34%) and divorced (31%). Respondents aged 30–39 make up the largest age group (20.5%), while those aged 60+ are the smallest (19.5%). In terms of income, 21.25% earn 8,000–15,000 RMB, while 17.5% earn 30,000 RMB or more. A bachelor's degree is the most common education level (21%), whereas PhD holders represent the smallest share (18.5%). Business owners constitute the largest occupation group (21.25%), and most respondents are from Shanxi Province (72%). Regarding preferences, BYD is the most favored EV brand (20%), followed by NIO, LI Auto, XPENG, and XIAOMI. Most respondents have 6–10 years of driving experience (21%), while only 18.5% have 1 year of experience.

The Consumer Behavior

Table 1: The Descriptive Statistics of Consumer Behavior

Classification	Mean	Std. Dev.	Meaning	Rank
Attitude	3.5988	.4496	Agree	1
Subjective Norms	3.5655	.4118	Agree	2
Perceived Behavioral Control	3.5160	.4329	Agree	3
Overall	3.5601	.3739	Agree	-

Table 1 presents descriptive statistics for consumer behavior across three dimensions: attitude, subjective norms, and perceived behavioral control. Attitude shows the highest mean ($M = 3.5988$, $SD = 0.4496$), followed by subjective norms ($M = 3.5655$, $SD = 0.4118$) and perceived behavioral control ($M = 3.5160$, $SD = 0.4329$). The overall consumer behavior mean of 3.5601 ($SD = 0.3739$) also falls within the "Agree" range, reflecting a generally positive disposition toward EV adoption.

The Perceived Quality

Table 2: The Descriptive Statistics of Perceived Quality

Classification	Mean	Std. Dev.	Meaning	Rank
Tangibles	3.5844	.5848	Agree	2
Reliability	3.5665	.4970	Agree	4
Responsiveness	3.5681	.5783	Agree	3
Assurance	3.5850	.5280	Agree	1
Empathy	3.5620	.4874	Agree	5
Overall	3.5732	.3449	Agree	

Table 2 presents descriptive statistics for perceived quality across five service dimensions. Assurance scored highest ($M = 3.5850$, $SD = 0.5280$), followed closely by tangibles ($M = 3.5844$), responsiveness ($M = 3.5681$), reliability ($M = 3.5665$), and empathy ($M = 3.5620$).

All dimensions fall within the "Agree" range. The overall perceived quality mean is 3.5732 (SD = 0.3449), indicating generally positive perceptions of EV-related services.

The Environmental Consciousness

Table 3: The Descriptive Statistics of Environmental Consciousness

Classification	Mean	Std. Dev.	Meaning	Rank
Environmental Concern	3.4338	.5522	Neutral	2
Environmental Awareness	3.5708	.5461	Agree	1
Overall	3.5023	.4880	Agree	-

Table 3 shows descriptive statistics for environmental consciousness, comprising environmental awareness and concern. Awareness has a higher mean ($M = 3.5708$, $SD = 0.5461$), interpreted as "Agree," while concern is slightly lower ($M = 3.4338$, $SD = 0.5522$), interpreted as "Neutral." The overall mean ($M = 3.5023$, $SD = 0.4880$) falls within the "Agree" range, indicating a generally positive orientation toward environmental responsibility.

The Customer Loyalty

Table 4: The Descriptive Statistics of Customer Loyalty

Classification	Mean	Std. Dev.	Meaning	Rank
Customer Loyalty	3.46	.571	Neutral	

Table 4 indicates that the overall mean of customer loyalty is 3.46 ($SD = 0.571$), which falls within the "Neutral" interpretation range. This implies that, although there are signs of behavioral loyalty, such as recommendation and repurchase tendency, attitudinal loyalty (e.g., paying a premium or following promotions) remains moderate and indicates room for improvement in building deeper brand attachment.

Differences in Gender Generate Differences in Customer Loyalty

Table 5: The Independent Samples t-test of the Gender Factor

Items	Gender	N	Mean	S.D.	t-value	p-value
Customer Loyalty	Female	288	3.417361	.5736162	.951	.342
	Male	112	3.562500	.5518397		

*The mean difference is significant at the 0.05 level.

Table 5 shows a p-value of 0.342 for customer loyalty by gender, which exceeds the 0.05 significance level. Therefore, the null hypothesis (H_0) is not rejected, indicating that there is no statistically significant difference in customer loyalty between genders.

Differences in Residential Area Generate Differences in Customer Loyalty

Table 6: The Independent Samples t-test of Residential Area

Items	Residential Area	N	Mean	S.D.	t-value	p-value
Customer Loyalty	Shanxi Province	288	3.417361	.5736162	-2.296	.022*
	Others	112	3.562500	.5518397		

*The mean difference is significant at the 0.05 level.

The independent samples t-test reveals a statistically significant difference in customer loyalty between respondents from Shanxi Province ($M = 3.42$, $SD = 0.57$) and those from other areas ($M = 3.56$, $SD = 0.55$), $t(398) = -2.296$, $p = 0.022$. Since the p-value is less than 0.05, the difference is statistically significant.

Differences in Marital Status, Age, Monthly Income, Educational Level, Occupation, Favorite Brand, and Driving Experience Generate Differences in Customer Loyalty

Table 7: The One-Way ANOVA of Marital Status, Age, Monthly Income, Educational Level, Occupation, Favorite EV Brand, and Driving Experience

Factor	Items	SS	Df	MS	F-value	Sig
Marital Status	Between Groups	.329	2	.165	.504	.604
	Within Groups	129.605	397	.326		
	Total	129.934	399			
Age	Between Groups	5.729	4	1.432	4.555	.001*
	Within Groups	124.206	395	.314		
	Total	129.934	399			
Monthly Income	Between Groups	5.074	4	1.268	4.013	.003*
	Within Groups	124.861	395	.316		
	Total	129.934	399			
Educational Level	Between Groups	5.595	4	1.399	4.443	.002*
	Within Groups	124.340	395	.315		
	Total	129.934	399			
Occupation	Between Groups	2.196	4	.549	1.698	.150
	Within Groups	127.738	395	.323		
	Total	129.934	399			
Favorite Brand	Between Groups	.428	5	.086	.260	.934
	Within Groups	129.506	394	.329		
	Total	129.934	399			
Driving Experience	Between Groups	5.599	4	1.400	4.447	.002*
	Within Groups	124.335	395	.315		
	Total	129.934	399			

*The mean difference is significant at the 0.05 level.

Table 7 summarizes the results of the One-way ANOVA tests examining differences in customer loyalty based on demographic and experiential factors. The p-values associated with

Marital Status (.604), Occupation (.150), and Favorite EV Brand (.934) exceed the significance threshold of 0.05. Thus, the null hypotheses for these variables cannot be rejected, indicating that differences in Marital Status, Occupation, and Favorite EV Brand do not significantly affect customer loyalty. Conversely, the p-values for Age (.001), Monthly Income (.002), Educational Level (.003), and Driving Experience (.002) are below 0.05, leading to the rejection of the null hypotheses for these factors. This indicates that customer loyalty differs significantly across groups categorized by Age, Monthly Income, Educational Level, and Driving Experience.

The Influences of Consumer Behavior on Customer Loyalty

Table 8: The Multiple Linear Regression Analysis of Customer Loyalty based on Consumer Behavior

Model	Coefficient			t-value	p-value
	Unstandardized Coefficients		Standardized Coefficients		
	B	Std.Error	Beta		
Constant	-.928	.162	.391	-5.743	.000*
X ₁ (Attitude)	.497	.049	.391	10.067	.000*
X ₂ (Subjective Norms)	.440	.062	.317	7.146	.000*
X ₃ (Perceived Behavioural Control)	.294	.056	.223	5.265	.000*

a. Dependent variable Y: Customer Loyalty

* The mean difference is significant at the 0.05 level.

Table 8 shows that attitude (X₁), subjective norms (X₂), and perceived behavioral control (X₃) all have statistically significant effects on customer loyalty ($p < .001$). Attitude is the strongest predictor ($\beta \approx .391$), followed by subjective norms ($\beta \approx .317$) and perceived behavioral control ($\beta \approx .223$). The model explains approximately 65.2% of the variance in customer loyalty (adjusted $R^2 = .652$), supporting the Theory of Planned Behavior.

The Influences of Perceived Quality on Customer Loyalty

Table 9: The Multiple Linear Regression Analysis of Customer Loyalty based on Perceived Quality

Model	Coefficient			t-value	p-value
	Unstandardized Coefficients		Standardized Coefficients		
	B	Std.Error	Beta		
Constant	-.652	.217	.139	-3.001	.003*
X ₁ = Tangibles	.135	.041	.139	3.307	.001*
X ₂ = Reliability	.258	.096	.225	2.703	.007*
X ₃ = Responsiveness	.139	.033	.141	4.170	.000*
X ₄ = Assurance	.131	.039	.113	3.362	.001*
X ₅ = Empathy	.494	.101	.413	4.876	.000*

a. Dependent variable Y: Customer Loyalty

* The mean difference is significant at the 0.05 level.

Table 9 shows that all five service quality indicators—tangibles, reliability, responsiveness, assurance, and empathy—significantly influence customer loyalty ($p < .05$). Empathy ($\beta \approx .413$) is the strongest predictor, followed by reliability (.225), responsiveness (.141), tangibles (.139), and assurance (.113). The model explains 58.6% of the variance in customer loyalty (adjusted $R^2 = .586$), highlighting the key role of perceived service quality in driving loyalty.

The Influences of Environmental Consciousness on Customer Loyalty

Table 10: The Multiple Linear Regression Analysis of Customer Loyalty based on Environmental Consciousness

Model	Coefficient		t-value	p-value
	Unstandardized Coefficients	Standardized Coefficients		
	B	Std.Error	Beta	
Constant	-.231	.074		
Environmental Concern (X ₁)	.764	.023	.739	.000*
Environmental Awareness (X ₂)	.298	.023	.286	.000*

a. Dependent variable Y: Customer Loyalty

* The mean difference is significant at the 0.05 level.

Table 10 shows that both environmental concern (X₁) and environmental awareness (X₂) significantly influence customer loyalty ($p < .001$). Environmental concern is the stronger predictor ($\beta \approx .739$), followed by environmental awareness (.286). The model explains 87.2% of the variance in customer loyalty (adjusted $R^2 = .872$), underscoring the strong impact of environmental consciousness on loyalty.

Conclusion

The study finds that most respondents are male, single, aged 30–40, hold a bachelor's degree, earn 8,000–15,000 RMB/month, operate their own business, and live in Shanxi. BYD is the most preferred EV brand, and most have 6–10 years of driving experience. Attitude is the strongest consumer behavior predictor of loyalty, followed by subjective norms and perceived behavioral control. Among perceived quality factors, assurance ranks highest, while environmental awareness has a greater impact than concern. Overall, customer loyalty is neutral. Results from Independent Samples t-tests indicate that there is no statistically significant mean difference in customer loyalty between male and female respondents. However, a significant difference in loyalty is observed across residential areas. Furthermore, One-way ANOVA analyses reveal no significant mean differences in customer loyalty across groups defined by marital status, occupation, and favorite brand. In contrast, significant mean differences in loyalty are found among groups based on age, monthly income, educational level, and driving experience. Moreover, Multiple Linear Regression (MLR) analysis demonstrates that all components of consumer behavior—attitude, subjective norms, and perceived behavioral control—positively influence customer loyalty. Similarly, all aspects of

perceived quality, including tangibles, reliability, responsiveness, assurance, and empathy, exert significant positive effects on loyalty. Lastly, environmental consciousness—measured by environmental concern and environmental awareness—also has a significant positive impact on customer loyalty.

Discussion

Demographic Factors

Age, income, education, residential area, and driving experience significantly affect customer loyalty. These findings align with those of Zhao et al. (2022), who identify urban, educated adults aged 31–40 as the primary EV buyers in Shanghai. Buhmann and Criado (2023) also emphasize the influence of age, gender, education, and experience on EV adoption. Senyapari and Akil (2023) further highlight income, urbanization, and access to renewable energy as key drivers of EV sales, reinforcing the role of socio-demographic factors in market growth.

Consumer Behavior

Attitude, subjective norms, and perceived behavioral control positively impact loyalty, consistent with Zhao et al. (2022), who note the roles of peer influence and government incentives. Buhmann and Criado (2023) find that status-conscious consumers favor EVs despite higher costs, while Tian et al. (2021) show that perceptions of advanced technology also drive purchase intentions.

Perceived Quality

All quality dimensions—tangibles, reliability, responsiveness, assurance, and empathy—positively affect loyalty. This supports Ouyang et al. (2020), who stress the importance of brand trust and after-sales support. Tian et al. (2021) and Cong et al. (2023) highlight the role of technological innovation in enhancing quality perceptions, with strong brands like Tesla and BYD benefiting from consumer confidence (Chawla et al., 2023).

Environmental Consciousness

Environmental concern and awareness significantly boost customer loyalty. This aligns with studies by Almansour (2022) and Paul and Rana (2012) on green product adoption. Haghighi et al. (2013) and Dong et al. (2020) also find that policy support and environmental values jointly encourage EV purchases.

The findings suggest several practical implications for enhancing customer loyalty. First, demographic factors such as age, income, education, and driving experience should guide targeted marketing strategies, with a focus on educated, higher-income individuals aged 30–40 and tailored programs for new drivers, while also adapting approaches to high-adoption regions. Second, consumer behavior plays a significant role, as attitudes, social norms, and perceived control strongly influence loyalty; thus, firms should leverage social influence through referrals and online communities, empower consumers via test drives and transparent financing, and clearly communicate policy incentives. Third, perceived quality—particularly

empathy and reliability—must be strengthened through improved service, effective marketing tactics, and continuous innovation in technology and battery performance. Finally, environmental consciousness emerges as the most influential factor, indicating the need for strong green messaging, engagement with eco-conscious younger consumers, alignment with government policies, and the promotion of sustainability initiatives such as CSR and battery recycling to build long-term trust and loyalty.

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KEY FACTORS AFFECTING CUSTOMER LOYALTY IN FIVE-STAR HOTELS IN CHINA INNER MONGOLIA

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Abstract: *In an increasingly competitive marketplace, identifying the key determinants of brand loyalty is vital for ensuring long-term business success. This study examines the influence of four pivotal factors—demographic characteristics, the marketing mix (7Ps), perceived quality, and consumer attitudes—on customer loyalty in Inner Mongolia. Demographic variables such as age, income, and education significantly shape consumer behavior; for instance, younger consumers often prioritize innovation, whereas higher-income individuals are more inclined toward premium products (Xie et al., 2022). The marketing mix—comprising product, price, place, promotion, people, process, and physical evidence—directly shapes consumer perceptions and brand engagement (Dündar & Öztürk, 2020). Perceived quality, especially when it exceeds customer expectations, enhances trust and reinforces brand loyalty (Yüksel & Yüksel, 2008; Zeithaml et al., 1988). Moreover, consumer attitudes—particularly cognitive appraisals and emotional attachment—strongly influence loyalty by shaping satisfaction, perceived value, and behavioral intentions (Zhang & Chen, 2022; Liu et al., 2022). This study employs a quantitative approach. Results from Independent Samples t-tests reveal statistically significant mean differences in customer loyalty between gender and residential area groups, indicating that female and urban consumers report higher loyalty scores. One-way ANOVA results show no significant differences in loyalty across age groups, favorite hotel preferences, or previous hotel experience. However, significant mean differences in loyalty are observed among groups categorized by marital status, monthly income, education level, and occupation. Furthermore, a Multiple Linear Regression (MLR) analysis confirms that all components of the marketing mix (7Ps) and the perceived quality dimensions (Tangibles, Reliability, Responsiveness, Assurance, and Empathy) exert positive, statistically significant effects on customer loyalty. In addition, both the cognitive and emotional dimensions of consumer attitudes are found to significantly enhance loyalty. These findings provide actionable insights for marketers seeking to strengthen customer engagement and tailor loyalty strategies to specific consumer segments in competitive and evolving markets.*

Keywords: *Marketing Mix 7Ps, Perceived Quality, Consumer Attitudes, Customer Loyalty*

Introduction

Understanding the multifaceted relationship between consumer behavior and brand loyalty is essential for sustaining profitability and driving market growth in a competitive business environment. Numerous factors, including demographics, consumer psychology, marketing strategies, and perceived quality, shape customer loyalty. Demographic variables—such as age, income, education, and location—significantly influence consumer preferences and purchasing behavior (Rugeiyamu, 2025). Younger consumers often prioritize innovation and digital engagement, whereas older individuals tend to value familiarity and functionality. Income

levels also shape expectations, with higher-income groups more inclined toward premium brands (Xie et al., 2022). In regions such as Inner Mongolia, urbanization and a growing middle class emphasize the need for region-specific branding strategies. Psychological factors—including perceptions, motivations, and attitudes—along with social and situational influences, further guide brand choice and loyalty. Consumer attitudes, which integrate beliefs, emotions, and intentions, play a pivotal role in shaping purchase decisions (Suomala, 2020).

The marketing mix (7Ps) remains a key framework for shaping consumer perception. Product quality, fair pricing, accessibility, effective promotion, service interactions, efficient processes, and tangible cues like packaging all contribute to loyalty (Dündar & Öztürk, 2020). Perceived quality is especially critical. As the Expectancy-Disconfirmation Theory suggests, loyalty increases when performance exceeds expectations (Yüksel & Yüksel, 2008). Strong brand equity—built through awareness, trust, and associations—further reinforces repurchase behavior and advocacy (Chaudhuri & Holbrook, 2001).

This study explores how demographic factors, consumer attitudes, the 7Ps of the marketing mix, and perceived quality jointly influence customer loyalty in Inner Mongolia. Insights from this research can guide businesses in building stronger customer relationships, enhancing brand equity, and sustaining a competitive edge in an evolving marketplace (Khan et al., 2023; Lal et al., 2020).

Literature Review

Theory of Self-regulated Learning

Demographic factors significantly shape customer loyalty by influencing how consumers connect with brands and make purchasing decisions. Age is a key variable, with younger generations (Millennials and Gen Z) favoring brands that reflect their values, especially those emphasizing authenticity, sustainability, and digital engagement (Pina & Dias, 2021; Fromm & Read, 2018). In contrast, older consumers (Gen X and Baby Boomers) value trust, consistency, and service quality, forming loyalty through long-term brand relationships (Mariam et al., 2023; Reichheld & Scheffer, 2000).

Gender differences also emerge, as women often show greater emotional attachment and social influence in brand loyalty, while men tend to focus on functionality (Eagly & Wood, 2012). Income further affects loyalty, with higher earners more inclined toward premium brands due to perceived prestige (Mittal & Kamakura, 2001). Understanding these demographic patterns allows firms to craft targeted strategies that foster retention, strengthen brand relationships, and ensure long-term profitability (Oliver, 2010).

Marketing Mix 7Ps

Each element of the 7Ps significantly shapes customer perceptions and loyalty. Product quality, variety, and innovation drive satisfaction and trust (Ayub & Mantilake, 2024). Pricing signals value—premium prices attract status-driven buyers, while discounts appeal to the price-sensitive (Kotler & Keller, 2016). Effective distribution ensures accessibility, enhancing satisfaction (Andrejić et al., 2023). Promotion builds emotional engagement and brand

advocacy through targeted communication (Bisschoff & Flint, 2022). People, including skilled and empathetic staff, foster trust and loyalty (Aburayya et al., 2020). Efficient processes reduce friction, boosting satisfaction (Noble & Allan, 2023). Physical evidence, such as packaging, reinforces professionalism and brand credibility (Spring et al., 2022). Managing these components well drives repeat purchases, customer retention, and long-term competitive advantage.

Perceived Quality

Perceived quality plays a vital role in building customer loyalty by driving satisfaction and repeat purchases (Dodds et al., 1991; Oliver, 2010). When products are perceived as superior, they boost satisfaction and encourage positive word of mouth (Kotler et al., 2002). Perceived value—closely tied to quality—increases when benefits are clear, further motivating loyalty (Zeithaml, 1988). Digital and social media marketing also enhance perceived value by strengthening customer engagement and trust (Li et al., 2020).

Consumer Attitudes

Consumer attitudes strongly influence brand loyalty by shaping satisfaction, perceived value, emotional connection, and behavioral intentions. Positive cognitive and emotional attitudes—based on product evaluations and trust—foster deeper commitment (Zhang & Chen, 2022; Liu et al., 2022). Attitudes also mediate cultural, social, and psychological influences, with social proof and cultural norms reinforcing loyalty (Czarnecka et al., 2020). Strategically, brands can strengthen loyalty by delivering high-quality service, emotional branding, and personalized engagement, thereby enhancing satisfaction and trust (Cuesta-Valiño et al., 2022).

Research Methodology

This study investigates the influence of Demographic Factors, Marketing Mix (7Ps), Perceived Quality, and Consumer Attitudes on Customer Loyalty toward five-star hotels in Inner Mongolia, China. The target population comprises residents of Inner Mongolia, with a sample size of 400 determined using Yamane's (1967) formula, despite the total population being unspecified. Data analysis is divided into Descriptive and Inferential Statistics. Descriptive statistics include frequencies, percentages, arithmetic means, and standard deviations. Inferential analysis involves Independent Samples t-tests, One-way ANOVA, and Multiple Linear Regression (MLR) to examine relationships and differences among variables.

Research Findings

Descriptive Statistics

Demographic Factors

Table 1: The Frequency and Percent Frequency Classified by Demographic Factor

Demographic Factor	Classification	Frequency	% Frequency
1. Gender	Female	245	61.25
	Male	155	38.75

2. Marital Status	Single	140	35.00
	Married	150	37.50
	Divorced	110	27.50
3. Age	20 under 30 years old	74	18.50
	30 under 40 years old	86	21.50
	40 under 50 years old	91	22.75
	50 under 60 years old	81	20.25
	60 years old and more	68	17.00
4. Monthly Income	Under 8,000 RMB	79	19.75
	8,000 under 15,000 RMB	86	21.50
	15,000 under 22,000 RMB	84	21.00
	22,000 under 30,000 RMB	83	20.75
	30,000 RMB and more	68	17.00
5. Educational Level	Junior High School	78	19.50
	High School	83	20.75
	Bachelor's Degree	85	21.25
	Master's Degree	82	20.50
	Ph.d	72	18.00
6. Occupation	Civil Servants	77	19.25
	State-owned Enterprises	84	21.00
	Private Enterprises	82	20.50
	Owned Business	81	20.25
	Others	76	19.00
7. Residential Area	China Inner Mongolia	275	68.75
	Others	125	31.25
8. Favorite Hotel	Manzhouli Shangri-La Hotel	67	16.75
	Baotou Shangri-La Hotel	78	19.50
	Inner Mongolia Hotel	69	17.25
	Hohhot Shangri-La Hotel	66	16.50
	Huolin Gol Yuanyuan International Hotel	63	15.75
	Others	57	14.25
9. Guest Experience	2 times	80	20.00
	3 times	84	21.00
	4 times	79	19.75
	5 times	85	21.25
	More than 5 times	72	18.00
Total		400	100.00

Table 1 highlights key respondent trends. Females make up 61.25% of participants, and the majority are married (37.50%). The most represented age group is 40–49 years (22.75%), and most earn between 8,000 and 15,000 RMB monthly (21.50%). A Bachelor's degree is the most common education level (21.25%), and most work in state-owned enterprises (21.00%). The majority reside in Inner Mongolia (68.75%). Baotou Shangri-La Hotel is the most preferred (19.50%). Regarding guest experience, most respondents have stayed 5 times (21.25%).

Marketing Mix 7Ps

Table 2: The Descriptive Statistics of Marketing Mix 7Ps

Classification	Mean	Std. Dev.	Meaning	Rank
Product	3.6906	.6414	Agree	2
Price	3.5281	.5424	Agree	6
Place	3.5556	.4948	Agree	4
Promotion	3.5603	.5084	Agree	3
People	3.5519	.5060	Agree	5
Process	3.7344	.5735	Agree	1
Physical Evidence	3.4881	.4270	Neutral	7
Overall	3.5870	.2859	Agree	-

Table 2 indicates general agreement with the hotels' marketing mix strategies, with an overall mean of 3.5870. Process scored highest (3.7344), followed by Product (3.6906), reflecting satisfaction with service efficiency and quality. Promotion (3.5603), Place (3.5556), People (3.5519), and Price (3.5281) showed moderate agreement. Physical Evidence received the lowest score (3.4881), indicating neutral perceptions of the service environment. These results underscore the strengths in service delivery and product quality, while highlighting Physical Evidence as an area for improvement.

Perceived Quality

Table 3: The Descriptive Statistics of Perceived Quality

Classification	Mean	Std. Dev.	Meaning	Rank
Tangibles	3.5281	.5298	Agree	4
Reliability	3.5355	.4706	Agree	2
Responsiveness	3.5163	.5413	Agree	5
Assurance	3.5450	.4897	Agree	1
Empathy	3.5335	.4775	Agree	3
Overall	3.5317	.3151	Agree	

The data in Table 3 show that all five dimensions of perceived quality fall within the "Agree" range, indicating overall positive service evaluations. Assurance ranked highest (3.5450), followed by Reliability (3.5355) and Empathy (3.5335), reflecting trust in staff and dependable, attentive service. Tangibles (3.5281) and Responsiveness (3.5163) scored slightly lower,

suggesting room for improvement in physical environment and promptness. The overall mean of 3.5317 indicates general satisfaction, with responsiveness and tangibles as key areas for improvement.

Consumer Attitudes

Table 4: Descriptive Statistics of Consumer Attitudes

Classification	Mean	Std. Dev.	Meaning	Rank
Emotional Attitude	3.3975	.6102	Neutral	2
Cognitive Attitude	3.5525	.5197	Agree	1
Overall	3.4750	.5163	Neutral	-

Table 4 shows that overall consumer attitude is Neutral (Mean = 3.4750), with higher agreement in cognitive attitude (3.5525) than emotional attitude (3.3975). This suggests that respondents rely more on rational evaluations—such as service quality and value—than on emotional attachment when forming brand loyalty. While cognitive attitude falls within the "Agree" range, emotional attitude remains Neutral, indicating a limited affective connection. Strengthening emotional engagement through personalized experiences and brand storytelling could enhance emotional loyalty.

Customer Loyalty

Table 5: The Descriptive Statistics of Customer Loyalty

Classification	Mean	Std. Dev.	Meaning	Rank
Customer Loyalty	3.43	.5408	Neutral	

Table 5 shows that customer loyalty has a mean score of 3.43 (SD = 0.54), indicating a Neutral level of loyalty among respondents.

The Inferential Statistics

Differences in Demographic Factors Generate Differences in Customer Loyalty

Differences in Gender Generate Differences in Customer Loyalty

Null Hypothesis (H_0): There is no significant difference in customer loyalty between male and female respondents ($\mu_1 = \mu_2$).

Alternative Hypothesis (H_a): There is a significant difference in customer loyalty between male and female respondents ($\mu_1 \neq \mu_2$).

Table 6: The Independent Samples t-test of the Gender Factor

Items	Gender	N	Mean	S.D.	t-value	p-value
Customer Loyalty	Female	245	3.4759	.5316	2.192	.029*
	Male	155	3.3548	.5487		

*The mean difference is significant at the 0.05 level.

The results in Table 6 show that the p-value for customer loyalty by gender is 0.029, which is below the significance threshold of 0.05. Therefore, the null hypothesis (H_0) is rejected, indicating a statistically significant difference in customer loyalty between genders. Specifically, female respondents reported a higher mean customer loyalty score ($M = 3.476$, $SD = 0.532$) than male respondents ($M = 3.355$, $SD = 0.549$). This difference suggests that gender is associated with variations in loyalty levels, with females exhibiting greater customer loyalty on average.

Differences in Residential Area Generate Differences in Customer Loyalty

The hypotheses tested are as follows:

Null Hypothesis (H_0): There is no significant difference in customer loyalty between respondents from Inner Mongolia and others ($\mu_1 = \mu_2$).

Alternative Hypothesis (H_a): There is a significant difference in customer loyalty between respondents from Inner Mongolia and others ($\mu_1 \neq \mu_2$).

Table 7: The Independent Samples t-test of Residential Area

Items	Residential Area	N	Mean	S.D.	t-value	p-value
Customer Loyalty	China Inner Mongolia	275	3.4815	.5183	2.904	.004*
	Others	125	3.3136	.5727		

*The mean difference is significant at the 0.05 level.

The results from Table 7 indicate that the p-value for customer loyalty with respect to residential area is 0.004, which is lower than the significance level of 0.05. Therefore, the null hypothesis (H_0) is rejected, indicating that customer loyalty differs significantly across residential areas. Specifically, respondents from Inner Mongolia reported a higher mean customer loyalty score than those from other areas. This mean difference reflects a measurable variation in loyalty levels between the two groups, indicating that residential location is associated with differing degrees of customer loyalty.

Differences in Marital Status, Age, Monthly Income, Educational Level, Occupation, Favorite Hotel, and Experience Stay in Hotel Generate Differences in Customer Loyalty

The hypotheses tested are as follows:

$H_0: \mu_i = \mu_j$ (no difference in customer loyalty across groups)

$H_a: \mu_i \neq \mu_j$ for at least one pair where $i \neq j$ (there is a difference in customer loyalty between at least one pair of groups)

Table 8: The One-Way ANOVA of Marital Status, Age, Monthly Income, Educational Level, Occupation, Favorite Hotel, and Experience Stay in Hotel

Factor	Items	SS	Df	MS	F-value	Sig
Marital Status	Between Groups	2.202	2	1.101	3.817	.023*

	Within Groups	114.502	397	.288		
	Total	116.704	399			
Age	Between Groups	2.292	4	.573	1.978	.097
	Within Groups	114.412	395	.290		
	Total	116.704	399			
Monthly Income	Between Groups	3.180	4	.795	2.766	.027*
	Within Groups	113.523	395	.287		
	Total	116.704	399			
Educational Level	Between Groups	3.426	4	.857	2.987	.019*
	Within Groups	113.277	395	.287		
	Total	116.704	399			
Occupation	Between Groups	3.748	4	.937	3.276	.012*
	Within Groups	112.956	395	.286		
	Total	116.704	399			
Favorite Hotel	Between Groups	.311	5	.062	.210	.958
	Within Groups	116.393	394	.295		
	Total	116.704	399			
Guest Experience	Between Groups	1.883	4	.471	1.619	.169
	Within Groups	114.821	395	.291		
	Total	116.704	399			

*The mean difference is significant at the 0.05 level.

Table 8 presents the results of one-way ANOVA tests assessing whether customer loyalty varies significantly across demographic and experiential factors. The p-values for Age (.097), Favorite Hotel (.958), and Guest Experience (.169) all exceed the conventional significance threshold of 0.05. As such, the null hypotheses for these variables cannot be rejected, indicating that there are no statistically significant differences in customer loyalty across age groups, preferred hotels, or guest experiences. In contrast, the p-values for Marital Status (.023), Monthly Income (.027), Educational Level (.019), and Occupation (.012) fall below the 0.05 threshold, leading to the rejection of their respective null hypotheses. These findings suggest that customer loyalty differs significantly across groups defined by marital status, income level, educational attainment, and occupation.

The Influences of Marketing Mix 7Ps on Customer Loyalty

To examine the influence of the Marketing Mix 7Ps on Customer Loyalty, this study employs Multiple Linear Regression (MLR) analysis with the following hypotheses:

Null Hypothesis (H_0): $\beta_i = 0$, indicating that the corresponding marketing mix variable has no significant effect on customer loyalty.

Alternative hypothesis (H_a): $\beta_i \neq 0$ (for $i = 1, 2, 3, 4, 5, 6, 7$), indicating that the marketing mix variable significantly influences customer loyalty.

The results of the analysis are presented in Table 9 and are expressed in terms of the predicted customer loyalty ($\hat{Y}$) in Equation (1).

$$\hat{Y} = -.931 + .081X_1 + .088X_2 + .090X_3 + .470X_4 + .187X_5 + .078X_6 + .229X_7$$

(.000) (.024) (.007) (.011) (.000) (.014) (.009) (.002)...(1)

Adjusted $R^2 = 0.636$

Table 9: The Multiple Linear Regression Analysis of Customer Loyalty based on Marketing Mix 7Ps

Model	Coefficient		Standardized Coefficients	t-value	p-value
	Unstandardized Coefficients				
	B	Std.Error			
Constant	-.931	.243		-3.826	.000*
X1 = Product	.081	.036	.096	2.259	.024*
X2 = Price	.088	.032	.088	2.710	.007*
X3 = Place	.090	.035	.082	2.561	.011*
X4 = Promotion	.470	.052	.442	9.006	.000*
X5 = People	.187	.075	.175	2.478	.014*
X6 = Process	.078	.030	.083	2.637	.009*
X7 = Physical Environment	.229	.072	.181	3.181	.002*

a. Dependent variable Y: Customer Loyalty

*The mean difference is significant at the 0.05 level.

Table 9 presents the results of the Multiple Linear Regression (MLR) analysis examining the impact of the 7Ps of the Marketing Mix—Product, Price, Place, Promotion, People, Process, and Physical Environment—on customer loyalty. All seven factors exhibit statistically significant effects, with p-values below the conventional significance level of 0.05. Among these, Promotion emerges as the most influential predictor, with the highest standardized beta coefficient ($\beta = 0.442$), indicating that promotional efforts play a critical role in driving customer loyalty. The Physical Environment ($\beta = 0.181$) and People ($\beta = 0.175$) also show substantial influence, emphasizing the importance of the service environment and staff in cultivating loyalty. Other elements, including Product ($\beta = 0.096$), Price ($\beta = 0.088$), Process ($\beta = 0.083$), and Place ($\beta = 0.082$), contribute more modestly but remain statistically meaningful.

Collectively, these seven marketing mix elements account for approximately 63.6% of the variance in customer loyalty, as reflected in the Adjusted R^2 value of 0.636. These findings underscore the importance of a comprehensive, balanced marketing strategy that integrates all 7 Ps to enhance customer loyalty effectively.

The Influences of Perceived Quality on Customer Loyalty

To examine the influence of perceived quality on customer loyalty, this study employs Multiple Linear Regression (MLR) analysis based on the following hypotheses:

Null hypothesis (H_0): $\beta_i = 0$ ($i = 1, 2$), indicating that perceived quality factors have no significant effect on customer loyalty.

Alternative hypothesis (H_a): $\beta_i \neq 0$ ($i = 1, 2$), indicating that perceived quality factors significantly influence customer loyalty.

The results of the analysis are presented in Table 10 and are expressed in terms of the predicted customer loyalty ($\hat{Y}$) in Equation (2).

$$\hat{Y} = -.593 + .097X_1 + .230X_2 + .142X_3 + .131X_4 + .538X_5$$

$$(.006) (.020) (.031) (.000) (.000) (.000) \dots \dots \dots (2)$$

$$\text{Adjusted } R^2 = 0.591$$

Table 10: The Multiple Linear Regression Analysis of Customer Loyalty based on Perceived Quality

Model	Perceived Quality				
	Coefficient		Standardized Coefficients Beta	t-value	p-value
	Unstandardized Coefficients B	Std.Error			
Constant	-.593	.215		-2.753	.006*
X ₁ = Tangibles	.097	.042	.096	2.330	.020*
X ₂ = Reliability	.230	.106	.200	2.171	.031*
X ₃ = Responsiveness	.142	.033	.142	4.319	.000*
X ₄ = Assurance	.131	.037	.119	3.562	.000*
X ₅ = Empathy	.538	.107	.475	5.009	.000*

a. Dependent variable Y: Customer Loyalty

*The mean difference is significant at the 0.05 level.

The results presented in Table 10 indicate that all five perceived quality dimensions—Tangibles (X_1), Reliability (X_2), Responsiveness (X_3), Assurance (X_4), and Empathy (X_5)—have statistically significant effects on customer loyalty, with p-values ranging from .000 to .031, all below the conventional significance level of 0.05. Among these predictors, Empathy (X_5) emerges as the most influential factor, with the highest standardized beta coefficient ($\beta = 0.475$). This suggests that empathetic service plays a crucial role in shaping customer loyalty. The remaining predictors rank in descending order of influence as follows: Reliability (X_2) with $\beta = 0.200$; Responsiveness (X_3) with $\beta = 0.142$; Assurance (X_4) with $\beta = 0.119$; and Tangibles (X_1) with $\beta = 0.096$.

The model's adjusted R^2 value of 0.591 indicates that approximately 59.1% of the variance in customer loyalty is explained by these five service quality dimensions. This underscores the importance of perceived service quality—particularly empathy—in driving customer loyalty within this context.

The Influences of Consumer Attitudes on Customer Loyalty

To examine the influence of consumer attitudes on customer loyalty, this study employs Multiple Linear Regression (MLR) analysis based on the following hypotheses:

Null hypothesis (H₀): $\beta_i = 0$ ($i = 1, 2$), indicating that consumer attitude factors have no significant effect on customer loyalty.

Alternative hypothesis (H_a): $\beta_i \neq 0$ ($i = 1, 2$), indicating that consumer attitude factors significantly influence customer loyalty.

The results of the analysis are presented in Table 11 and are expressed in terms of the predicted customer loyalty ($\hat{Y}$) in Equation (3).

$$\hat{Y} = .390 + .769X_1 + .120X_2$$

(.000) (.000) (.000) (3)

Adjusted $R^2 = 0.899$

Table 11: The Multiple Linear Regression Analysis of Customer Loyalty based on Consumer Attitudes

Model	Coefficient		Standardized Coefficients Beta	t-value	p-value
	Unstandardized Coefficients B	Std.Error			
Constant	.390	.060		6.448	.000*
X ₁ = Emotional Attitude	.769	.019	.868	40.657	.000*
X ₂ = Cognitive Attitude	.120	.022	.115	5.403	.000*

Dependent variable Y: Customer Loyalty

*The mean difference is significant at the 0.05 level.

As shown in Table 11, both consumer attitude indicators—Emotional Attitude (X₁) and Cognitive Attitude (X₂)—have p-values of .000, which are well below the significance threshold of 0.05. This indicates that both factors statistically significantly influence Customer Loyalty. Among these, Emotional Attitude (X₁) is the most influential predictor, with a standardized beta coefficient of approximately 0.868, suggesting a very strong positive effect on Customer Loyalty. In contrast, Cognitive Attitude (X₂), while also significant, has a much smaller standardized beta coefficient of around 0.115, indicating a less substantial but still meaningful impact.

The model's adjusted R^2 is approximately 0.899, indicating that 89.9% of the variance in Customer Loyalty is explained by changes in Emotional and Cognitive Attitudes combined. This highlights that consumer attitudes, particularly emotional responses, are critical drivers of customer loyalty in this context.

Conclusion

This study explored the influence of demographic factors, the Marketing Mix (7Ps), perceived service quality, and consumer attitudes on customer loyalty in the hotel industry, with a focus on respondents in Inner Mongolia, China. The majority of participants were female, married, aged 40–49, held a bachelor's degree, worked in state-owned enterprises, and earned a monthly income of 8,000–15,000 RMB. The Baotou Shangri-La Hotel was the most preferred hotel among respondents.

The Independent Samples t-test indicates statistically significant differences in customer loyalty by gender and residential area. However, according to the One-way ANOVA, variables such as age, favorite hotel, and experience with hotels do not play a major role in differentiating customer loyalty. In contrast, marital status, monthly income, educational level, and occupation do show significant differences in customer loyalty levels. The results of the Multiple Linear Regression (MLR) analysis indicate that all components of the Marketing Mix—Product, Price, Place, Promotion, People, Process, and Physical Environment—exert positive and statistically significant effects on customer loyalty. Similarly, all dimensions of Perceived Quality, including Tangibles, Reliability, Responsiveness, Assurance, and Empathy, are found to influence customer loyalty positively. Furthermore, both the Cognitive and Emotional aspects of Consumer Attitude also demonstrate significant positive impacts on customer loyalty.

Discussion

Demographic Factors

The study reveals that gender, marital status, income, education, occupation, and residential area significantly influence customer loyalty, while age, favorite hotel, and hotel stay experience do not. These findings align with previous research indicating that factors such as income (Kandampully et al., 2015; Eid, 2015), education (Lee et al., 2017; Han et al., 2015), and gender (Sosianika et al., 2021) shape loyalty through varied preferences and behaviors. While some literature (e.g., Pina & Dias, 2021) supports age as a loyalty determinant, the present study suggests that age differences may not always translate into significant behavioral outcomes in the hotel sector.

Marketing Mix (7Ps)

All components of the Marketing Mix significantly impact customer loyalty, with Process being the most influential. This supports prior research (e.g., Cuesta-Valiño et al., 2022; Chahal & Bala, 2010) emphasizing customer value and brand equity as key loyalty drivers. Studies such as Niñerola et al. (2016) and Chang (2020) highlight that both tangible features (e.g., price, performance) and brand-related perceptions mediate consumer loyalty, reinforcing the importance of an integrated marketing strategy.

Perceived Quality

All five dimensions of perceived quality—Tangibles, Reliability, Responsiveness, Assurance, and Empathy—positively affect loyalty. These results echo those of Ashraf et al. (2018), who find that service quality impacts brand loyalty through customer satisfaction. Related findings (e.g., Keshavarz & Jamshidi, 2018; Wilkins et al., 2009) support the idea that satisfaction and perceived value are key mediators. Studies also show that brand perceptions and narrative-driven experiences (Ryu et al., 2019; Foroudi et al., 2018) influence loyalty, especially in online and hospitality contexts.

Consumer Attitudes

Both emotional and cognitive attitudes significantly enhance customer loyalty. This is consistent with Herbas Torrico and Frank (2019), who note that personalized offerings foster loyalty. Moreover, consumer engagement in brand communities (Coelho et al., 2018) and macro-level brand perceptions (Lee et al., 2017) play crucial roles in strengthening attitudinal connections and loyalty.

Implication For Practices

Demographic Factors

Effective loyalty strategies in the hotel industry must focus on meaningful demographic variables such as gender, marital status, income, education, occupation, and residential area. Female guests, urban residents, married individuals, and mid-income earners show higher loyalty, warranting tailored campaigns, such as wellness packages and digital services. Hotels should shift from traditional segmentation (e.g., age or preferred hotel) toward data-driven targeting. Generational preferences must also be addressed—Gen Z and Millennials value authenticity and social responsibility, while older generations prioritize service consistency and brand trust.

Marketing Mix (7Ps)

All 7Ps significantly affect customer loyalty. Key strategies include:

- Process: Prioritize seamless operations (e.g., check-in/out systems).
 - Promotion: Use personalized, digital, and experiential marketing.
 - Product: Invest in innovation (e.g., eco-friendly rooms).
 - Physical Environment & People: Maintain cleanliness and train staff for service excellence.
 - Price & Place: Ensure transparent pricing and leverage location-based marketing.
 - High-impact factors—Promotion, Physical Environment, and People—should be prioritized.
- A continuous-improvement mindset is vital to staying competitive.

Perceived Quality

Perceived service quality, especially Empathy, Reliability, and Assurance, strongly predicts customer loyalty. Hotels must:

- Train staff in emotional intelligence and proactive service.
- Use pricing and branding tactics (e.g., scarcity, testimonials).
- Leverage CSR and influencer marketing for added trust.
- Strengthen internal systems, such as staff development and feedback loops.
- Future strategies should delve deeper into brand capability and integrity as core components of quality perception.

Consumer Attitudes

Consumer attitudes—especially emotional—have the strongest influence on loyalty (Adjusted $R^2 = 0.899$). Key actions include:

- Creating emotionally engaging experiences.
- Reinforcing cognitive trust through consistent service and rational messaging.
- Bridging emotional and cognitive elements in messaging (e.g., eco-initiatives that appeal both logically and emotionally).
- Monitoring customer sentiment and aligning employee behavior with brand personality.

Emotional connections must be strategically cultivated to drive loyalty and advocacy.

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THE FACTORS INFLUENCE THE TENDENCY TO TURNOVER INTENTION: A CASE OF FUZHOU LIMING VOCATIONAL AND TECHNICAL COLLEGE

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Abstract: *This study integrates Herzberg's Two-Factor Theory and Social Exchange Theory as theoretical foundations. It seeks to uncover how motivators (such as a sense of achievement and recognition), hygiene factors (such as salary and working conditions), and employees' perceptions of rewards and effort within the organization collectively affect graduates' turnover intentions in the early stages of their careers. The research design employs a questionnaire survey method for empirical analysis. A total of 400 questionnaires were distributed, and 362 valid questionnaires were returned, yielding an effective response rate of 90.75%. Through regression analysis and hypothesis testing, it was found that demographic variables such as gender, major, graduation year, industry of employment, nature of the enterprise, income level, and work experience do not exhibit significant statistical correlations with graduates' turnover intention. This indicates that individual background factors are not the key determinants of their turnover intentions. Both social exchange factors and variables from the Two-Factor Theory demonstrate significant impacts. Employees' perceptions of organizational rewards and work-related efforts significantly predict their turnover intention. The variable of "employee effort" has the most pronounced effect. Meanwhile, both motivators and hygiene factors have significant effects on turnover intention. Hygiene factors (such as salary and job stability) have a significant impact on graduates.*

Keywords: *Turnover Intention, Reward Factors, Contribution Factors, Motivator Factors, Hygiene Factors*

Introduction

In today's rapidly changing, competitive job market, turnover intention among graduates is a growing concern. From 2021 to 2023, graduate turnover rates increased from 10.56% to 14.14%, with similar trends observed at Fuzhou Liming Vocational and Technical College. While existing studies emphasize external factors such as salary, working conditions, and career advancement, they often overlook the unique challenges early-career graduates face during their career exploration stage, including adaptation, growth needs, and internal psychological factors. Moreover, much of the prior research has been conducted in Western contexts, with limited consideration of China's distinct cultural influences, such as *guanxi* and *mianzi*.

To address these gaps, this study focuses on the turnover intentions of graduates from Fuzhou Liming Vocational and Technical College, exploring both external and internal factors that shape their early-career experiences. Guided by Herzberg's Two-Factor Theory and Social

Exchange Theory, the research highlights how motivation, organizational support, and cultural dynamics collectively influence turnover decisions. The goal is to provide valuable insights to help organizations and educational institutions better support early-career professionals, reduce turnover, and enhance long-term organizational stability.

To guide this inquiry, three core research questions were formulated:

RQ1: How do demographic variables (gender, major, graduate year, working industry, nature of the company, monthly income, working experience) influence the turnover intention of graduates in the career exploration stage?

RQ2: How does social exchange theory (employee rewards and employee contributions) influence the turnover intention of graduates in the career exploration stage?

RQ3: How do the two-factor theory factors (motivators and hygiene factors) influence the turnover intention of graduates in the career exploration stage?

The objectives of this research are threefold.

RO1: To study the influences of demographic factors (such as gender, major, graduate year, working industry, nature of the company, monthly income and working experience) on turnover intention.

RO2: To study the influence of Social Exchange Theory (employee rewards, employee contributions) on turnover intention.

RO3: To study the influence of the Two-Factor Theory (motivator factors, hygiene factors) on turnover intention.

Literature Review

Social Exchange Theory (SET)

Social Exchange Theory, introduced by Homans (1958) and expanded by Blau (1964), explains workplace relationships as exchanges of contributions (time, effort, skills) and rewards (compensation, recognition, growth opportunities). For early-career graduates, SET provides insight into turnover intention by showing how unmet expectations—such as limited support, recognition, or career development—can lead to dissatisfaction and a higher likelihood of leaving. Conversely, when organizations fulfill both tangible and psychological contracts by offering fair and meaningful rewards, graduates feel valued and supported, thereby reducing their turnover intentions.

Two-Factor Theory

Herzberg's Two-Factor Theory (1959) distinguishes between motivators (intrinsic factors such as achievement, recognition, and personal growth) and hygiene factors (extrinsic factors such as pay, working conditions, and job security). For early-career graduates, motivators play a particularly critical role in fostering job satisfaction and reducing turnover intention, as they are often driven by career advancement and self-development. However, insufficient hygiene factors may still lead to dissatisfaction. This framework helps identify how both intrinsic and extrinsic elements shape graduates' job satisfaction and retention in the early stages of their careers (Rugeiyamu, 2025).

Mobley's Turnover Process Model

Mobley's Turnover Process Model (1977) examines both mental and physical processes to outline the main steps workers go through when considering quitting their jobs. This model is very helpful for understanding why recent grads want to leave their jobs, especially how unhappiness can drive them to do so. The model starts with being unhappy with a job, which can happen when expectations are not met, there are not enough rewards, or there are not enough chances to grow. People start to think about quitting when they are unhappy (Mobley, 1977), and workers begin to consider whether to stay or leave. Graduates just starting their careers may be more likely to be unhappy because they have high hopes for growth (Dlouhy & Froidevaux, 2024).

The next step is the evaluation of alternatives stage. This is when employees consider job options outside their current company or opportunities within it. This stage is important for new graduates just starting in their careers, as they seek jobs that better align with their goals (Mobley, 1977). People are more likely to leave if they think these other options are better, especially if they pay more or help them move up in their careers (Wan & Duffy, 2022). After this, workers might start looking for new jobs and actively seek new opportunities. At this time, young professionals who are unhappy and have other options are likely to want to quit their jobs (Hom et al., 2012). They look for a new job harder if they are unhappy with their current one and think other jobs might be better. Finally, workers reach a point where they want to quit, and that is when they decide to leave the company (Mobley, 1977). This step is a formal choice for recent graduates who are unhappy and see better chances (Cropanzano & Mitchell, 2005). By combining cognitive evaluation with other methods, this model gives a clear structure for studying turnover intention (Nguyahambi & Rugeiyamu, 2025).

Employee Rewards

Social Exchange Theory (SET) says that employees and companies can get along well if they receive fair and sufficient rewards, such as a good salary, praise, and opportunities to advance within the company. According to Wan and Duffy (2022), how happy people are with their jobs and how likely they are to quit depend heavily on whether they think they are getting a fair salary and the benefits they need, such as health insurance. It is also important to give employees opportunities to advance in their careers and to praise their work to increase their involvement and commitment (Cropanzano & Mitchell, 2020). These results come from survey questions about fair pay, fair job growth opportunities, and being recognized for your work.

Employee Contributions

SET really appreciates the time, effort, and skills of its employees. Huang et al. (2020) say that workers are more likely to feel like they belong and care about the company when they know that their skills and work are important. This makes it less likely that people will leave their jobs. According to Jiang et al. (2021), companies need to actively show their employees that they appreciate the time and effort they put into hard projects and new ideas. This is important for the company's success and keeping workers. These results align with the survey questions

that asked how employees' skills and hard work affect the organization's ability to reach its goals.

Motivators

Herzberg's Two-Factor Theory posits that intrinsic motivators such as achievement, recognition, the nature of the work itself, responsibility, advancement, and growth are key to driving job satisfaction. Duffy et al. (2019) argue that giving employees opportunities to achieve their career goals and be recognized for their work makes them happier and less likely to leave. Li and Zhang (2022) also say that giving employees opportunities to grow their careers in line with their personal goals. Achievement boosts motivation and lowers the chance of them leaving the company. To better understand these themes, we ask employees how they feel about success, responsibility, and opportunities to advance in their careers.

Hygiene Factors

Hygiene factors such as company policies, supervision, relationships, work conditions, remuneration, and job security play a crucial role in preventing job dissatisfaction. According to Zhang et al. (2021), workers are more likely to leave their jobs if they are unhappy with their pay and receive insufficient support. Singh and Loncar (2020) said that for a workplace to be stable and happy. There must be clear rules and good relationships between bosses and workers. These results align with concerns about the quality of supervision, working conditions, and the company's rules. This ensures that all these cleanliness factors are considered.

Background of Liming Vocational and Technical College

Fuzhou Liming Polytechnic College is a full-time regular institution of higher learning located in Fuzhou, Fujian Province, China. It has a three-year academic program and began recruiting students from both within and outside the province in 2004. The college now has two campuses, one of which is an ecological garden campus. The college currently has six secondary colleges. A total of 8 major categories, namely tourism, medical and health care, and equipment manufacturing, are offered, covering 26 specialties. By establishing themselves through skills and strengthening practical teaching, teachers and students have repeatedly won gold medals in national and provincial vocational skills competitions, with nearly 500 awards. The college actively promotes school-enterprise cooperation and deepens the integration of industry and education. It has cultivated and been approved for 4 provincial-level industrial college pilot projects, won 2 provincial-level educational and teaching achievement awards, jointly developed 42 practical training courses with enterprises, and jointly built 105 off-campus practical training bases. Six teachers' teaching and research achievements have won national awards, among which two teachers' research papers have won the first prize at the national level. There is 1 national-level scientific research project, 80 provincial-level scientific research projects and 13 provincial-level educational reform projects. There are 5 provincial-level offline excellent courses and 5 online excellent courses. The college's achievements in teaching and nurturing students have been reported by authoritative media over 80 times, and it has received numerous honors at both the national and provincial levels in Fujian.

Research Methodology

This study adopts a quantitative research design, with a questionnaire survey as the primary method of data collection. The population for this study consists of graduates from Fuzhou Liming Vocational and Technical College, specifically those who completed their studies in 2021, 2022 and 2023 and are currently working. According to official statistics from the institution (Fuzhou Liming Vocational and Technical College, 2023), there are 3,640 graduates in total. This group is highly relevant to the research because they are in the early-career stage, typically defined as the first few years of professional employment, during which turnover intention is often high due to career exploration and workforce adjustment. Simple Random sampling will be employed to select individual participants within each stratum. This ensures that every graduate from each year (2021, 2022, and 2023) has an equal chance of being selected, thus reducing bias and increasing the representativeness of the sample.

This study will use a survey to find out why recent grads want to leave their jobs. The questionnaire will ask about several important factors, such as demographic information, gender, major, graduation year, industry of employment, company type, monthly income and work experience. Social Exchange Theory factors (organizational rewards, emotional rewards, and work contribution), and Two-Factor Theory factors (motivational factors and hygiene factors).

This study will send the survey via well-known platforms such as "Wenjuanxing," "Jinshuju," and "Google Forms." These platforms will be easy for people to access, and they can fill out the survey online. This study can send the survey link in several ways, such as via email, social media, and through your school's alumni groups and career centers. The study aims to reach many graduates from diverse fields and areas by spreading the word through these channels.

Research Findings

The Demographic Factors of Students in Fuzhou Liming Vocational and Technical College

Table 1: Descriptive Characteristics

Items	Options	Frequency	Percent%
Gender	Male	191	52.9
	Female	171	47.1
Major	Science	96	26.4
	Engineering	77	21.5
	Business	74	20.4
	Arts	97	26.7
	Other	18	5.0
	2021	113	31.1
Graduated Year	2022	99	27.3
	2023	150	41.6
Working Industry	Manufacturing	80	22.0
	Technology	81	22.3

	Finance	73	20.1
	Education	35	9.6
	Healthcare	86	24.0
	Other	7	1.9
Working Company	State-owned enterprise	108	29.8
	Private enterprise	121	33.3
	Foreign-funded enterprise	33	9.1
	Entrepreneurial enterprise	91	25.1
	Other	9	2.8
Monthly Income	Less than 3,000	84	23.1
	3,000-5,000	73	20.1
	5,001-8,000	78	21.5
	8,001-10,000	78	21.8
	More than 10,000	49	13.5
Working Experience	Less than 3months	80	22.0
	3 months-6 months	68	18.7
	6 months-1 year	75	20.9
	1 year-2 years	67	18.5
	2 years-3 years	72	19.8
	Total	362	100.0

The distribution of work experience shows that the sample group is generally at the early stages of their professional development, with over 60% of graduates having less than 1 year of work experience. This confirms that the sample is concentrated among young individuals who have just entered the workforce, making it significant for studying their employment quality, adaptation process, and future development paths. The empirical analysis provides a clear contextual foundation, revealing the overall characteristics of graduates from Fuzhou Liming Vocational and Technical College across gender, professional background, employment sector, income level, and work experience.

The mean for Turnover Intention is 2.99, close to neutral. However, considering the standard deviations of its items, there is significant volatility, exceeding 1.3 and far higher than those of other variables. This indicates significant discrepancies in employees' opinions about whether they intend to leave their jobs. This relates to varying work experiences, job pressures, or personal development expectations, and it represents a direction worthy of in-depth analysis. The sample group's overall evaluation of the organizational environment and their work leans towards neutrality, without extreme tendencies of satisfaction or dissatisfaction, while simultaneously revealing substantial individual differences in turnover intentions.

The Different Impacts of Demographic Variables on Turnover Intention of Graduates in The Career Exploration Stage

This study employed independent-samples t-tests and a one-way ANOVA to examine the effects of gender, major, graduation year, working industry, and company type on graduates' turnover intention. The results indicate significant gender differences, with males ($M = 3.018$, $SD = 0.595$) reporting higher turnover intention than females ($M = 2.961$, $SD = 0.713$; $t = 1.819$, $p = 0.01$). Significant differences are also observed across majors ($F = 2.480$, $p = 0.001$). However, post hoc tests reveal that only graduates in Science ($M = 3.058$) differ significantly from those in the "Other" category ($M = 2.911$; $p = 0.010$). In contrast, no substantial differences exist among Science, Engineering, Business, and Arts. By contrast, graduation year exerts no significant effect ($F = 0.087$, $p = 0.917$), with mean turnover intention scores remaining consistent across 2021 ($M = 2.970$), 2022 ($M = 3.000$), and 2023 ($M = 3.001$) cohorts. Industry differences are statistically significant ($F = 2.778$, $p = 0.041$), with employees in manufacturing ($M = 3.058$) showing higher turnover intention than those in education ($M = 2.851$, $p = 0.043$) and healthcare ($M = 2.943$, $p = 0.047$). Similarly, company type plays a role ($F = 1.987$, $p = 0.046$), with employees in entrepreneurial enterprises ($M = 3.059$) and other enterprises ($M = 3.040$) reporting higher turnover intention compared to those in state-owned ($M = 2.980$), private ($M = 2.954$), and foreign-funded enterprises ($M = 2.964$). Overall, the findings suggest that graduates' turnover intention is significantly shaped by gender, academic major, industry, and company type, while graduation year shows no discernible effect.

Turnover intention among graduates shows clear variation across several background factors. Male graduates report higher turnover intentions than females, and differences exist across majors, with science graduates showing higher levels than those in other fields. Industry also matters: employees in manufacturing display significantly stronger turnover intention than those in education and healthcare. Company type further influences results, with employees in start-ups reporting the highest turnover intention, while those in state-owned, private, and foreign enterprises report lower levels. Income and work experience also play a role—graduates with monthly earnings below 3,000 yuan or with 2–3 years of work experience report the highest turnover intention, while those earning above 10,000 yuan or with 1–2 years of experience show the lowest. In contrast, graduation year does not have a significant effect on turnover intention. Overall, structural factors such as gender, field of study, industry, company type, income, and work experience are stronger predictors of turnover intention than temporal factors, such as graduation year.

Social Exchange Theory Influences the Turnover Intention of Graduates

The multiple regression analysis, grounded in Social Exchange Theory (SET), demonstrates that employee rewards and employee contributions significantly influence turnover intention. The model is statistically significant ($F = 369.552$, $p < 0.001$) and has strong explanatory power ($R^2 = 0.672$, Adjusted $R^2 = 0.671$), indicating that these two factors explain 67.1% of the variance in turnover intention. Results indicate that higher employee rewards ($B = -0.404$, $\beta = -0.460$, $t = -12.852$, $p < 0.001$) and greater employee contributions ($B = -0.423$, $\beta = -0.474$, $t = -13.245$, $p < 0.001$) both significantly reduce turnover intention. The variance inflation factors ($VIF = 1.410$) confirm no multicollinearity concerns. These findings align with SET,

suggesting that when employees perceive equitable rewards and actively contribute, their intention to leave diminishes.

Table 3: Multiple Regression Analysis

Item	Unsatd. B	Std. Beta	t	Sig.	VIF	F
C	5.509		58.180	0.000		
Employee Rewards	-0.404	-0.460	-12.852	0.000	1.410	369.552 ***
Employee Contributions	-0.423	-0.474	-13.245	0.000	1.410	
R Square			0.672			
Adjusted R-Square			0.671			

NOTE: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Two-Factor Theory Factors (Motivators and Hygiene Factors) Influence the Turnover Intention of Graduates

Table 4: Two-Factor Theory Factors Multiple Regression Analysis

Item	Unstd. B	Std. Beta	t	Sig.	VIF	F
C	5.434		51.226	0.000		
Motivators	-0.456	-0.500	-13.102	0.000	1.334	277.902 ***
Hygiene Factors	-0.360	-0.397	-10.412	0.000	1.334	
R Square			0.607			
Adjusted R-Square			0.605			

NOTE: * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

The overall model is statistically significant, with an F-value of 277.902 and a significance level of 0.000, indicating robust explanatory power for turnover intention. The coefficient of determination, R^2 , is 0.607, and the adjusted R^2 is 0.605, suggesting that motivators and hygiene factors together can explain approximately 60.5% of the variance in turnover intention. The unstandardized regression coefficient for motivators is -0.456, with a standardized coefficient of -0.500, a t-value of -13.102, and a significance level of 0.000. This demonstrates that motivators exert a significantly negative impact on turnover intention; that is, the stronger the motivators, the lower the graduates' propensity to leave. Similarly, the unstandardized coefficient for hygiene factors is -0.360, with a standardized coefficient of -0.397, a t-value of -10.412, and a significance level of 0.000, indicating that hygiene factors significantly inhibit turnover intention.

The variance inflation factors (VIFs) for both independent variables are 1.334, well below the threshold for multicollinearity, suggesting no apparent multicollinearity between motivators and hygiene factors. The findings corroborate the core tenets of Herzberg's Two-Factor Theory, emphasizing the need to address graduates' motivational needs and ensure fundamental workplace conditions and environments to effectively mitigate their turnover intention. These insights provide empirical evidence for employment management strategies for university graduates and talent retention policies within enterprises.

Conclusion

Turnover Intention Also Varies Across Different Academic Majors.

According to the research findings, among the demographic factors, gender, academic major, work industry, enterprise nature, monthly income, and work experience all exert significant influences on turnover intention. In contrast, graduation year shows no notable difference. The average turnover intention of male graduates is 3.018, significantly higher than that of female graduates at 2.961 ($t = 1.819$, $p = 0.01$), indicating a disparity in turnover intention based on gender.

Turnover intention also varies across different academic majors. Graduates from science and engineering majors exhibit turnover intentions of 3.058 and 3.010, respectively, which are significantly higher than those from business (2.951), arts (2.955), and other majors (2.911) ($F = 2.480$, $p = 0.001$), suggesting that academic background influences occupational mobility.

In the work industry, the manufacturing sector (3.058) and other industries (3.171) show relatively high turnover intentions, while the education sector has the lowest (2.851) ($F = 2.778$, $p = 0.041$), highlighting the significant role of industry type in employee stability.

Enterprise nature also has a notable impact, with employees in entrepreneurial enterprises demonstrating the highest turnover intention (3.059). In contrast, those in state-owned enterprises (2.980) and private enterprises (2.954) show lower levels ($F = 1.987$, $p = 0.046$).

Monthly income shows a negative correlation with turnover intention: individuals earning less than 3,000 yuan per month display the highest turnover intention (3.079), while those earning over 10,000 yuan per month have the lowest (2.833) ($F = 1.989$, $p = 0.041$).

Work experience reveals that the group with 2 to 3 years of experience has the highest turnover intention (3.128), whereas the group with 1 to 2 years of experience has the lowest (2.901) ($F = 2.234$, $p = 0.031$).

Graduation year does not show a significant difference in turnover intention, with graduates from 2021 to 2023 displaying turnover intentions of 2.970, 3.000, and 3.001, respectively ($F = 0.087$, $p = 0.917$), indicating a limited impact of graduation time on turnover intention.

Excluding the graduation year, other demographic variables significantly influence turnover intention, suggesting that an employee's gender, academic major, industry, enterprise type, income level, and work experience are pivotal factors. These findings imply that enterprises

should adopt differentiated retention strategies in talent management that take these characteristics into account.

Herzberg's Two-Factor Theory Exerts Significant Negative Impacts on Turnover Intention

Based on the regression analysis results, both motivators and hygiene factors within Herzberg's Two-Factor Theory exert significant negative impacts on turnover intention. The standardized regression coefficients for motivators and hygiene factors are -0.500 and -0.397, respectively, both achieving high statistical significance ($p < 0.001$). Enhancements in both motivators and hygiene factors can effectively reduce graduates' propensity to leave.

Motivators encompass elements such as employees' sense of achievement, recognition, growth opportunities, and the inherent challenges of the work itself. These factors fulfill employees' intrinsic psychological needs, thereby enhancing job satisfaction and reducing turnover. Hygiene factors, on the other hand, pertain to external conditions, including the work environment, remuneration, company policies, and interpersonal relationships, ensuring that employees' basic needs and job security are met and preventing turnover due to an unfavorable environment.

In influencing turnover intention, these two sets of factors operate both independently and complementarily. Motivators directly elevate employees' intrinsic motivation and enthusiasm for work, whereas hygiene factors provide stable external support and assurance. A deficiency in hygiene factors can lead to employee dissatisfaction, yet hygiene factors alone are insufficient to galvanize employee proactivity. Conversely, the absence of motivators may lead employees to feel a lack of achievement and a sense of belonging, thereby increasing the risk of turnover.

Together, motivators and hygiene factors account for approximately 60.5% of the variance in turnover intention, underscoring the pivotal role they play in employee retention. Enterprises and organizations should concurrently focus on cultivating both motivators and hygiene factors to meet employees' fundamental needs while stimulating their intrinsic potential, effectively reducing turnover rates and fostering organizational stability and development.

The Impact of Motivators and Hygiene Factors in Herzberg's Two-Factor Theory on Graduates' Turnover Intention

To analyze the impact of motivators and hygiene factors in Herzberg's two-factor theory on graduates' turnover intention, this study employed a regression model to test their statistical significance and direction of influence. The results indicate that motivators have a significant positive impact on turnover intention, with an unstandardized regression coefficient of 0.162, a standardized regression coefficient of 0.175, a t-value of 3.03, and a p-value of 0.003. The influence of hygiene factors is even more pronounced, with an unstandardized regression coefficient of 0.250, a standardized regression coefficient of 0.275, a t-value of 4.78, and a p-value less than 0.001. The model's R^2 is 0.158, and the adjusted R^2 is 0.153, suggesting that motivators and hygiene factors can explain approximately 15.3% of the variance in turnover intention, demonstrating low explanatory power.

This implies that during the career exploration phase, graduates are highly sensitive to intrinsic motivators such as job content, a sense of achievement, and growth opportunities. At the same time, they also maintain a strong focus on the external environment, including salary and benefits, working conditions, and interpersonal relationships. When these two types of needs are met, it develops higher expectations. Dissatisfaction with the limitations of their current positions among graduates leads to an increased intention. This phenomenon reflects that new graduates attach great importance to rapid returns, promotion channels, and value realization in their career development, rather than merely being satisfied with their current work situation. Therefore, when formulating incentive and security mechanisms, organizations should avoid the "provision" approach. Instead, they should emphasize the clarity of development paths and the alignment with individual values, thereby effectively reducing the turnover risk of new employees.

Discussion

Part 1: To Answer Research Question No. 1

What are the different impacts of demographic variables (gender, major, graduated year, working industry, nature of the company, monthly income and working experience) that influence the turnover intention of graduates in the career exploration stage?

During the occupational exploration phase, the influence of demographic variables on graduates' turnover intention exhibits pronounced multidimensional disparities. Research findings reveal that six variables—gender, academic major, work industry, enterprise nature, monthly income, and work experience—exert significant impacts on turnover intention. In contrast, graduation year shows no notable difference.

The average turnover intention of male graduates is significantly higher than that of female graduates. This outcome reflects that males are more inclined to actively seek higher developmental prospects or salary returns during the early stages of their careers. Gender differences affect Turnover Intention. Traditional expectations may prompt men to change jobs more often to pursue career goals. Females show lower Turnover Intention. This may come from stronger loyalty or preference for stability.

Academic Major shows important differences. Science and engineering majors have higher Turnover Intention than business, arts, or other majors. Reasons include high pressure, slow promotions, or poor job fit in entry-level positions. Science and engineering graduates also have more transferable skills. This gives them greater job mobility.

Working industry makes a significant difference. Manufacturing and "other" industries show high Turnover Intention. Education shows the lowest Turnover Intention. Industry attractiveness and job satisfaction vary. Education offers stable careers, clear promotions, and social recognition. These strengthen commitment and reduce Turnover Intention. Manufacturing often has high intensity, poor rewards, or limited growth. This makes employees consider changing jobs.

Nature of the company matters. Entrepreneurial enterprises have the highest Turnover Intention. This suggests weaker stability and security. State-owned and private enterprises show lower levels. Differences in structure, compensation, and development opportunities explain this. Entrepreneurial firms have limited resources and unstable positions. This leads to higher turnover.

The monthly income level shows clear patterns. Lower income is linked to higher Turnover Intention. Those earning below 3,000 yuan show the strongest Turnover Intention. Economic returns remain key for job stability. Higher earners prefer stable development in current roles.

Working experience reveals trends. Graduates with 2-3 years' experience show the highest Turnover Intention. Those with 1-2 years show the lowest. This connects to the "bottleneck period" in career exploration. After 2-3 years, graduates better understand their situation. If they see limited growth, they consider leaving. Employees with 1-2 years' experience are still adapting. They have not formed strong job-change intentions.

Graduate year does not significantly affect Turnover Intention. Whether graduates finished in 2021, 2022, or 2023, Turnover Intention depends on personal traits and work environment. Time since graduation does not matter.

Several Demographic Factors influence Turnover Intention. These include gender, Major, industry, company type, monthly income, and work experience. Companies should consider these differences. They need targeted retention strategies. This improves employee stability and reduces talent loss.

Part 2: To Answer Research Question No. 2

How do Social Exchange Theory (Employee Rewards and Employee Contributions) influence the turnover intention of graduates in the career exploration stage?

According to social exchange theory, a reciprocal relationship predicated on the principle of mutual benefit exists between employees and organizations. When employees perceive that their inputs—labor, capabilities, and time—are met with commensurate returns—such as remuneration, benefits, recognition, development opportunities, and fair treatment—they are inclined to sustain and reinforce this exchange relationship, manifesting in heightened organizational loyalty and a stronger intention to remain. Conversely, should employees' sense that the returns are inadequate or inequitable, despite substantial inputs, they will develop psychological expectations of relationship rupture, thereby fostering turnover intentions.

This study reveals that, during the occupational exploration phase, both employee returns and employee inputs significantly influence turnover intention, thereby validating the applicability of social exchange theory within this demographic. The pronounced impact of employees' perceptions of returns underscores that, in the early stages of their careers, graduates are particularly sensitive to whether the organization responds to their contributions. Early-career Graduates see employee rewards as key measures of their workplace value. These include both material and intangible incentives. If they feel underappreciated, Turnover Intention increases.

Regarding employee returns, graduates value several returns. These include salary, fair promotions, training resources, and work support. Many interviewees stated they would stay with modest pay if growth opportunities existed. Companies without feedback systems risk causing frustration. This frustration often leads to turnover. Rewards involve more than quantity. Quality and fit matter equally. In terms of employee inputs, although graduates are willing to exert effort in learning and actively integrating into the organizational culture, a psychological disparity arises if these inputs are not reciprocated with commensurate returns. However, they notice if efforts are not rewarded fairly. This creates a psychological gap. The imbalance signals potential breakdowns in social exchange. It leads to emotional disengagement and a sense of less responsibility. Today's job market offers many choices. This situation increases graduates' confidence to change jobs.

Social Exchange Theory (SET) provides a clear framework. It effectively explains Turnover Intention patterns. To stabilize newly employed young workers, organizations must strategically focus on two dimensions: first, ensuring a rational incentive mechanism to enhance employees' positive perceptions of returns; second, establishing an effective communication and feedback system to ensure that employees' inputs are acknowledged and valued. Only when graduates genuinely perceive that "I am worthy of the organization's investment, and the organization merits my dedication" will this exchange relationship endure, ultimately motivating them to stay and thrive.

Part 3: To Answer Research Question No. 3

How do Two-Factor Theory factors (Motivators and Hygiene Factors) influence the turnover intention of graduates in the career exploration stage?

According to Herzberg's Two-Factor Theory, the factors influencing employees' work attitudes can be categorized into motivators and hygiene factors. Motivators, including a sense of achievement, the significance of the work itself, opportunities for growth, and recognition, can stimulate employees' intrinsic motivation. Hygiene factors, on the other hand, include salary, company policies, interpersonal relationships, work environment, and job security. Although they do not directly evoke enthusiasm, their absence is prone to trigger employee dissatisfaction, which subsequently leads to turnover intentions.

This study finds that both motivators and hygiene factors significantly affect graduates' turnover intentions. This result indicates that, during the initial stages of occupational exploration, graduates pay dual attention to the work environment and personal development. They not only anticipate reasonable material security and external conditions but also aspire to derive a sense of value, growth, and belonging from their work.

In terms of motivators, graduates place particular emphasis on the challenging nature of work and opportunities for growth. Monotonous, repetitive work content, a lack of creativity, or the absence of a platform for career development can easily lead to occupational burnout and turnover intentions. Early-career Graduates need meaningful work. Even with good starting pay, they lose interest without opportunities for achievement or learning, recognition from leaders. Team atmosphere and organizational mission also form key Motivators. Many young

employees want to be noticed. They expect quick acknowledgment of their work. This positive feedback affects their long-term commitment.

Hygiene factors are equally important. New graduates lack a stable career belonging. Their security depends on external conditions. These include salary levels, office environment, team support, and reasonable workloads. When these basics are not met, employees leave first. They may overlook potential growth opportunities. The study finds certain company traits cause problems. High work intensity, poor communication, or chaotic management create dissatisfaction. This situation leads to strong Turnover Intention.

Motivators and Hygiene factors interact in real work. For example, unfair leadership hurts Hygiene factors. Combined with poor growth opportunities (weak Motivators), this increases negative feelings. Together, these gaps push graduates toward leaving. This combined effect shows Two-Factor Theory's strong explanatory power. Two-Factor Theory gives a clear framework. It explains Turnover Intention during early careers. Organizations should work on two fronts. First, improve basic security systems to reduce dissatisfaction. Second, design work motivation to boost meaning and achievement. Only when both basic satisfaction and inner motivation exist will graduates stay. Then they keep exploring and investing in careers.

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STUDY ON THE FACTORS INFLUENCING SMART PRINTING PLATFORMS USERS' CONTINUANCE INTENTION BASED ON TAM

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Abstract: *This study investigates the factors influencing university students' continuance intention to use smart printing platforms, focusing on the roles of Perceived Usefulness and Perceived Ease of Use. A total of 423 questionnaires were distributed to university students, yielding 403 valid responses after excluding 20 invalid responses due to uniform option selections. The sample population was characterized by a homogeneous educational background and an age range of 20 to 23 years. SPSS was employed for data analysis, employing descriptive statistics, correlation analysis, and multiple linear regression. The results revealed no significant differences in continuance intention based on gender or age ($p > 0.05$). The multiple regression model, with an R^2 value of 0.62 and an adjusted R^2 value of 0.58, demonstrated that Perceived Usefulness ($\beta = 0.65$, $p < 0.001$) and Perceived Ease of Use ($\beta = 0.42$, $p < 0.002$) had significant positive effects on continuance intention. In contrast, gender and age did not have a significant impact. This study supports the hypotheses that Perceived Usefulness and Perceived Ease of Use are key determinants of university students' continuance intention to use smart printing platforms, underscoring their importance in enhancing user satisfaction and platform adoption.*

Keywords: *Continuance Intention, Smart Printing Platforms, Perceived Usefulness, Perceived Ease of Use, TAM*

Introduction

In the digital age, the rapid integration of technologies such as the internet, big data, and artificial intelligence has driven the transformation of traditional industries, with smart printing platforms emerging as a key innovation that combines cloud computing and IoT to offer remote, personalized, and efficient printing services. These platforms enhance user convenience and experience, but their sustainable development increasingly depends on customer loyalty, which strengthens user engagement, boosts brand reputation, and supports long-term growth. With evidence showing a strong link between continuance intention and revenue growth, this study adopts the Technology Acceptance Model (TAM) to explore how users' perceptions of ease of use and usefulness influence their willingness to continue using smart printing platforms, aiming to provide a theoretical foundation for effective user retention strategies and fill the current research gap.

This study focuses on three core questions: first, whether users' demographic characteristics (such as gender and age) significantly influence their intention to continue using smart printing platforms; second, to what extent users' perceived ease of use affects their continuance intention; and third, how users' perceived usefulness impacts their decision to keep using the

platforms. The research aims to explore the effects of these factors on users' continuance intention, providing theoretical support for enhancing user experience and improving user retention.

This study not only extends the applicability of the Technology Acceptance Model (TAM) in theory but also provides practical guidance for the optimization and marketing strategies of smart printing platforms, thereby holding significant theoretical and practical value. Theoretically, by applying TAM to smart printing platforms, the study validates its applicability and explanatory power in emerging technology contexts and enriches research on user continuance behavior and loyalty. Practically, the study identifies key factors influencing users' continuance intention, offering insights for platform design and functional optimization to improve user satisfaction and loyalty. It also highlights the critical role of user experience in sustaining usage intention, supporting businesses in developing more effective marketing strategies, enhancing market competitiveness, and promoting the broader adoption and popularization of smart printing technology.

Theoretical Framework and Research Hypotheses

Technology Acceptance Model (TAM) Theory

The Technology Acceptance Model (TAM), proposed by Fred D. Davis in 1986, is a significant theoretical model in the fields of information systems and computer technology. Originating from the Theory of Reasoned Action (TRA), TAM aims to explain and predict users' acceptance of information technology. Its core constructs—Perceived Usefulness and Perceived Ease of Use—have become key factors in understanding user behavior. As research has progressed, TAM has been continually expanded to incorporate external variables such as user characteristics, organizational support, and system features. Its application scope has also expanded beyond traditional information systems to include e-commerce, online healthcare, and social media. Through the TAM model, researchers can gain deeper insights into users' technology acceptance behavior and usage intentions, thereby providing theoretical support for optimizing systems and enhancing the user experience.

Workplace Fun and Employees' Innovation Behavior

The Technology Acceptance Model (TAM), introduced by Davis (1989), explains users' attitudes and behavioral intentions toward new technologies through two key constructs: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). TAM has been extensively applied across various fields—including information systems, e-commerce, mobile technology, and educational technology—to understand and predict technology adoption behavior. In information systems, studies have shown that PU and PEOU significantly influence user acceptance of ERP, CRM, and EHR systems (Venkatesh et al., 2003; Agarwal & Prasad, 1998). In China, Zhang Chi (2023) demonstrated the positive effects of PU, PEOU, and social influence on college students' intention to use generative AI tools, while Tu Ran (2024) found that voice-based eco-driving assistance systems were accepted due to high PU and PEOU. In e-commerce, besides PU and PEOU, factors like trust and security are also critical (Gefen et al., 2003; Kim et al., 2010; Xu Hengrui, 2024). In mobile technology, TAM explains behaviors in mobile reading, learning, and health, with studies validating TAM in

areas such as smart home products (Zeng Fangui, 2024), food blockchain traceability (Yu Kunpeng, 2023), and mobile AI assistants (Wang Ling, 2023). In educational technology, PU, PEOU, and social influence impact learners' intention and satisfaction with platforms (Davis et al., 1992; Wang et al., 2010; Tian Degang, 2023; Xu Jinfen, 2024; Hong Chaohui, 2024). Despite limited direct research on smart printing platforms, analogous applications in related fields provide a theoretical foundation to explore users' continuance intention.

Perceived Ease of Use (PEOU) refers to the degree to which an individual believes that using a system requires minimal effort, which affects attitudes and behavioral intentions (Davis, 1989). PEOU positively correlates with PU and plays a key role in shaping favorable user attitudes. It is supported by theories such as self-efficacy, the cost-benefit paradigm, and the diffusion of innovation, all of which emphasize ease as a driver of adoption. Measurement tools such as the PEOU scale (Davis, 1989) and validated instruments are used to assess it. Perceived Usefulness (PU), defined as the belief that a system enhances job performance, directly affects intention and indirectly impacts usage behavior. PU is influenced by individual traits (e.g., age, education), system characteristics (e.g., compatibility, usability), and external factors (e.g., social influence, organizational support) (Davis, 1989). In contexts such as e-commerce and mobile applications, PU has been shown to drive adoption by offering convenience, efficiency, and practical value. Measurement of PU is typically conducted using TAM scales and analyzed using statistical models, such as structural equation modeling, to evaluate its predictive power for user behavior.

In the context of smart printing platforms, users' continued usage intention is influenced by both their perceptions of the platform and their demographic characteristics. If a platform offers intuitive interfaces, simplified operations, and intelligent features that enhance efficiency and convenience, users are more likely to perceive it as useful and easy to use, thereby increasing their willingness to continue using it. Additionally, demographic factors such as gender, educational background, and occupation may influence variations in technology acceptance and use behavior. For instance, males may show higher technological inclination, users with higher education may better understand and adapt to new platforms, and individuals in occupations with frequent printing needs may exhibit stronger continuance intention. Based on this, the following hypotheses are proposed:

H1: Perceived usefulness positively influences users' intention to continue using smart printing platforms.

H2: Perceived ease of use positively influences users' intention to continue using smart printing platforms.

H3: Users' demographic characteristics (gender, educational background, and occupation) significantly influence their intention to continue using smart printing platforms.

Building on the above research and hypotheses, the conceptual model of this study (Figure 1) comprehensively explores these relationships, offering valuable insights for smart printing platforms seeking sustainable growth.

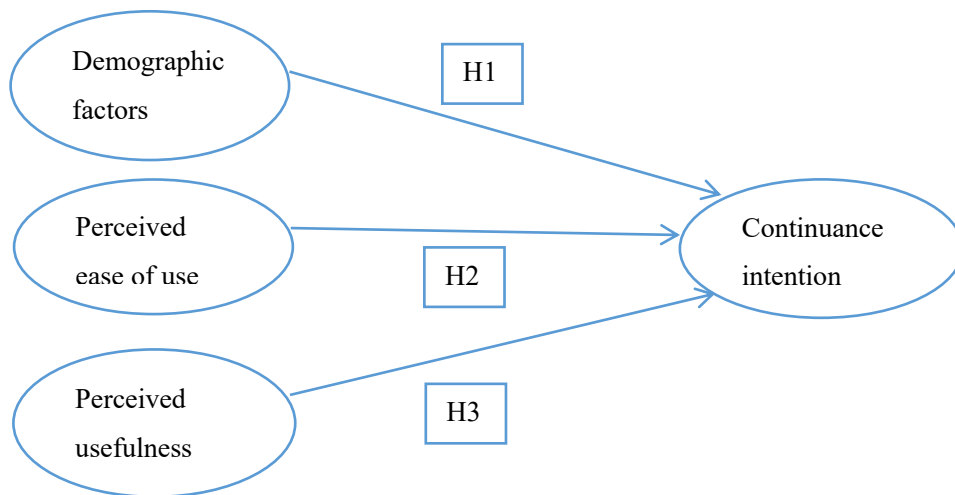


Figure 1: Conceptual Model

Research Methods

This study adopts an empirical approach to examine key factors influencing users' continuous intention to use smart printing platforms. The research proceeds in sequential steps: selecting representative samples to capture diverse user traits; defining variables (perceived usefulness, ease of use, continuous intention) grounded in the Technology Acceptance Model (TAM) to design a questionnaire; collecting primary data via surveys to ensure authenticity; analyzing data using statistical software; and applying variance analysis, t-tests, and regression to explore variable relationships, validate hypotheses, identify critical factors, and inform platform optimization.

The research focuses on Guangzhou college students, a group with high printing demands and frequent use of smart printing platforms, making them ideal for assessing platform effectiveness, satisfaction, and improvement needs in academic contexts. Following Yamane's (1967) formula for large populations, the sample size is set at a minimum of 400, recruited via convenience sampling across over ten university town printing shops.

The questionnaire, refined through a pilot test, uses a 5-point Likert scale. It adapts scales from Davis (1989), Adams et al. (1986), Taylor & Todd (1995), and Bhattacharjee (2001) to fit smart printing scenarios. Data collection prioritizes privacy protection, with participants informed of research purposes and assured anonymity. Valid questionnaires (screened for completeness and consistency) are input into statistical software for analysis.

Content validity was assessed using the Index of Item-Objective Congruence (IOC), with three experts (with over 10 years of business management research experience) rating item relevance on a 3-point scale (1 = relevant, 0 = uncertain, -1 = irrelevant). Items with $\text{IOC} \geq 0.5$ were retained; those with $\text{IOC} < 0.5$ underwent revision. The final questionnaire achieved an average IOC of 0.69 (range: 0.36–0.90) after revising four items, meeting validity standards. For reliability, Cronbach's Alpha (α) was used, given its suitability for Likert scales, with a threshold of $\alpha \geq 0.7$. The coefficients for perceived usefulness (0.84), perceived ease of use

(0.81), and continuance intention (0.87) all exceeded 0.7, confirming strong internal consistency.

Results and discussion

Data Analysis Results

In conducting the present study, which aims to investigate the factors influencing users' continuance intention to use smart printing platforms, a total of 423 questionnaires were initially distributed to university students, who constitute the primary user base of such platforms. After a rigorous data screening process, 20 invalid responses were excluded from the analysis due to uniform option selections across all items, which indicated a lack of genuine engagement with the survey. This exclusion ensured the integrity and reliability of the dataset, ultimately yielding 403 valid responses for analysis. Each participant was compensated with 2 Chinese Yuan (RMB) for their time and effort in completing the questionnaire, a practice that is commonly employed in survey research to enhance response rates and participant cooperation.

The sample population was characterized by a homogeneous educational background, given that all participants were enrolled as undergraduate students at the time of the study. This homogeneity in educational level was anticipated, as the focus was on university students who are typically the primary users of smart printing services on campus. The participants' ages ranged from 20 to 23 years, reflecting the typical age range of undergraduate students in China. This demographic profile is important to consider when interpreting the results, as it may influence the generalizability of the findings to other user groups with different educational backgrounds or age ranges.

The collected data were analyzed using SPSS, a widely recognized statistical software package known for its robust capabilities in data management, statistical analysis, and graphical representation. SPSS was chosen for its user-friendly interface, comprehensive suite of statistical tools, and flexibility in handling diverse data types. The analysis involved a series of statistical procedures, including descriptive statistics to summarize the sample's characteristics, correlation analysis to examine relationships among variables, and multiple regression analysis to test hypothesized relationships among perceived ease of use, perceived usefulness, and users' intention to continue using smart printing platforms.

The following sections of this chapter will present the results of the data analysis in detail, including descriptive statistics of the sample characteristics, t-test, ANOVA and the results of the multiple regression analysis. These findings will provide insights into the factors that influence users' decisions to continue using smart printing platforms and will be discussed in the context of existing literature and theoretical frameworks.

Descriptive Statistics *Sample*

Table 1: Sample Distribution

Demographic Factor	Classification	Frequency	%
Gender	Male	138	34.24
	Female	265	65.76
Age	20	148	36.72
	21	124	30.77
	22	86	21.34
	23	45	11.17
	Total	403	100

The table provides a demographic breakdown of a sample consisting of 403 individuals. The sample is categorized by gender and age as follows. For gender, male is 138 individuals, accounting for 34.24% of the sample; female is 265 individuals, making up 65.76% of the sample. For age, Age 20 is 148 individuals, representing 36.72% of the sample. Age 21, 124 individuals, comprising 30.77% of the sample. Age 22, 86 individuals, accounting for 21.34% of the sample. Age 23, 45 individuals, making up 11.17% of the sample. Overall, the sample is predominantly female, with a higher proportion of individuals aged 20 and 21.

Descriptive of Variables

Table 2: The Descriptive Statistics of Perceived Usefulness (PU)

Item	1	2	3	4	5	Mean	SD
PU1	0	1	10	202	190	4.4417	0.7645
PU2	1	1	22	177	202	4.4342	0.7829
PU3	1	6	47	230	119	4.1414	0.8938
PU4	1	3	6	130	263	4.6154	0.7987
PU5	1	5	26	195	176	4.34	0.8365
PU6	2	1	19	178	203	4.4367	0.7879
PU7	0	3	18	194	188	4.4069	0.8008
PU8	0	3	15	172	213	4.4764	0.7933

Table 3: The Descriptive Statistics of Perceived Ease of Use (PEU)

Item	1	2	3	4	5	Mean	SD
PEU1	0	3	49	225	126	4.1762	0.7499
PEU2	1	0	13	171	218	4.5012	0.7496
PEU3	2	6	35	192	168	4.2854	0.7695
PEU4	2	4	42	227	128	4.1787	0.7859
PEU5	1	15	48	192	147	4.1638	0.8115

PEU6	2	5	40	187	169	4.2804	0.7864
PEU7	4	20	62	210	107	3.9826	0.8545
PEU8	0	2	20	172	209	4.4591	0.7694

Table 4: The Descriptive Statistics of Continuance Intention

Item	1	2	3	4	5	Mean	SD
CI1	0	1	12	164	226	4.5261	0.6996
CI2	0	7	21	211	164	4.3201	0.7897
CI3	3	2	29	212	157	4.2854	0.8002
CI4	1	2	22	187	191	4.402	0.7782
CI5	3	2	11	161	226	4.5012	0.7499
CI6	1	5	10	166	221	4.4913	0.7588

Hypothesis Testing Result

(1) Demographic Factors

H1: Users' demographic characteristics (gender and age) will influence continuance intention to use smart printing platforms.

Independent-samples t-tests and one-way ANOVA will be used to test the impact of demographic factors.

Table 5: The Independent Samples t-test Results of Gender

DV	Gender	N	Mean	S.D. t-value	p-value
Continuance Intention	Male	138	4.408	0.78 -1.45	0.349
	Female	265	4.469	0.72	

Based on the results presented in the table, the inter-group difference was not statistically significant ($p\text{-value} = 0.349$), indicating that there is no significant difference in the continuance intention to use smart printing platforms among university students of different genders.

The following table presents the results of the one-way Analysis of Variance (ANOVA) of Age. According to the table, the inter-group difference was not statistically significant ($p\text{-value} = 0.401$), suggesting that there is no significant difference in the continuance intention to use smart printing platforms among university students of different ages.

Table 6: ANOVA of Age

	SS	df	MS	F	p
Between Groups	12.345	3	4.115	0.987	0.401
Within Groups	1654.678	399	4.147	-	-
Total	1667.023	402	-	-	-

(2) Results of Regression Analysis

H2: Perceived ease of use positively influences the continuance intention to use smart printing platforms.

This study was designed to investigate how users' perceptions of the ease of use of smart printing platforms influence their intention to continue using them. To achieve this objective, a straightforward linear regression model was employed. In this model, the dependent variable was users' continuance intention, representing their willingness to continue using the smart printing platforms, while the independent variable was perceived ease of use, which captures users' subjective assessment of how easily they can operate the platforms. The regression analysis results, as detailed in Table 4.7, offer valuable insights into the relationship between perceived ease of use and users' continuance intention.

Table 7: Regression Analysis of Continuance Intention on Perceived Ease of Use

Variable	Coefficients	Std. Error	t	p
Constant	1.52	0.35	6.38	0.001
Perceived Ease of Use	0.63	0.23	7.83	0.001
$R^2 = 0.44$				
Adjusted $R^2 = 0.39$				
$F = 22.34$ ($p < 0.001$)				

Based on the above variable settings, the regression equation is:

$$\text{Continuance intention} = 1.52 + 0.63 \cdot \text{Perceived Ease of Use} + \epsilon$$

The constant term in the regression equation is 1.52, with a standard error of 0.35. This suggests that, even when perceived ease of use is zero, users still exhibit a baseline level of continuance intention. More significantly, the coefficient for perceived ease of use is 0.63, with a standard error of 0.23. This positive coefficient indicates a strong and positive association between perceived ease of use and users' continuance intention. Specifically, for every one-unit increase in perceived ease of use, users' continuance intention is expected to increase by 0.63 units, holding all other factors constant. The t-value of 7.83 and the p-value of <0.001 for perceived ease of use strongly support the hypothesis that ease of use significantly affects users' intention to continue using the platforms. In terms of model fit, the R^2 of 0.44 indicates that 44% of the variability in users' continuance intention is explained by perceived ease of use. The adjusted R^2 of 0.39, after accounting for the number of predictors and sample size, further confirms the robustness of the model. Additionally, the F-statistic of 22.34, with a p-value of <0.001 , provides strong evidence against the null hypothesis that perceived ease of use does not affect continuance intention. Overall, these findings underscore the importance of enhancing the user-friendliness of smart printing platforms to foster sustained user engagement.

H3: Perceived usefulness positively influences the continuance intention to use smart printing platforms.

It is hypothesized that perceived usefulness positively influences the continuance intention to use smart printing platforms. In other words, when users perceive greater usefulness from the smart printing platform, they are more likely to develop and maintain a stronger intention to continue using it.

To empirically test this hypothesis, a regression analysis was conducted, with the continuance intention to use smart printing platforms as the dependent variable and perceived usefulness as the independent variable. The results of the regression analysis are presented in Table 8.

Table 8 Regression Analysis of Continuance Intention on Perceived Usefulness

Variable	Coefficients	Std. Error	t	p
Constant	2.27	0.42	8.12	0.001
Perceived Usefulness	0.78	0.28	7.23	0.001
R ² = 0.62				
Adjusted R ² = 0.58				
F = 42.41 (p < 0.001)				

Based on the above variable settings, the regression equation is:

Continuance intention = 2.27 + 0.78 · Perceived Usefulness + ϵ

The constant term in the regression equation is 2.27, with a standard error of 0.42. This indicates that even when the perceived usefulness of the smart printing platform is zero, users still have a baseline level of intention to continue using it, though it is relatively moderate.

The coefficient for perceived usefulness is 0.78, with a standard error of 0.28. This positive coefficient strongly suggests a significant, positive relationship between perceived usefulness and users' continuance intention. Specifically, for every one-unit increase in perceived usefulness, users' intention to continue using the smart printing platform is expected to increase by 0.78 units, assuming all other factors remain constant. The t-value of 7.23 and the p-value of <0.001 for perceived usefulness provide compelling statistical evidence supporting the hypothesis that perceived usefulness positively impacts users' continuance intention.

In terms of model fit, the R² of 0.62 indicates that 62% of the variability in users' continuance intention is explained by perceived usefulness. This is a relatively high proportion, suggesting that perceived usefulness is a strong predictor of users' intention to continue. The adjusted R² of 0.58, after accounting for the number of predictors and the sample size, further confirms the model's reliability and robustness. Additionally, the F-statistic of 42.41, with a p-value of <0.001, provides strong evidence against the null hypothesis that perceived usefulness does not affect users' continuance intention.

Overall, these findings provide empirical support for the hypothesis that perceived usefulness plays a crucial role in shaping users' intention to continue using the smart printing platform.

This study aimed to explore the impact of multiple factors on users' intention to continue using smart printing platforms. To this end, a multiple linear regression model was constructed, with users' continuance intention as the dependent variable and Perceived Usefulness and Perceived

Ease of Use as independent variables. SPSS statistical software was used for the multiple linear regression analysis. The dependent and independent variables were entered into the software, and regression analysis was performed to obtain statistical measures, including regression coefficients, standard errors, t-values, and p-values, as shown in the table below.

Table 9: Multiple Regression Analysis Results

Variable	Coefficients	Std. Error	t	p
Constant	2.52	0.45	7.32	0.001
Perceived Usefulness	0.65	0.18	6.53	0.001
Perceived Ease of Use	0.42	0.12	5.22	0.002
$R^2 = 0.62$				
Adjusted $R^2 = 0.58$				
$F = 42.41$ ($p < 0.001$)				

Based on the above variable settings, the regression equation is:

$$\text{Continuance intention} = 2.52 + 0.65 \cdot \text{Perceived Usefulness} + 0.42 \cdot \text{Perceived Ease of Use} + \epsilon$$

The R^2 value was 0.62, indicating that the model could explain 62% of the variance in the dependent variable. The adjusted R^2 value was 0.58, which accounted for the number of independent variables in the model's goodness-of-fit, further validating the model's robustness.

The coefficient for the Perceived Usefulness variable was 0.65, with a standard error of 0.18, a t-value of 6.53, and a p-value of 0.001, indicating that Perceived Usefulness had a significant positive effect on users' continuance intention. The coefficient for the Perceived Ease of Use variable was 0.42, with a standard error of 0.12, a t-value of 5.22, and a p-value of 0.002, indicating that Perceived Ease of Use also had a significant positive effect on users' continuance intention.

Perceived Usefulness had a significant positive effect on users' continuance intention (coefficient = 0.65, $p < 0.001$), supporting Hypothesis H3. This suggests that when users perceive smart printing platforms as useful, they are more likely to continue using them. Perceived Ease of Use also had a significant positive effect on users' continuance intention (coefficient = 0.42, $p < 0.001$), supporting Hypothesis H2. This indicates that when users perceive smart printing platforms as easy to use, they are also more likely to continue using them.

Conclusion

This study aimed to investigate the factors influencing users' continuance intention to use smart printing platforms based on the Technology Acceptance Model (TAM). Drawing on a sample of 403 university teachers and students, the study empirically examined the impact of demographic factors, perceived ease of use, and perceived usefulness on users' intention to continue using smart printing platforms. The results of the multiple regression analysis revealed several key findings.

Firstly, the study found that demographic factors, including gender and age, did not significantly influence users' intention to continue using smart printing platforms. This finding suggests that regardless of users' gender or age, their continuance intention is more strongly driven by other factors such as perceived ease of use and perceived usefulness. Secondly, the study supported the hypothesis that perceived ease of use positively influences users' intention to continue using smart printing platforms. When users perceive the platform to be easy to use, they are more likely to continue using it. This finding aligns with the TAM framework, which posits that ease of use is a critical factor in determining users' acceptance and continued use.

Lastly, the study also confirmed that perceived usefulness positively influences users' intention to continue using smart printing platforms. Users who perceive the platform as useful for improving their work efficiency or solving specific problems are more likely to continue using it. This finding underscores the importance of ensuring that smart printing platforms meet users' needs and expectations to foster continued usage. In summary, the study concluded that perceived ease of use and perceived usefulness are the primary factors influencing users' intention to continue using smart printing platforms. In contrast, demographic factors such as gender and age play a lesser role.

Discussion

This study contributes to the existing literature on user acceptance and continuance intention of technology by providing insights into the factors that influence users' decisions to continue using smart printing platforms. By employing the TAM framework, the study fills a gap in the literature on the application of TAM to smart printing platforms, a relatively nascent area of research.

Firstly, the finding that demographic factors such as gender and age do not significantly influence users' intention to continue using smart printing platforms contrasts with some previous studies that have reported gender and age differences in technology acceptance. For instance, studies in e-commerce have shown that younger users and males tend to be more accepting of new technologies (Gefen et al., 2003). However, the current study suggests that, for smart printing platforms, these demographic factors are less important in shaping users' continuance intention. These finding challenges existing assumptions and highlights the need to consider context-specific factors when analyzing technology acceptance.

The finding that perceived ease of use positively influences users' continuance intention aligns with the core tenets of the TAM model. Prior studies across domains, including information systems, mobile technology, and educational technology, have consistently shown that ease of use is a critical factor in determining users' acceptance and continued use (Davis, 1989; Venkatesh et al., 2003; Liu Xuhui, 2021). The current study extends this finding to the context of smart printing platforms, demonstrating that the platform's interface and functionality are key drivers of user satisfaction and loyalty.

The positive influence of perceived usefulness on users' continuance intention also aligns with the TAM framework and previous research. Studies in fields such as online healthcare, social media, and e-commerce have consistently shown that users are more likely to adopt and

continue using technologies they perceive as useful for enhancing work efficiency or solving specific problems (Agarwal & Prasad, 1998; Zhang Chi, 2023; Xu Hengrui, 2024). The current study extends this finding to smart printing platforms, highlighting the importance of ensuring that platforms offer tangible benefits and value to users to foster sustained usage.

Furthermore, this study contributes to the understanding of users' interaction with smart printing platforms by providing empirical evidence of the complex interplay between perceived ease of use and perceived usefulness. Previous studies have suggested that perceived ease of use and perceived usefulness are interrelated constructs, with ease of use often influencing users' perceptions of usefulness (Davis, 1989; Venkatesh & Davis, 2000). The current study supports this notion, finding that both constructs have independent and significant effects on users' continuance intention. However, the study also suggests that the relationship between these constructs may be more nuanced in the context of smart printing platforms, warranting further investigation.

Additionally, this study extends the application of TAM to a new technological domain—smart printing platforms. While TAM has been widely applied across fields such as information systems, e-commerce, and mobile technology, its use in smart printing platforms remains relatively limited. The current study demonstrates the applicability and explanatory power of TAM in this new context, offering insights into the factors influencing users' acceptance and continued use of smart printing services. This finding has important implications for researchers and practitioners in the field of smart printing technology, as it suggests that TAM can be used as a valuable theoretical framework for analyzing user behavior and designing effective marketing strategies.

Moreover, the current study contributes to the growing body of literature on user acceptance and continuance intention of emerging technologies. As technology continues to evolve rapidly, understanding the factors that influence users' decisions to adopt and continue using these technologies becomes increasingly important. The findings of this study provide valuable insights into the key drivers of user continuance intention in the context of smart printing platforms, informing the development of more effective user retention strategies and enhancing the long-term success of these platforms.

Practical Implications

Based on the findings of this study, several practical implications can be drawn for platform developers and managers of smart printing services.

Firstly, platform developers should focus on enhancing the ease of use of smart printing platforms. This can be achieved by designing intuitive user interfaces, providing clear usage instructions, and offering robust customer support. By making the platform easy to navigate and use, developers can increase users' satisfaction and likelihood of continued usage.

Secondly, platform developers should ensure that their smart printing platforms offer significant value to users. This can be accomplished by integrating features that enhance work

efficiency, reduce costs, or increase convenience. By demonstrating the platform's usefulness, developers can foster trust and loyalty among users.

Lastly, platform managers should consider targeting their marketing efforts to user segments most likely to benefit from smart printing services. By understanding users' needs and preferences, managers can tailor their marketing strategies to effectively communicate the value of smart printing platforms and drive adoption.

In conclusion, this study's findings provide valuable insights for platform developers and managers seeking to enhance users' intention to continue using smart printing platforms. By prioritizing ease of use and usefulness, and targeting the right user segments, platform developers can foster sustained growth and success in the rapidly evolving smart printing market.

Recommendation for Future Research

While this study provides valuable insights into the factors influencing users' continuance intention to use smart printing platforms, several avenues for future research remain to build on the current findings.

Firstly, future studies could expand the sample population to include users from different regions and demographic backgrounds. This would help to assess the generalizability of the current findings and identify any potential cultural or regional differences in users' perceptions and behaviors.

Secondly, future research could explore the influence of other factors not considered in the current study, such as system quality, service quality, and social influence. These factors may also play important roles in shaping users' continuance intention and provide additional insights into the mechanisms underlying technology acceptance.

Thirdly, longitudinal studies could examine how users' perceptions and behaviors change over time. This would provide a deeper understanding of the dynamic nature.

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RESEARCH ON INFLUENCING FACTORS OF MINERAL WATER COMPANIES' PRODUCTS IN CHINA

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Abstract: *This study explores the key factors influencing consumer marketing behavior toward mineral water brands in China, based on the 4Ps marketing mix framework (product, price, place, and promotion). It also examines how demographic characteristics—including gender, age, education, occupation, and income—moderate such behaviors. A structured questionnaire was distributed to 369 consumers from diverse demographic backgrounds to collect data on their perceptions of product attributes, pricing, distribution channels, promotions, and overall marketing responses. Adopting a quantitative research design, this research used descriptive statistics to summarize respondent profiles. t-tests, ANOVA with multiple comparisons, and multiple regression analysis were applied to analyze group differences and the effects of the 4Ps, with multicollinearity controlled for. Results show that product, price, place, and promotion all exert significant positive influences on consumer behavior. Product is a particularly strong determinant; perceived price affordability and value positively affect purchase intention; convenient distribution channels enhance consumer engagement; and effective promotion improves awareness and responsiveness. These findings provide actionable insights for mineral water enterprises to optimize marketing strategies by integrating product development, pricing, distribution, promotion, and targeted consumer segmentation.*

Keywords: *Marketing Behavior, Mineral Water Companies, Marketing Mix 4Ps, Demographic Characteristics*

Introduction

Background

The bottled water industry, particularly the mineral water segment in China, has experienced rapid growth driven by rising living standards, health awareness, and changing consumer preferences—with the Chinese bottled water market reaching 69 billion yuan in 2020 and growing at over 10% annually—though it faces challenges including intense competition, product homogeneity, and low brand loyalty, as international and domestic brands adopt distinct positioning strategies (Lee & Jang, 2022); meanwhile, consumer purchasing decisions have shifted from price-driven to quality and brand-focused, with increased attention to water sources, sustainability, and convenience, leading to the integration of online and offline sales channels, and existing research gaps regarding factors influencing marketing behavior have prompted this study to use the 4Ps Marketing Mix framework and SCP model to analyze key factors shaping mineral water companies' marketing strategies and provide theoretical support for industry trends (Xue et al., 2021).

Research Questions

- 1) How does the marketing mix (4Ps: product, price, place, and promotion) influence the marketing behavior of mineral water companies?
- 2) Are there differences in the impact of marketing behavior of mineral water companies with different demographic characteristics?

Research Hypotheses

- H1: Consumers with distinct demographic factors exhibit varying marketing behavior.
H1a: There are differences in marketing behavior between consumers of different genders.
H1b: There are differences in marketing behavior between consumers of different ages.
H1c: Differences in marketing behavior between consumers with different levels of education.
H1d: Differences in marketing behavior between consumers with different work experience.
H1e: Differences in marketing behavior between consumers with different levels of income.
H2: The Marketing Mix has a positive influence on marketing behavior.
H2a: A well-designed product has a positive influence on the marketing behavior.
H2b: Appropriate prices have a positive impact on the marketing behavior.
H2c: Efficient Place positively affects the marketing behavior.
H2d: Well-executed promotion has a positive influence on the marketing behavior.

Research Objectives

- 1) To investigate the impact of products on the marketing behavior of mineral water companies.
- 2) To explore the influence of price on the marketing behavior of mineral water companies.
- 3) To examine the effect of place on the marketing behavior of mineral water companies.
- 4) To study the impact of promotion on the marketing behavior of mineral water companies.
- 5) To study the differences in the impact of marketing behavior of mineral water companies with different demographic characteristics.

Scope of the Research

This research focuses on the marketing behavior of mineral water enterprises, using the 4Ps marketing theory (product, price, place, promotion) to explore how these elements influence enterprises' market performance and consumers' purchasing decisions, with the research objects being consumers who purchased mineral water in the past six months; it takes Zhengzhou City, Henan Province as the geographical focus due to its diverse consumer base and mature circulation system, adopts a questionnaire survey to collect data on consumers' preferences and responses related to the 4Ps elements, schedules data collection and analysis from February to May 2025, and uses descriptive statistics, correlation analysis, and multiple regression to quantitatively analyze the influence of marketing factors on consumers' purchasing behavior, providing theoretical and practical support for mineral water enterprises to optimize marketing strategies.

Research Framework

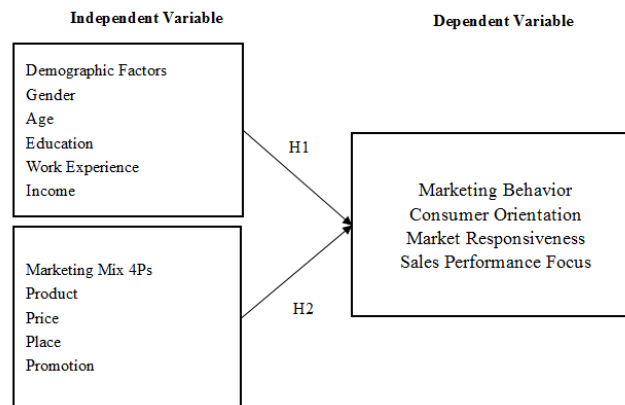


Figure 1: Conceptual Framework

Benefits of the Research

This research has both theoretical and practical significance: theoretically, it enriches the application of the 4Ps marketing theory and SCP model in the mineral water industry, filling the research gap in the industry's marketing behavior; practically, it provides actionable insights for mineral water enterprises to optimize their 4Ps strategies and enhance competitiveness, and offers data support for government departments to formulate industry policies, regulate the market, and promote the industry's green and sustainable development.

Literature Review

Related Theories

The Marketing Mix 4Ps Marketing Theory

Proposed by Jerome McCarthy in 1960, the 4Ps marketing mix theory comprises product, price, place, and promotion and serves as a fundamental framework for enterprises to enhance competitiveness (Li et al., 2024). Scholars have enriched its connotations by exploring product innovation, diversified pricing, omnichannel distribution, and integrated communication, while also emphasizing the synergy among the four elements. The theory has been adapted across industries and extended to the 7 Ps. It has further evolved with digitalization and technologies such as big data and AI, shifting from a static model to a dynamic tool (Keskin et al., 2021). Despite continuous development, the 4Ps framework remains highly applicable and core to modern marketing management (Pineda & Fabella, 2019).

The SCP Model

The SCP (Structure-Conduct-Performance) model, an important analytical framework in business and organization, posits that market structure (e.g., firm number, concentration, entry barriers, product differentiation), market conduct (e.g., pricing, product innovation, promotion, mergers), and market performance (e.g., profitability, efficiency, consumer welfare) are interrelated, with unidirectional causal relationships initially but later expanded to reversed and

participative models to better adapt to real market dynamics (Tan & Wang, 2017); it has been widely applied in various industries, integrated with tools like Porter's Five Forces, used in public policy evaluation, and adapted to address new challenges from digitalization and network economies, and in this research, it helps explore how market structure influences mineral water companies' marketing behavior and performance, providing theoretical support for their marketing strategies and industry policies (Shivany et al., 2015, Forleo & Palmieri, 2023).

Related Studies

Demographic Factors on Marketing Behavior

Demographic factors, including gender, age, education level, work experience, and income, are important determinants of consumer marketing behavior, as they influence consumers' product perceptions, purchasing decisions, and responses to marketing efforts: gender leads to differences in shopping motivations and responsiveness to promotions; age (across generational cohorts) affects technology adoption and brand engagement preferences (Chen et al., 2018); education level impacts information processing and rational evaluation abilities; work experience shapes brand preferences and service demands; and income directly determines purchasing power and consumption patterns, with understanding these factors helping businesses tailor marketing strategies for better targeting and engagement (Khan & Hanif, 2018).

Marketing Mix 4Ps

The Marketing Mix 4Ps (Product, Price, Place, Promotion) is a fundamental tactical toolkit for firms to shape consumer marketing behavior, with each element interacting with market structure and influencing market performance: Product, as the core of marketing, requires innovation, differentiation, and lifecycle-based adjustments based on market competition levels; Price, a flexible strategic tool, is determined by market structure (competitive markets rely on cost control, oligopolistic/monopolistic markets have more pricing autonomy) and impacts profitability and market share (Ziglio, 2021); Place, the conduit connecting products and consumers, involves diversified distribution in competitive markets and barrier-building through key resource control in oligopolistic/monopolistic markets, evolving into user-centric ecosystems with digitalization (Chen et al., 2024); Promotion varies by market structure, focusing on quick visibility and sales in competitive markets and long-term brand building in less competitive markets, and all four elements, when aligned with consumer needs and market conditions, jointly influence consumer perceptions, behaviors, and firm competitiveness, supported by empirical research (Tan et al., 2024).

Marketing Behavior

Marketing behavior, a key indicator of a firm's market performance and strategic responsiveness, encompasses three core dimensions: consumer orientation (focusing on meeting consumer needs across product design to after-sales service to boost brand loyalty), market responsiveness (responding quickly and effectively to market changes like competitor strategies or consumer demand shifts to maintain competitiveness), and sales performance

focus (prioritizing sales growth, market expansion, and profitability through data-driven, results-oriented management, especially critical in fast-moving consumer goods like bottled water) (Tan, 2020).

Related Research

Related research provides a robust theoretical foundation for this study's model construction: the Marketing Mix 4Ps strategy is widely recognized as a key tool for enterprises to achieve market orientation and influence consumer behavior, brand performance, and market responsiveness, with scholars exploring its four dimensions (product, price, place, promotion) from multiple perspectives to support the causal logic between marketing elements and performance (Wood, 2018); additionally, the SCP theory offers a holistic framework for analyzing how market structure shapes corporate marketing behavior and performance, while some studies highlight the need for agile and adaptive marketing behavior to adapt to dynamic market changes like technological shifts and evolving consumption trends (Amaldoss & He, 2024).

General Background of Mineral Water Companies' Products in China

China's mineral water industry is transitioning from initial to mature, with growing market concentration and segmentation, leading enterprises dominating through large-scale investment while SMEs thrive via differentiated products and localized strategies; product variety has expanded, packaging has diversified to meet scenario-based needs and eco-friendly trends, competition involves both national players with full-channel advantages and regional SMEs targeting niche markets, channels combine traditional offline and growing online platforms, regulations focus on safety and sustainability, and consumer behavior is shaped by health awareness, brand trust, and convenience—all of which provide contextual support for this study's SCP-based analysis of marketing behavior and performance.

Research Methodology

Research Design

This research adopts a quantitative approach, targeting consumers who purchased mineral water in the past 6 months, and uses a 5-point Likert scale to measure their perceptions of the Marketing Mix 4Ps (Product, Price, Place, Promotion). It integrates the SCP model market-competition factors, collects 400 questionnaires via online and offline random sampling, and uses descriptive statistics, reliability/validity tests, correlation analysis, and multiple regression analysis to explore how marketing behavior affects consumers' purchase decisions.

Population and Sample Size

This research's population includes all consumers who have purchased mineral water at least once in the past six months, totaling 24310 people in Zhengzhou with diverse demographic characteristics, and since surveying the entire population is impractical, a sample of 400 individuals (calculated via Yamane's formula, meeting the requirements of 95% confidence level and 5% margin of error) was selected using the Simple Random Sampling method; the

sample was recruited from brand databases, e-commerce users and social media groups in Zhengzhou via email surveys, with follow-up reminders to ensure valid responses, focusing on analyzing the impact of 4Ps marketing mix on consumers' purchase decisions.

Data Collection

This research collects data through five structured steps: first, reviewing literature on mineral water marketing to establish a theoretical foundation; second, designing a questionnaire based on 4Ps and the SCP model with a Likert five-point scale and refining it via a pilot test of 30 consumers; third, distributing the formal questionnaire via email with WenJuanXing, supplemented by reminders and incentives to boost response rates; fourth, gathering and screening questionnaires by removing invalid responses such as those completed too quickly, with straight-lining answers, or logical errors to obtain valid data; finally, importing valid data into SPSS for descriptive statistics, correlation analysis, and regression analysis to test hypotheses, with strict quality control throughout to ensure scientific and reliable research results.

Research Instrument

This research adopted a five-point Likert scale (1 = strongly disagree, 5 = strongly agree) with a questionnaire covering basic information and marketing-related dimensions—including product, price, place, promotion, overall marketing perception, as well as mineral water companies' consumer orientation, market responsiveness, and sales performance focus (five items per dimension)—and used mean ($\bar{x}$) and standard deviation (S.D.) for quantitative data analysis based on Best (1981)'s evaluation criteria.

Content Validity and Reliability

This study conducts validity and reliability analyses on the questionnaire: validity is evaluated by the Index of Objective Consistency (IOC) (rated by three mathematics education experts, with $\text{IOC} = 1.00 \geq 0.5$, meeting research requirements) and the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (used with Bartlett's Test of Sphericity to verify suitability for factor analysis, which confirms structural validity); reliability is analyzed via KMO (assessing factor analysis suitability based on specific value criteria) and Cronbach's Alpha (evaluating internal consistency, with sub-scale reliability ≥ 0.6 acceptable, overall scale ≥ 0.8 good, and all items' corrected item-total correlation ≥ 0.4).

Data Analysis

This section outlines the data analysis procedures, including descriptive and inferential statistics. Descriptive statistics were used to organize and summarize survey data, with frequency and percentage analysis presenting respondents' demographic profiles, and mean and standard deviation illustrating consumers' perceptions of the 4Ps marketing mix, while also testing for extreme values and data normality. Inferential statistics were employed to examine research hypotheses: t-tests and one-way ANOVA were used to verify differences in consumer

perceptions of the 4Ps across demographic groups, and multiple linear regression analysis was conducted to assess the impact of 4Ps dimensions on purchasing behavior, with tests for normality, multicollinearity, and homoscedasticity to ensure robustness, and the findings were interpreted in the context of China's mineral water industry.

Analysis Result

Demographic Statistics

The Demographic Factors of Consumers

Table 1 presents the demographic characteristics of 369 valid respondents in this research: females (55%) slightly outnumber males (45%); the sample is dominated by young consumers (42.3% aged 20-30, 27.4% aged 31-40); most respondents have a high educational background (60.7% with bachelor's degree, 21.1% with master's degree); work experience is evenly distributed across early-career, mid-career, and experienced groups; and the majority are middle-income earners (40.9% with monthly family income of 5,000-10,000 yuan). This demographic profile (young, well-educated, moderately affluent) provides a reliable basis for subsequent empirical analysis of the impact of Marketing Mix 4Ps on mineral water consumption behavior.

Table 1: Descriptive Characteristics

Items	Options	Frequency	Percent%
Gender	Male	166	45
	Female	203	55
Age	20-30 years	156	42.3
	31-40 years	101	27.4
	41-50 years	71	19.2
	51 years or older	41	11.1
	High school or below	54	14.6
Education	Bachelor's degree	224	60.7
	Master's degree	78	21.1
	Others	13	3.5
Work Experience	Less than 4 years	96	26.0
	4-8 years	107	29.0
	9-13 years	103	27.9
	Over 13 years	63	17.1
Monthly Income of the Family	Less than 5000	96	26
	5000-10000yuan	151	40.9
	10001-15000yuan	88	23.8
	Over 15000 yuan	34	9.2
Total		369	100

Marketing Mix 4Ps

Descriptive statistics of the Marketing Mix 4Ps dimensions show that all mean scores are around the 3.0 midpoint of the five-point Likert scale, indicating neutral perceptions of Chinese mineral water companies' marketing practices, without obvious positive or negative tendencies.

The product dimension has an overall average of 3.010 (SD = 0.753), reflecting a neutral evaluation of product attributes that meet basic expectations but lack distinctive features; the price dimension has an overall score of 2.997 (SD = 0.750), meaning prices are acceptable but not particularly attractive or high; the place dimension has an aggregate score of 3.011 (SD = 0.745), showing neutral evaluations of distribution channels that ensure accessibility but not competitive differentiation; the promotion dimension has an overall score of 3.002 (SD = 0.763), indicating current promotional strategies are neither compelling nor ineffective and have limited impact on consumer attitudes or purchase intentions.

Marketing Behavior

The composite marketing behavior score is 3.006 (SD = 0.743), which is also interpreted as neutral. Taken together, these findings reveal that the marketing mix strategies of mineral water companies in China achieve a baseline level of adequacy but lack pronounced strengths in consumer perception. This neutrality underscores the necessity for enterprises to pursue product innovation differentiation, adopt more flexible pricing mechanisms, optimize distribution efficiency, and implement more targeted and innovative promotional initiatives to strengthen consumer engagement and enhance market performance.

Inferential Statistics

This section uses inferential statistics to examine how demographic variables affect consumers' responses to marketing behavior by mineral water companies. Independent-samples t-test reveals a significant gender difference ($p = 0.021$), with females showing higher engagement than males. One-way ANOVA and post hoc tests indicate significant age-related differences ($p = 0.003$), with consumers aged 51 and above responding more positively than younger groups. Significant differences by education ($p = 0.015$) indicate that respondents with bachelor's and master's degrees have higher marketing behavior scores than those with lower levels of education. For work experience ($p = 0.028$), those with over 13 years of experience exhibit significantly stronger engagement than less experienced consumers. Income analysis ($p = 0.041$) further shows that the middle-to-higher income group (10,001–15,000 yuan) reports significantly higher scores than the lowest income group. Overall, gender, age, education, work experience, and family income all significantly influence consumer marketing behavior toward mineral water products.

Marketing Mix 4Ps Influence the Marketing Behavior of Mineral Water Companies

Table 2: Multiple Regression Analysis

		Unstandardize d Coefficients B	Standardized Coefficients Beta	t	Sig.	VIF	F	Sig.
Model 1	(Constant)	0.079		0.517	0.605			
	Products	0.398	0.404	9.522	0.000	1.403	103.907***	0.000
	Price	0.193	0.195	4.871	0.000	1.252		

Place	0.119	0.119	2.954	0.003	1.27 2
Promotion	0.263	0.271	6.510	0.000	1.34 7
R Square					0.533
Adjusted R-Square					0.528

NOTE : * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

Multiple regression analysis shows that the 4Ps model significantly predicts consumers' marketing behavior toward mineral water ($F = 103.907$, $p < 0.001$), with an R^2 of 0.533, indicating strong explanatory power. All four dimensions exert positive and significant effects: product has the strongest impact ($\beta = 0.404$), followed by promotion ($\beta = 0.271$), price ($\beta = 0.195$), and place ($\beta = 0.119$). VIF values are all below 10, ruling out multicollinearity. The findings confirm that 4Ps elements significantly affect consumer behavior in China's mineral water industry, with product and promotion as the most crucial factors, supporting the need for enterprises to strengthen product development, promotion, pricing, and channel optimization.

Conclusion and Discussion

Conclusion

The research's demographic results show that most respondents are young, well-educated, middle-income groups (predominantly 20-30 years old, with at least a bachelor's degree, a monthly income of 5,000-10,000 yuan, and 55% female), providing a solid basis for analyzing consumer behavior. Regarding Research Question 1, multiple regression analysis reveals all 4Ps dimensions have significant positive impacts on consumers' marketing behavior toward mineral water companies: product ($\beta=0.404$) is the strongest driver, followed by promotion ($\beta=0.271$), price ($\beta=0.195$), and place ($\beta=0.119$), with the model explaining 53.3% of variance and no multicollinearity issues. For Research Question 2, inferential statistics confirm significant differences in marketing behavior across demographics: females, older consumers (51 years or older), those with higher education (master's degree), more work experience (over 13 years), and middle-to-higher income (10,001-15,000 yuan) exhibit higher engagement, indicating demographic characteristics moderate consumer behavior and should be considered in marketing strategies.

Discussion

In the discussion section, regression results show that among the 4Ps, product has the strongest impact on consumers' marketing behavior toward mineral water, as Chinese consumers prioritize quality, source purity, health value, packaging and brand reputation, requiring enterprises to focus on product innovation and differentiation; price, while less influential than product and promotion, still significantly affects consumer behavior by influencing perceived value and purchase willingness, and needs to match product positioning; place, though with the smallest coefficient, improves purchase convenience and brand availability to support consumer engagement; promotion ranks second, with advertising, digital campaigns and sales activities effectively boosting purchase intention and brand interaction, and the overall 4Ps model jointly explains consumer behavior, supporting the importance of coordinated marketing

strategies. Meanwhile, demographic variables including gender, age, education, work experience and income all lead to significant differences in consumer responses: women, older consumers, highly educated groups, those with longer work experience and higher-income respondents show higher marketing engagement, indicating that mineral water enterprises should adopt segmented and targeted marketing strategies rather than one-size-fits-all approaches, which is consistent with existing literature and helps enhance competitiveness in China's market.

Implication for Practice

This section outlines key practical implications for mineral water enterprises: companies should prioritize product innovation and quality control to enhance consumer trust and loyalty; adopt reasonable and differentiated pricing strategies combined with promotions to improve perceived value; optimize online and offline distribution channels to increase product accessibility; develop integrated and targeted promotional strategies that align with product attributes; implement demographic-based market segmentation by gender, age, education, work experience and income to improve targeting efficiency; and integrate the 4Ps in a coordinated way to form a cohesive marketing system, thereby strengthening consumer engagement, brand loyalty and overall market competitiveness.

Future Research

Future research can expand this study by using larger, more geographically diverse samples across urban-rural areas and different regions of China to explore cultural and geographic variations. It may also include additional variables such as digital marketing, social influence, environmental awareness and brand trust to create a more comprehensive analytical framework beyond the 4Ps. Moreover, adopting qualitative methods, such as in-depth interviews and focus groups, can help reveal consumers' deeper psychological motivations. These extensions will strengthen theoretical understanding and provide more practical guidance to mineral water enterprises in refining their marketing strategies.

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ENHANCING CAREER MATURITY THROUGH SELF-EFFICACY: A STUDY OF THIRD-YEAR Z UNIVERSITY STUDENTS IN YUNNAN, CHINA

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Abstract: *This study investigates the impact of self-efficacy on career maturity among third-year university students in Yunnan, China, and evaluates a Self-Efficacy-based Career Maturity Enhancement Course. A quasi-experimental design was adopted, with 47 experimental group students (receiving a two-month course) and 46 control group students (in the regular curriculum). Pre-test and post-test data were analyzed via SPSS 27.0 using t-tests and correlation analysis, and a satisfaction questionnaire was administered. Results show the experimental group had significantly higher self-efficacy ($M=3.853$, $p<.001$) and career maturity ($M=3.713$, $p<.001$) than the control group, with a strong positive correlation between self-efficacy and career maturity ($r=.697$, $p<.01$). Student satisfaction with the course was high (overall $M=4.13$). This study demonstrates that self-efficacy interventions effectively boost career maturity, providing theoretical and practical guidance for the design of college career education curricula.*

Keywords: *Career Maturity, Self-Efficacy, University Students, Career Education, Intervention*

Introduction

China's economy is undergoing rapid digital transformation, driven by artificial intelligence and high-tech innovation, with the digital economy accounting for 41.5% of the national GDP in 2022. This transformation reshapes traditional industries and creates new job demands, placing higher requirements on the talent cultivation of higher education institutions. In response, the Chinese government launched policies such as the "2024 National College Graduates Employment and Entrepreneurship Promotion Action" to improve the quality of graduate employment and professional training. However, the number of college graduates in China reached 11.485 million in 2023, and the continued growth of the graduate population has intensified employment competition, making it critical for students to develop professional career-planning skills and adapt to market changes.

Career maturity has become a key factor in helping college students make informed career decisions. Research indicates that students with high career maturity are better able to make rational career choices, whereas those with low career maturity may face difficulties in making employment decisions, which can impact their future career development (Dhar, Kanungo & Chowdhury, 2025).

Existing research shows that students with high career maturity can better align their career choices with their personal abilities and industry demands. In contrast, those with low career maturity often experience indecision in employment and may encounter obstacles to future career development. Against this backdrop, universities need to move beyond pure academic knowledge teaching and focus on enhancing students' career planning and decision-making capabilities. Self-efficacy, a core psychological construct proposed by Bandura, is closely associated with career development and has been proven to be an important predictor of career maturity. This study uses third-year students from Z University in Yunnan as the research subjects, explores the impact of self-efficacy on career maturity, and evaluates the effectiveness of a tailored Career Maturity Enhancement Course grounded in self-efficacy theory, aiming to provide empirical support for the design of college career education courses in China.

This study sets three core research questions: (1) What are the differences in self-efficacy and career maturity levels between the experimental and control groups? (2) What positive effect does self-efficacy have on career maturity? (3) What is the level of student satisfaction with the Self-Efficacy-based Career Maturity Enhancement Course? Corresponding research objectives are proposed: to explore group differences in self-efficacy and career maturity; to verify the predictive effect of self-efficacy on career maturity; and to examine students' satisfaction with the intervention course, thereby providing practical guidance for college career education practice.

Literature Review

Theoretical Foundation

Self-efficacy theory, proposed by Bandura (1986), holds that an individual's belief in their ability to complete specific tasks directly affects their behavioral motivation, persistence, and resilience, which are core psychological factors in career development, especially for college students in the early stage of career decision-making. This psychological trait not only affects students' initiative in participating in career-planning activities but also significantly enhances their career maturity.

Nauta (2007) noted a positive correlation between self-efficacy and career exploration, emphasizing that self-confidence in personal abilities is the driving force behind students' active exploration of career opportunities. Domestic Chinese research has further validated the close relationship between self-efficacy and career maturity: Lü (2008) and Yan (2011) found, through empirical research, that self-efficacy is a strong predictor of college students' career maturity, and that higher self-efficacy is associated with more rational career decision-making. Zhao (2019) and Ye (2020) further explored the mechanism underlying this relationship, finding that self-efficacy can enhance career maturity by promoting students' adaptability and resilience, with personality traits mediating this process.

Xiao (2021) linked self-efficacy to career decision-making ability and stress resilience, noting that students with high self-efficacy can better cope with career-related challenges and setbacks. Li (2022) and Wan (2022) emphasized the role of psychological counseling in improving students' self-efficacy, while Li (2023) highlighted the importance of family support as an external environmental factor. Collectively, these studies show that joint efforts by

schools and families can cultivate students' self-efficacy, which, in turn, helps them make more rational career decisions and adapt to the dynamic labor market, forming a positive cycle of career development. Thus, a supportive environment enhances self-efficacy and contributes to better career development for college students (Susiyawati et al., 2025).

Definition Of Core Concepts

The concept of career maturity was first proposed by Super (1955), who defined it as an individual's understanding of career-related information and the mastery of career goal-setting in different life stages, framing it as a lifelong developmental construct. Crites (1965) expanded this definition, emphasizing that career maturity is the ability to make appropriate career choices according to personal and environmental characteristics, and regarded it as a continuous and progressive developmental process.

Subsequent scholars have further refined the concept of career maturity from different perspectives: Savickas (1984) defined it as an individual's preparedness to complete career development tasks at different stages; Betz (1988) linked it to the progressive mastery of career goals and pointed out its close connection with career development stages; King (1989) added a practical dimension, holding that career maturity is the readiness to make career decisions and timely adjustments based on real-world information; Levinson (1998) emphasized the consistency and realism of career decision-making as core connotations of career maturity; Savickas (1999) condensed the concept to the degree of rationality in an individual's career choice behavior; Coertse (2004) integrated educational and professional knowledge into the definition, noting that career maturity includes the ability to make scientific career decisions based on professional knowledge and educational experience.

Based on the above research, this study defines the career maturity of third-year Chinese college students as the ability to formulate career decisions and development plans that align with personal abilities, interests, and market demands, which comprehensively reflects an individual's rational judgment, goal-setting, and decision-making capabilities in the process of career development. It is an important indicator of college students' employment readiness.

Research Status

Career maturity has become a critical indicator for assessing an individual's vocational awareness, career decision-making ability, and planning competence in both international and domestic academic research. Internationally, research on career maturity began early, with Super (1955) laying the theoretical foundation, and subsequent scholars such as Crites, Savickas, and Levinson continuously enriching and refining its theoretical foundations and measurement systems. International research primarily focuses on the core dimensions of career maturity, including career goal setting, decision-making consistency, and career development readiness. It has been confirmed that individual traits (e.g., gender, self-efficacy), psychological factors (e.g., self-confidence, psychological resilience), and external environmental conditions (e.g., social support, family background) are important influences on career maturity (Gelissen, 2006; Ashwani, 2019). Among them, self-efficacy is widely recognized as a key antecedent variable of career maturity (Betz, 1988; Zhao, 2009).

In China, scholars have localized and expanded research on career maturity by integrating it with the country's social, educational, and labor-market characteristics. Peng and Long (2001) adapted the career maturity research framework based on self-efficacy theory, emphasizing the role of psychological factors in the development of college students' career maturity; Ma (2003) found that the attitude of students in career preparation stage has a significant impact on their career maturity level; Xu et al. (2006) and Liu (2009) revised and improved the career maturity measurement tools suitable for Chinese college students, and further verified the influence of psychological traits on career maturity. A distinctive feature of domestic research is its focus on culturally specific factors such as career identity and family background (Xiong, 2006; Liu, 2009), which play an important role in the career decision-making of Chinese college students under the influence of collectivist cultural norms.

Although both international and domestic research have confirmed the important role of self-efficacy in the development of career maturity, there are still research gaps: few empirical studies have explored the effectiveness of self-efficacy-based intervention courses for career maturity among college students in southwest China, a region with unique educational and labor market characteristics; in addition, there are few studies on evaluating the effectiveness of tailored career maturity enhancement courses for third-year college students, who are at a critical stage of graduation and employment. This study addresses these gaps and provides empirical evidence for the application of self-efficacy theory in Chinese college career education practice.

Method

This study employs a quasi-experimental pretest-posttest control-group design to examine the impact of self-efficacy on college students' career maturity and to evaluate the effectiveness of the Self-Efficacy-based Career Maturity Enhancement Course. Cluster random sampling is used to select the research sample; SPSS 27.0 is employed for the statistical analysis of quantitative data; and a satisfaction questionnaire is used to assess students' evaluation of the intervention course, ensuring the scientificity and rigor of the research design.

Research Population And Samples Population

The research population is third-year students from Yunnan Vocational College of Economics and Foreign Trade (Z University), with a total of 50 classes and approximately 2,000 students in this grade. These students are in the critical stage of career exploration and employment preparation, and improving their career maturity is of great practical significance for their subsequent employment and career development.

Samples

Cluster random sampling is used to select sample classes from the 50 third-year classes, ensuring that the distributions of gender, major, and other demographic variables in the selected samples are consistent with those of the overall population, thereby reducing sampling bias. Class 41 (47 students) is designated as the experimental group, which participates in the two-

month Self-Efficacy-based Career Maturity Enhancement Course; Class 34 (46 students) is the control group, which continues to take the school's regular career planning curriculum without additional intervention.

Sampling Limitation

This study selects only two classes as its research sample, so the sample size is relatively small. Although efforts are made to ensure consistency in demographic variables between the sample and the overall population, the generalizability of the research results may still be limited. Therefore, the research conclusions should be interpreted with caution when applied to other contexts, and future research is recommended to expand the sample size and include students from different regions, institutions, and majors to improve the external validity of the research results.

Research Instrument

Three research instruments are designed for this study based on Bandura's self-efficacy theory and Super's career development theory, combined with the characteristics and career development needs of third-year Chinese college students, including a Career Maturity Enhancement Course lesson plan, a paper-based assessment test, and a course satisfaction questionnaire. All instruments are designed to measure core variables such as self-efficacy, psychological resilience, and career maturity, and have undergone content validity verification to ensure the reliability and validity of the research tools.

Career Maturity Enhancement Course Lesson Plan

A two-month Career Maturity Enhancement Course is designed for the experimental group, with one 90-minute session every two weeks, totaling four sessions and 360 minutes of instructional time. The course is divided into four thematic phases, integrating theoretical instruction, practical exercises, and interactive activities, and is co-designed with corporate human resources professionals to ensure the practical relevance of its content to the Chinese labor market. The four phases of the course include Career Cognition and Planning (Weeks 1-2), Self-Efficacy Enhancement (Weeks 3-4), Skills Training (Weeks 5-6), and Psychological Resilience Enhancement (Weeks 7-8), with specific teaching content and methods detailed in Table 1.

The control group uses the traditional lecture-based teaching method, with the same teachers, textbooks, and teaching hours as the experimental group, to control for the influence of irrelevant variables, such as teaching staff and learning time, on the research results, ensuring comparability between the two groups.

Paper-Based Assessment Test

A 20-item multiple-choice paper-based test is developed to assess students' understanding and mastery of EPQ personality, self-efficacy, psychological resilience, and career maturity, with 5 items per construct, 5 points per item, and a total score of 100. The test includes both

conceptual and scenario-based questions, with four optional answers (a, b, c, d) for each question, which can effectively measure students' cognitive level of the core variables. The same test is administered as a pre-test (one week before the course starts) and a post-test (one week after the course ends) to both the experimental and control groups to measure changes in self-efficacy and career maturity levels.

Course Satisfaction Questionnaire

A 10-item 5-point Likert scale questionnaire is designed to measure the experimental group students' satisfaction with the Career Maturity Enhancement Course, with the scoring standard: 1=Strongly Disagree, 2=Disagree, 3=Moderate, 4=Agree, 5=Strongly Agree. The questionnaire assesses satisfaction with each of the four course phases (2 items per phase) and overall satisfaction with the course design, content, and format (2 items). The questionnaire is administered to the experimental group after the course ends, and descriptive statistics are used to analyze satisfaction results; a mean score of ≥ 4 indicates high satisfaction.

Data Analysis Method

SPSS 27.0 statistical software is used for all data analysis in this study. The specific statistical methods are as follows: (1) Independent samples t-test: used to compare the differences in self-efficacy and career maturity levels between the experimental group and the control group after the intervention, and Cohen's d is calculated to measure the effect size (small effect: $d=0.2$, medium effect: $d=0.5$, large effect: $d=0.8$); (2) Paired samples t-test: used to analyze the pre-test and post-test changes in career maturity of the experimental group to verify the effectiveness of the intervention course; (3) Pearson correlation analysis: used to explore the correlation between self-efficacy and career maturity; (4) Descriptive statistics (mean, standard deviation): used to analyze the results of the course satisfaction questionnaire and describe the distribution characteristics of the core variables.

Table 1: Career Maturity Enhancement Course Lesson Plans (Experimental Group)

Session Theme	Core Teaching Methods	90-Minute Session Structure
Career Cognition and Planning (Weeks 1-2)	Individual belief building, confidence cultivation, group discussion and case-based teaching	Scenario Creation (5 mins); Open Classroom Discussion (10 mins); Collaboration and Exploration (15 mins); Practical Application (15 mins); Q&A and Summary (45 mins)
Self-Efficacy Enhancement (Weeks 3-4)	Simulated scenario exercises, stress management workshops, one-on-one feedback, and	Scenario Creation (5 mins); Open Classroom Discussion (10 mins); Collaboration and Exploration (15 mins);

	emotional regulation training	Practical Application (15 mins); Q&A and Summary (45 mins)
Skills Training (Weeks 5-6)	Mock interviews, resume optimization, career information literacy training and corporate HR collaboration	Scenario Creation (5 mins); Open Classroom Discussion (10 mins); Collaboration and Exploration (15 mins); Practical Application (15 mins); Q&A and Summary (45 mins)
Psychological Resilience Enhancement (Weeks 7-8)	Role-playing, job search frustration simulation, coping strategy exercises, stress resilience training.	Scenario Creation (5 mins); Open Classroom Discussion (10 mins); Collaboration and Exploration (15 mins); Practical Application (15 mins); Q&A and Summary (45 mins)

Source: Self-Developed for This Study

Results

This study answers the three core research questions through statistical analysis of pre-test and post-test data and satisfaction questionnaire results. All statistical tests reach a significant level ($p < .001$), and the effect size calculation indicates that the intervention course has a strong educational impact, confirming the effectiveness of the Self-Efficacy-based Career Maturity Enhancement Course.

Self-Efficacy And Career Maturity Differences (Experimental Vs. Control Group)

Independent-samples t-test results indicate significant differences in self-efficacy and career maturity between the experimental and control groups after the intervention, with large effect sizes for both variables (Cohen's $d > 0.8$), as shown in Tables 2 and 3.

For self-efficacy, the experimental group ($M=3.853$, $SD=0.873$) scores significantly higher than the control group ($M=3.059$, $SD=0.877$), $t(91)=4.379$, $p < .001$, with a large effect size (Cohen's $d=0.908$). For career maturity, the experimental group ($M=3.713$, $SD=0.677$) also scores significantly higher than the control group ($M=3.075$, $SD=0.404$), $t(91)=5.497$, $p < .001$, with an effect size Cohen's $d=1.140$, which is also a large effect. The above results indicate that the Self-Efficacy-based Career Maturity Enhancement Course has a significant positive impact on students' self-efficacy and career maturity.

Table 2: Self-Efficacy Difference Analysis (Experimental Vs Control Group)

Measure	N	Mean	SD	df	t-Stat	P	Cohen's d
Experimental Group	47	3.853	0.873	91	4.379	<.001	0.908
Control Group	46	3.059	0.877	91	4.379	<.001	0.908

Source: Study Survey Data (2025)

Table 3: Career Maturity Difference Analysis (Experimental Vs Control Group)

Measure	N	Mean	SD	df	t- Stat	P	Cohen's d
Experimental Group	47	3.713	0.677	91	5.497	<.001	1.140
Control Group	46	3.075	0.404	91	5.497	<.001	1.140

Source: Study Survey Data (2025)

The Positive Effect Of Self-Efficacy On Career Maturity

Paired-samples t-test results for the experimental group indicate a significant improvement in career maturity from pre-test to post-test, with a medium-to-large effect size (Cohen's $d = 0.778$), as shown in Table 4. The experimental group's career maturity pre-test score is $M=3.051$ ($SD=0.458$). The post-test score is $M=3.713$ ($SD=0.677$), $t(46)=5.329$, $p<.001$, indicating that the intervention course effectively improves the career maturity level of the experimental group students, especially in self-awareness, career goal clarity, and career decision-making ability.

Pearson correlation analysis further confirms the relationship between self-efficacy and career maturity, showing a strong positive correlation between the two variables ($r=.697$, $p<.01$), which verifies the core research hypothesis of this study: self-efficacy has a significant positive predictive effect on career maturity, and improving students' self-efficacy can effectively enhance their career maturity.

Table 4: Career Maturity Pre-Test And Post-Test Differences (Experimental Group)

Measure	N	Mean	SD	DF	T-Stat	P	Cohen's d
Pre-Test	47	3.051	0.458	46	5.329	<.001	0.778
Post-Test	47	3.713	0.677	46	5.329	<.001	0.778

Source: Study Survey Data (2025)

Student Satisfaction With The Career Maturity Enhancement Course

Descriptive statistics for the 10-item satisfaction questionnaire show that the experimental group students have high overall satisfaction with the Career Maturity Enhancement Course,

with an average score of 4.13 (SD=0.55) on a 5-point Likert scale, as shown in Table 5. All items of the questionnaire received a mean score ≥ 3.91 , indicating high satisfaction.

The highest mean scores are for Item 3 (Self-Efficacy Enhancement simulated scenario exercises and stress management workshops) and Item 6 (Career information literacy training), both with $M=4.30$; the lowest mean score is for Item 10 (Overall course content and format), with $M=3.91$, indicating minor areas for improvement in the course delivery format. The standard deviation of the questionnaire items ranges from 0.81 to 0.99, indicating moderate to high consistency in student responses, with Item 7 and Item 8 (Psychological Resilience Enhancement) showing the smallest variation ($SD=0.81$) and Item 2 and Item 9 showing the largest ($SD=0.99$). The above results confirm that the Self-Efficacy-based Career Maturity Enhancement Course has high student acceptance and approval.

Table 5: Student Satisfaction with the Career Maturity Enhancement Course

Item No.	Question Theme	Mean	SD	Interpretation
1	Career interest tests and career maturity scale	4.11	0.94	High
2	SMART goal-setting discussions and case teaching	4.06	0.99	High
3	Self-efficacy scenario exercises and stress workshops	4.30	0.98	High
4	One-on-one feedback and emotional regulation training	4.19	0.90	High
5	HR-collaborated mock interviews and resume optimization	4.04	0.91	High
6	Career information literacy training	4.30	0.91	High
7	Psychological resilience role-playing activities	4.11	0.81	High
8	Job search frustration simulation activities	4.11	0.81	High
9	Overall course design and organization	4.19	0.99	High
10	Overall course content and format	3.91	0.88	High
—	Total Average	4.13	0.55	High

Source: Study Survey Data (2025)

Discussions

This study's empirical results confirm three core conclusions that not only answer the research questions but also enrich empirical research on self-efficacy and career maturity in the Chinese context and provide practical enlightenment for college career education practice.

First, the Self-Efficacy-based Career Maturity Enhancement Course has a significant effect on improving college students' self-efficacy and career maturity, with large effect sizes for both variables ($d=0.908$ for self-efficacy, $d=1.140$ for career maturity). The control group, which received the traditional lecture-based career planning curriculum, showed no significant changes in self-efficacy or career maturity, validating the need to develop targeted, theory-driven career education intervention courses for college students. This result is consistent with Bandura's (1986) self-efficacy theory and Nauta's (2007) research conclusions, demonstrating that structured self-efficacy intervention activities can effectively enhance students' self-belief in career development and promote improvements in their career maturity. The course's integration of theoretical instruction and practical exercises (e.g., mock interviews, scenario simulations) makes the intervention more targeted and practical, which is key to its effectiveness.

Second, this study confirms a strong positive correlation between self-efficacy and career maturity ($r = .697$, $p < .01$), indicating that self-efficacy is a significant positive predictor of college students' career maturity. This finding is consistent with the research of domestic scholars such as Lü (2008) and Yan (2011). Further, it extends existing research by demonstrating that self-efficacy can be effectively cultivated through systematic course interventions and that improvements in self-efficacy can directly drive career maturity. The medium-to-large effect size of the experimental group's pre-test and post-test career maturity changes ($d=0.778$) shows that the intervention course effectively activates the positive role of self-efficacy in career maturity development, and significantly improves students' self-awareness, career goal setting, and decision-making capabilities—core components of career maturity. For third-year college students at a critical stage in their employment preparation, improving self-efficacy is an effective way to enhance their career maturity and employment readiness.

Third, the experimental group students have high overall satisfaction with the intervention course ($M=4.13$), indicating the practical relevance and acceptability of the course design. The highest satisfaction with self-efficacy workshops and career information literacy training ($M=4.30$) indicates that students have a strong demand for practical, interactive career education content, which is very different from the traditional lecture-based career planning curriculum that focuses on the transmission of theoretical knowledge. The slightly lower satisfaction with the overall course format ($M=3.91$) indicates that there is still room for improvement in the course delivery mode, such as adopting a hybrid online and offline teaching mode, increasing the frequency of practical exercises, and providing more personalized career counseling services to meet the diverse career development needs of students. The high consistency of student responses ($SD=0.81-0.99$) indicates that the course can meet the career development needs of students with different majors and gender characteristics, and is highly universal.

In the context of China's rapid digital economic development and increasing pressure on college graduates to find employment, this study's findings have important practical implications for college career education practice. On the one hand, universities should take self-efficacy as a key breakthrough point for improving students' career maturity, integrate self-efficacy cultivation into the entire undergraduate career education curriculum system, and design targeted intervention activities according to the different stages of students' career development; on the other hand, universities should strengthen industry-academia collaboration, introduce corporate HR professionals into career education teaching, and integrate practical content such as mock interviews, resume optimization, and career information literacy training into the curriculum to bridge the gap between theoretical teaching and real-world employment needs, and improve students' practical career development capabilities.

Recommendations

Based on the research findings and limitations, this study proposes five targeted recommendations for the design and implementation of college career education in China, as well as for future research on self-efficacy and career maturity, aiming to improve the effectiveness of career education further and enhance college students' career maturity and employment readiness.

Expand the sample size and research diversity: This study selects only two classes from one university in Yunnan as its research sample, and the sample size is relatively small, limiting the generalizability of the results. Future research should expand the sample size, include students from different regions (eastern, central, western China), different types of institutions (vocational colleges, undergraduate universities, comprehensive universities), and different majors (liberal arts, science, engineering, management), and conduct cross-regional and cross-institutional comparative research to improve the external validity of the research results and make the research conclusions more universal.

Optimize the intervention course duration and delivery format: The two-month intervention course in this study has achieved significant short-term effects, but long-term behavioral change and career maturity require an extended intervention and an optimized delivery format. Universities should integrate self-efficacy-based career education across the entire undergraduate curriculum, not just the third year of employment preparation, and design progressive career education content tailored to the career development characteristics of freshmen, sophomores, juniors, and seniors. At the same time, in response to students' minor dissatisfaction with the course format, universities can adopt a hybrid online and offline teaching mode, develop micro-course resources for career education, and increase the frequency of offline practical exercises to improve the course's flexibility and interactivity.

Integrate multiple data collection and research methods: This study relies solely on quantitative methods (paper-based tests, questionnaires) to collect data, which cannot fully capture students' subjective experiences and psychological changes during career maturity development. Future research should adopt a mixed research method combining quantitative and qualitative methods, use semi-structured interviews, behavioral observations, and peer assessments to

collect qualitative data, and combine it with quantitative data for comprehensive analysis, to reduce research bias and gain a deeper understanding of the mechanism of self-efficacy on career maturity, and the actual effect of the intervention course on students' career development.

Explore complex causal models with advanced statistical methods: This study only verifies the direct positive effect of self-efficacy on career maturity and does not examine mediating or moderating variables in this relationship. Future research can use structural equation modeling (SEM) to explore the mediating role of variables such as psychological resilience, career identity, and career exploration behavior in the relationship between self-efficacy and career maturity, and the moderating role of variables such as family support, gender, and major, to construct a more comprehensive and in-depth causal model of career maturity development, and provide more targeted theoretical guidance for college career education intervention.

Integrate psychological counseling with career education: This study's findings and existing research both show that psychological factors, such as self-efficacy and psychological resilience, are important influences on career maturity. Universities should integrate professional psychological counseling services into career education practice, set up special career psychological counseling centers, provide personalized psychological counseling and career guidance for students, help students improve their self-efficacy and psychological resilience, relieve employment pressure and anxiety, and provide comprehensive psychological and professional support for students' career decision-making and employment preparation. At the same time, universities can offer regular career psychology lectures and group counseling to cultivate students' positive career psychology and enhance their overall career development capabilities.

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SERVICE QUALITY AND CUSTOMER SATISFACTION IN THE AIRLINE INDUSTRY: A CASE STUDY OF MALAYSIA AIRLINES IN MALAYSIA

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Abstract: *This study examines the relationship between service quality dimensions and customer satisfaction in the airline industry, with a specific focus on Malaysia Airlines. The research targets Generation Z passengers and aims to identify which aspects of service quality have the greatest influence on customer satisfaction. A quantitative research approach was employed, and data were collected through an online questionnaire distributed via social media platforms. A total of 385 valid responses were obtained for analysis. Descriptive statistics, reliability analysis, and inferential analysis were used to evaluate five key service quality dimensions: reliability, responsiveness, assurance, tangibility, and empathy. The findings indicate that reliability, assurance, tangibility, and empathy have a significant positive impact on customer satisfaction with Malaysia Airlines services. This study provides practical insights for Malaysia Airlines to enhance service quality, address existing gaps, and improve customer satisfaction and loyalty. Additionally, the findings contribute to a better understanding of customer satisfaction in the airline industry and offer a foundation for future research involving different customer demographics and service attributes.*

Keywords: *Service Quality, Customer Satisfaction, SERVQUAL Dimensions, Airline Industry, Malaysia Airlines*

Introduction

The airline industry has evolved into one of the most competitive service sectors worldwide, where success is no longer determined solely by ticket pricing but by the ability to deliver superior service experiences. In an era of globalization and digital transformation, passengers expect not only safe and efficient travel but also personalized, seamless, and memorable service encounters. Service quality has therefore become a critical differentiator, directly influencing customer satisfaction, loyalty, and long-term profitability (Tussyadiah, 2020; Usman et al., 2023). Airlines that fail to meet these expectations risk losing market share to competitors who prioritize customer-centric strategies.

The SERVQUAL framework, encompassing reliability, responsiveness, assurance, tangibility, and empathy, has been widely applied to evaluate service quality in the airline industry (Parasuraman et al., 1988). Each dimension captures a distinct aspect of passenger experience,

ranging from operational consistency and staff professionalism to physical facilities and personalized care. Previous studies consistently demonstrate that higher service quality leads to greater satisfaction, which in turn fosters loyalty and strengthens brand image (Mohamad, 2022; Koçali et al., 2025). However, the relative importance of these dimensions may vary across passenger demographics, airline types, and evolving travel contexts, highlighting the need for continuous reassessment.

Malaysia Airlines, as one of Southeast Asia's premier full-service carriers, has long positioned itself as a brand synonymous with hospitality and service excellence. Yet, the airline faces persistent challenges, including intense competition from low-cost carriers, fluctuating economic conditions, and rapidly changing passenger expectations. Generation Z travelers, in particular, represent a growing customer segment with distinct preferences for speed, digital engagement, and personalized experiences (Ali et al., 2025). Understanding how this demographic perceives service quality is crucial for Malaysia Airlines to refine its strategies and sustain competitiveness.

This study therefore investigates the relationship between service quality dimensions and customer satisfaction among Generation Z passengers of Malaysia Airlines. By identifying which aspects of service quality most strongly influence satisfaction, the research provides practical insights for service improvement and customer retention. Beyond its managerial implications, the study contributes to the broader literature on airline service quality by offering a generational perspective, thereby enriching academic discourse and guiding future research in aviation management.

Literature Review

Overview

Previous studies consistently highlight the critical role of service quality in shaping customer satisfaction, loyalty, and airline competitiveness. The SERVQUAL model (Parasuraman et al., 1988) remains the most widely adopted framework, capturing both tangible and intangible aspects of service delivery. Reliability, encompassing punctuality and operational consistency, is often cited as the strongest predictor of satisfaction (Xue & Ylagan, 2024). Tangibility, including aircraft cleanliness and staff appearance, also plays a decisive role in shaping perceptions (Koçali et al., 2025). Assurance, reflecting professionalism and safety, is particularly valued in full-service airlines (Idris & Mohamad, 2023). Empathy, through personalized attention, has been shown to foster loyalty among younger passengers (Günel & Gümüş, 2025). While responsiveness is important, some studies suggest its impact is comparatively weaker, especially when passengers prioritize efficiency over interpersonal interaction (Ramli et al., 2024).

Beyond SERVQUAL, emerging perspectives highlight the influence of digitalization, generational differences, and post-pandemic safety concerns. Digital service innovations, such as mobile apps and AI-driven support, are increasingly integrated into tangibility and responsiveness dimensions (Simón-Moya, 2019). Generation Z passengers, in particular, demand speed, personalization, and digital engagement, requiring airlines to adapt service strategies (Ali et al., 2025). Furthermore, health and safety protocols have become central to

assurance, with passengers evaluating airlines based on their crisis management and hygiene standards (Usman et al., 2023). These insights underscore that service quality is not static but evolves with technological, social, and environmental changes, making continuous improvement essential for sustaining customer satisfaction and loyalty.

Reliability

Reliability refers to the airline's ability to provide the services accurately and consistently, including punctuality and dependable operations. Studies show reliability is one of the strongest predictors of customer satisfaction (Xue & Ylagan, 2024; İnan, 2025), as delays and cancellations often lead to dissatisfaction.

Responsiveness

Responsiveness reflects the airline staff's willingness to assist passengers promptly and address their needs. Research suggests that responsiveness influences customer satisfaction and loyalty (Ramli et al., 2024; Ali et al., 2025) by improving overall service experiences.

Assurance

Assurance relates to staff professionalism, competence, and the ability to inspire trust and confidence among passengers. It plays a key role in customer satisfaction, particularly in full-service airlines where high standards are expected (Idris & Mohamad, 2023; Bakır et al., 2025).

Tangibility

Tangibility includes physical elements such as aircraft cleanliness, seating comfort, facilities, and staff appearance. Tangible aspects significantly influence passenger's perceptions of service quality and satisfaction (Ramli et al., 2024; Koçali et al., 2025).

Empathy

Empathy involves providing personalized attention and understanding the passenger's needs. Empathetic service delivery positively influences customer satisfaction (Günel & Gümüş, 2025; Wang, 2023) and overall service perception.

Customer Satisfaction

Customer Satisfaction is a key outcome of service quality and is closely linked to customer loyalty and airline image. Research consistently shows that higher service quality leads to higher satisfaction, which in turn increases customer retention (Mohamad, 2022). Previous findings also suggest that a positive destination image leads to greater visitor satisfaction, which in turn leads to greater destination loyalty (Jamaludin et al., 2018; Mohamad, 2022; Mohamad et al., 2022).

Methodology

Study Design

This study adopted a quantitative research design to examine the relationship between service quality dimensions and customer satisfaction among Malaysia Airlines passengers. A cross-sectional survey approach was chosen as it allows for the collection of standardized data from a large sample, enabling statistical analysis of relationships between variables. The SERVQUAL framework (Parasuraman et al., 1988) guided the operationalization of service quality dimensions.

Sampling

The target population consisted of Generation Z passengers (aged 18–32) who had flown with Malaysia Airlines within the past six months. A non-probability convenience sampling method was employed, leveraging social media platforms to reach respondents. This approach was suitable given the digital engagement habits of Generation Z. A total of 385 valid responses were collected.

Questionnaire Design

The questionnaire consisted of closed-ended questions using a five-point Likert scale (strongly disagree to strongly agree). It measured the five SERVQUAL dimensions and overall customer satisfaction (Parasuraman et al., 1988).

Data Analysis

Descriptive statistics summarized respondent's perceptions, while Pearson correlation analysis examined the relationship between service quality dimensions and customer satisfaction.

Results

All service quality dimensions showed a positive relationship with customer satisfaction. Reliability and tangibility had the strongest relationships, followed by empathy and assurance. Responsiveness showed a comparatively weaker relationship. Overall, respondents reported moderate to high satisfaction with Malaysia Airlines services.

Discussion

The findings suggest Malaysia Airlines should prioritize improving reliability and tangibility to enhance customer satisfaction. While responsiveness showed a weaker relationship, improving response time and service efficiency may further enhance passenger experiences. Personalized services and staff professionalism are particularly important (Ali et al., 2025; Günel & Gümüş, 2025) for attracting and retaining younger passengers, such as Generation Z.

Conclusion

This study confirms that service quality dimensions significantly influence customer satisfaction at Malaysia Airlines, with reliability and tangibility being the most influential. Continuous service improvement is essential (Tussyadiah, 2020; Usman et al., 2023) for maintaining competitiveness and customer loyalty. Future research may explore different passenger segments or compare full-service and low-cost airlines.

Tables and Figure

Table 1: Reliability Test

Items	Number of Items	Cronbach Alpha
Reliability (IV)	7	0.818
Responsiveness (IV)	7	0.824
Assurance (IV)	6	0.831
Tangibility (IV)	7	0.829
Empathy (IV)	6	0.821
Customer satisfaction (DV)	7	0.824

Source: From SPSS

Table 2: Descriptive Analysis for Dependent Variable (Customer Satisfaction)

	Mean	Std. Deviation	N
The overall service quality provided by the airline staff meets my standards.	3.79	1.187	385
I am satisfied with the quickness and attentiveness of the airline staff's responses.	3.81	1.105	385
The aircraft was clean and comfortable throughout my journey.	3.87	1.092	385
I am satisfied with the value for money provided by the ticket price.	3.80	1.111	385
I trust the airline's safety measures are effective in ensuring passenger safety.	3.79	1.153	385
I am pleased with how the airline handled health and safety procedures during my flight.	3.84	1.167	385
I am pleased with my overall experience flying with this airline.	3.86	1.169	385

Source: Developed From SPSS

Table 3: Descriptive Analysis for Independent Variable (Reliability)

	Mean	Std. Deviation	N
This airline keeps accurate records.	3.85	1.094	385
This airline does what it promises.	3.82	1.125	385
Employees are helpful when there is a problem.	3.86	1.164	385
The airline provides services on time.	3.77	1.182	385
The airline tries to solve customer problems.	3.81	1.184	385
The airline regularly meets my service standards.	3.79	1.105	385
I could rely on the airline staff to respond to my needs effectively and quickly.	3.84	1.142	385

Source: Developed From SPSS

Table 4: Descriptive Analysis for Independent Variable (Responsiveness)

	Mean	Std. Deviation	N
Airline staff are always there to help.	3.80	1.199	385
The airline quickly handles complaints.	3.78	1.144	385
The ground staff are quick to respond.	3.79	1.171	385
Airline staff are willing to help customers.	3.88	1.099	385
Airline staff gives quick services.	3.84	1.137	385
Airline staff provides timely updates on service issue and delays.	3.77	1.188	385
I felt that the airline staff were available and willing to help whenever I needed assistance.	3.89	1.096	385

Source: Developed From SPSS

Table 5: Descriptive Analysis for Independent Variable (Assurance)

	Mean	Std. Deviation	N
Airline staff are always respectful to customers.	3.89	1.143	385
I feel safe when interacting with the airline's staff.	3.79	1.138	385
Airline staff know how to answer customer questions.	3.88	1.113	385
The behavior of airline staff gives customers confidence.	3.83	1.185	385
Airline staff clearly explained safety protocols, which increased my sense of security. The airline staff made me feel secure and confident throughout my journey.	3.86	1.135	385
	3.87	1.123	385

Source: Developed From SPSS

Table 6: Descriptive Analysis for Independent Variable (Tangibility)

	Mean	Std. Deviation	N
This airline has modern equipment and technology.	3.85	1.113	385
The cleanliness and organization of the airport facilities (check-in counters, lounges, etc.) were satisfactory.	3.79	1.153	385
The airline staff were considerate and understanding of my personal needs and preferences.	3.77	1.178	385
The airline's materials look appealing.	3.84	1.130	385
The airline's planes look modern.	3.80	1.128	385
The airline staff uniforms look good.	3.88	1.157	385
The airline's offices, terminals, and gates look appealing.	3.77	1.189	385

Source: Developed From SPSS

Table 7: Descriptive Analysis for Independent Variable (Empathy)

	Mean	Std. Deviation	N
The airline gives customers personal attention.	3.79	1.195	385
The airline has convenient operating hours.	3.83	1.117	385
The airline cares about customers' interests.	3.78	1.149	385
The airline staff understands customer's specific needs.	3.79	1.186	385
The airline provides services that meet my expectations.	3.76	1.184	385
The airline's staff were quick to acknowledge and address any emotional distress I experienced.	3.79	1.187	385

Source: Developed From SPSS

Table 8: Demographic Profile from Respondents

Item	Frequency	Percentage
Gender		
• Male	184	47.8
• Female	201	52.2
TOTAL	385	100
Age		
• 18-22	129	33.5
• 23-27	161	41.8
• 28-32	95	24.7
TOTAL	385	100
Purpose of Travel		
• Leisure	96	24.9
• Business	76	19.7
• Visiting family/friends	101	26.2
• Conference	84	21.8
• Training	28	7.3
TOTAL	385	100

Source: Developed From SPSS

Table 9: Pearson Correlation Coefficients

Variable	Customer Satisfaction
Reliability	0.841**
Responsiveness	0.812**
Assurance	0.801**
Tangibility	0.843**
Empathy	0.854**

Source: Developed From SPSS

Table 10: Hypothesis Testing

Hypothesis	Findings	Strength	Result
H1: There is a significant relationship between reliability and customer service satisfaction within Malaysia Airlines.	0.841	Positive	H1 is accepted
H2: There is a significant relationship between responsiveness and customer service satisfaction within Malaysia Airlines.	0.812	Negative	H2 is rejected
H3: There is a significant relationship between assurance and customer service satisfaction within Malaysia Airlines.	0.801	Negative	H3 is rejected
H4: There is a significant relationship between tangibility and customer service satisfaction within Malaysia Airlines.	0.843	Positive	H4 is accepted
H5: There is a significant relationship between empathy and customer service satisfaction within Malaysia Airlines.	0.854	Positive	H5 is accepted

Source: Developed From SPSS

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CUSTOMER SATISFACTION TOWARDS FOODPANDA SERVICE DELIVERY IN KLANG VALLEY

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Abstract: *This study explores customer satisfaction toward Foodpanda's service delivery in Klang Valley, focusing on how service quality and food quality contribute to users' overall experience in Malaysia's rapidly expanding post-pandemic online food delivery (OFD) landscape. As consumer expectations continue to shift in urban environments, updated insights are needed to understand the factors that shape satisfaction within platform-based food services. A quantitative survey was conducted among active Foodpanda users, using established SERVQUAL and OFD-specific measures to assess perceptions of both service performance and food attributes. The results highlight that food quality plays a central role in shaping satisfaction, particularly through elements such as freshness, taste, temperature, and packaging integrity. Service quality also remains important, with reliability and responsiveness emerging as key contributors to positive user experiences. These findings reinforce the relevance of e-SERVQUAL and Expectancy Disconfirmation Theory in explaining satisfaction within digital delivery ecosystems, where operational consistency and customer expectations intersect. Overall, the study offers practical implications for improving delivery reliability, food handling practices, and customer experience management. It provides timely insights for OFD platforms and foodservice operators in dense urban regions like Klang Valley, where delivery conditions and product quality are critical for sustaining customer satisfaction and platform competitiveness.*

Keywords: *Customer Satisfaction, Service Quality, Food Quality, Online Food Delivery*

Introduction

Malaysia's OFD market has continued to expand since the pandemic, with platform-to-consumer services and quick commerce (q-commerce) becoming entrenched in urban lifestyles. Statista projects Malaysia's Online Food Delivery revenue to reach US\$3.22 billion in 2025 and grow at a 9.3% CAGR through 2030, reflecting persistent consumer adoption and platform innovations in meal and grocery delivery segments (Statista, 2025).

Foodpanda has strategically broadened service scope beyond meals to q-commerce through partnerships that compress delivery times and increase item availability. Notably, Foodpanda Malaysia and AEON announced a 2023 partnership enabling users to access ~13,000 items from AEON MaxValu, AEON Wellness, and Daiso stores with 30-minute deliveries (Foodpanda Malaysia, 2023). Klang Valley, the study's setting, is Malaysia's largest urban agglomeration (~8.8 million people in 2024).

Empirical studies post-2020 highlight evolving customer satisfaction drivers. A systematic literature review (UiTM, 2024) focused on Foodpanda reports that service quality, food variety, and promotions substantially affect satisfaction outcomes. Complementary OFD studies in Klang Valley (Zahidi et al., 2022) found ease of use, availability, and privacy significantly relate to satisfaction.

Problem Statement

Although OFD platforms have expanded rapidly, customer satisfaction toward Foodpanda's service delivery in Klang Valley remains variable, with mixed evidence on which factors most strongly matter now. Recent Malaysian work suggests food quality and service quality continue to be important, but perceived value, trust, and pricing can dominate satisfaction in digital settings (Ali et al., 2025). At the same time, risk perceptions during the MCO period negatively affected OFD usage intentions (Poon & Tung, 2022). Operational realities also complicate service delivery: rider safety and logistics pressure—including risky behaviors at intersections—can disrupt timeliness and food condition (UiTM, 2023; Sunway University, 2023). These inconsistencies create a research gap: despite many studies on OFD in Malaysia, a focused, updated case assessing Foodpanda's service delivery and food quality determinants of satisfaction within Klang Valley is needed.

Therefore, this study addresses the current level of customer satisfaction toward Foodpanda's service delivery in Klang Valley and identifies key service and food quality elements that influence satisfaction in the 2022–2025 context.

Literature Review

Service Quality

In OFD, service quality extends classical SERVQUAL (reliability, responsiveness, assurance, empathy, tangibles) to e SERVQUAL dimensions—fulfilment, efficiency, privacy/security, system availability—reflecting app mediated ordering, tracking, and delivery (Hasan, Mohammad Asri, Bashirun, & Mustakim, 2024). Foodpanda focused models in Malaysia find that trust, perceived usefulness, and price fairness can overshadow convenience or raw service quality in explaining satisfaction (Ali et al., 2025), while hospitality wide bibliometric work still places service quality at the core of satisfaction and loyalty outcomes (Olawuyi & Kleynhans, 2025). Complementary Malaysian synthesis on Foodpanda highlights service dimensions, variety, and promotions as recurring antecedents (Ahmad et al., 2024); and MSU affiliated research emphasises workforce capability and training as drivers of consistent service execution (Almabrouk, Azam, Tham, & Khatibi, 2024), with MSU work in Selangor pointing to ease of use and facilitating conditions as technology adoption enablers (Yeap & Md Kassim, 2024).

Large sample OFD analysis confirms reliability/assurance, system operation, traceability and maintaining food condition (treated within service quality) significantly increase satisfaction and reuse intention (Wu et al., 2024). Malaysian urban realities—risky riding behaviours and congestion—can degrade timeliness and reliability (Malik, Rusli, Mohd Nusa, & Adinegoro,

2023; Sunway University, 2023), while fast service/restaurant evidence underscores cleanliness, ambience, and waiting time in shaping reviews and overall evaluations (Amoozegar et al., 2025; Norazha et al., 2022/2023). Hospitality literature reviews from 2024 reiterate SERVQUAL's relevance and the importance of recovery/communication in service systems (Abdulrab & Hezam, 2024).

Given mixed effect sizes for service quality after including trust/value constructs (Ali et al., 2025), instruments for Klang Valley should cover fulfilment reliability, responsiveness, assurance/security, and system availability, and explicitly account for usability/trust pathways typical of app ecosystems (Hasan et al., 2024; Olawuyi & Kleynhans, 2025). MSU affiliated work underscores training & development for frontline consistency (Almabrouk et al., 2024) and facilitating conditions/social influence for digital adoption (Yeap & Md Kassim, 2024), supporting inclusion of capability/usability covariates in the service quality block for Foodpanda's dense urban operations.

Food Quality

Food quality continues to be identified as the most influential determinant of customer satisfaction in Malaysian OFD research, particularly through attributes such as taste, freshness or temperature, presentation, packaging integrity, and menu variety (Hasan, Ibrahim, & Koh, 2025; Ling et al., 2024). Post-pandemic work also highlights that food quality interacts with health considerations and price value to shape continuance intention, with gender moderating some behavioural pathways (Teo, Liew, & Lim, 2024). A systematic review specifically analysing Foodpanda's Malaysian market performance further supports food variety and promotional initiatives as recurrent antecedents of positive consumer evaluations (Ahmad et al., 2024).

Additional insight comes from MSU-affiliated research that examines consumer perceptions toward local food experiences. A study by Ibrahim, Shariffuddin, Zain, Salim, and Zainul, (2023) exploring food destination reputation and perceived value found that consumers evaluate food based not only on sensory attributes, but also on *perceived experiential value* and *attractiveness*. Although conducted in the context of Melaka's local food scene, the findings underscore that Malaysian consumers commonly use broader value-based judgements when assessing food quality. This aligns with OFD behaviour, where consumers rely on platform images, food descriptions, branding cues and perceived reputation when forming expectations of delivered food.

Recent scientific discussion also points to the importance of intelligent and active packaging technologies—such as freshness indicators and thermal-stability materials—in sustaining food quality during last-mile delivery (Abekoon et al., 2024). Local Malaysian studies on packaging practices reveal that structural durability and hygiene standards significantly influence consumers' perception of food quality, particularly when food is transported under urban conditions (Noh Nik Wan et al., 2024). Considering Klang Valley's traffic density and rider-related delivery risks, maintaining packaging integrity becomes a critical factor in protecting temperature, freshness and taste during delivery (Wu et al., 2024; Malik et al., 2023).

Thus, food quality in this study is operationalised not only through sensory and physical dimensions but also through experiential and value-based perceptions consistent with Malaysian consumer behaviour and supported by MSU-affiliated evidence (Ibrahim et al., 2023).

Customer Satisfaction

Customer satisfaction in OFD contexts emerges from a blend of service quality, food quality, perceived value, trust, price fairness, and overall platform usability (Ali et al., 2025; Ahmad et al., 2024). Malaysian Foodpanda-focused studies emphasise that trust, perceived usefulness, and price fairness frequently outweigh convenience when predicting satisfaction (Ali et al., 2025). Hospitality-wide bibliometric findings also highlight service quality as a stable predictor of satisfaction and customer loyalty (Olawuyi & Kleynhans, 2025). Consistent with these conclusions, large-scale OFD models reveal that reliability, assurance, and system operation significantly drive satisfaction and intention to reuse the platform (Wu et al., 2024).

Post-pandemic OFD behaviour also indicates that health considerations, food quality, service quality, and perceived value form integrated determinants of continuance intention, with gender moderating the role of service quality and ease of use (Teo et al., 2024). Social influence, promotional appeal, and perceived time-saving benefits further contribute to satisfaction formation within the Malaysian OFD market (Mansor et al., 2025). Delivery-related risks such as congestion and rider safety concerns influence satisfaction indirectly through their effect on delivery timeliness and food condition (Malik et al., 2023; Sunway University, 2023).

MSU-affiliated research by Ibrahim et al. (2023) reinforces the role of perceived value in shaping consumer satisfaction. Their findings demonstrate that perceived value and food attractiveness significantly contribute to satisfaction and behavioural intention within the Malaysian food consumption context. This aligns closely with OFD environments where consumers judge satisfaction not solely on the delivered product, but on the value experience created through convenience, presentation, reputation and overall perceived worth. Therefore, the conceptualisation of satisfaction in this study incorporates both operational service factors and psychological value-based drivers consistent with the MSU research perspective.

Methodology

The primary instrument is a structured questionnaire divided into sections: demographics, service quality, food quality, and customer satisfaction. Items were adapted from SERVQUAL and OFD-specific scales validated in Malaysian studies (Zuhairah Hasan et al., 2024; Ahmad et al., 2024). Reliability was assessed using Cronbach's Alpha (>0.7 threshold), ensuring internal consistency (Mat Hasan et al., 2025).

The target population comprises office workers, students, and housewives in Klang Valley. Klang Valley is selected due to its high OFD penetration and urban density. According to the Department of Statistics Malaysia (DOSM), Klang Valley's population exceeds 7.5 million, making it a representative urban cluster for OFD studies (DOSM, 2023). This large population

ensures diversity in demographics, which is critical for generalizing findings (Mansor et al., 2025).

A non-probability random sampling technique was used to select 295 respondents who had prior experience with Foodpanda. The sample size is justified based on statistical power requirements for correlation and regression analysis, where $N > 200$ is recommended for reliable estimates (Ali et al., 2025; Mat Hasan et al., 2025). Inclusion criteria: respondents must have used Foodpanda at least once in the past 6 months. Exclusion: respondents unfamiliar with OFD services. This approach balances feasibility and representativeness for bachelor-level research.

Data Analysis

Based on Table 1, it shows some items have a high average mean 2.8 to 3.05, where most of the respondents give a positive feedback. In these results, there have 295 observations. The higher score of mean is food quality which is 3.010 and the lowest score of mean is service quality. For the standard deviation, the service quality has value at 0.33 while the food quality, the standard deviation is 0.40 and the standard deviation for customer satisfaction is value at 0.42.

Table 1 - Descriptive Statistics

	Mean	Std. Deviation
Tangibility	3.010	0.429
Reliability	3.019	0.734
Responsiveness	3.011	0.424
Assurance	2.980	0.423
empathy	3.016	0.413
Service Quality	2.802	0.330
Food Quality	3.010	0.403
Customer Satisfaction	3.056	0.426

N=295

The variables are service quality and food quality to the customer satisfaction. Base on Table 2, the relationship of the service quality and food quality shows a value of 0.00. In addition, the relationship value of customer satisfaction towards service quality and food quality also shows significant relationships, which are 0.00 and 0.00 respectively.

Table 2 - Pearson Correlation

Variables	1	2	3
Service Quality	--	.684**	.599**
Food Quality		--	.722**
Customer Satisfaction			--

** . Correlation is significant at the 0.01 level (2-tailed)

Data at Table 3 shows that customer satisfaction represents adjusted R^2 is 54% to the service quality and food quality that are supported by R^2 , 54%, it shows that the service quality is significant to the customer satisfaction. This is because the value shows on t-test is 3.650, which is highly significant by referring to $p > 0.00$. Not just that, the food quality also shows a highly significant relationship to the customer satisfaction by referring to the $p > 0.00$, which the t-test value is 10.813.

Table 3 - Multiple Regression

Statistic	Value
R	.736
R^2	.542
Adjusted R^2	.539
Std. Error of the Estimate	.28933

In this study, hypotheses testing is to find the relationship of customer satisfaction between service quality and food quality. Table 5 shows a summary of hypotheses testing. The result for H1 and H2 are accepted. Table 5 is the summary of hypotheses testing.

Table 5 - Hypothesis testing

Hypothesis	Result
H1: There is a relationship between Service Quality and Customer Satisfaction.	Accepted
H2: There is a relationship between Food Quality and Customer Satisfaction.	Accepted

Conclusion

This study examined customer satisfaction toward Foodpanda's service delivery in Klang Valley, focusing on the influence of service quality and food quality. The findings confirm that both variables significantly affect satisfaction, with food quality emerging as the most influential predictor. Regression analysis demonstrated that food quality ($\beta = .587$, $p < .001$) had a stronger impact than service quality ($\beta = .198$, $p < .001$), explaining 54% of the variance in customer satisfaction. These results align with recent Malaysian OFD studies emphasizing the primacy of food attributes—such as freshness, taste, and packaging integrity—in shaping consumer evaluations (Effendi et al., 2025; Hasan et al., 2025).

Service quality remains relevant, particularly dimensions such as reliability and responsiveness, which were found to contribute positively to satisfaction. This supports the continued applicability of SERVQUAL and its digital adaptation, e-SERVQUAL, in online food delivery contexts (Zuhairah Hasan et al., 2024). Reliability, in particular, was identified as the most influential service quality dimension, consistent with prior research highlighting the importance of accurate order fulfillment and timely delivery in urban environments (Wu et al., 2024; Norazha et al., 2022).

Theoretically, the study reinforces Expectancy Disconfirmation Theory (EDT) as a robust framework for understanding satisfaction formation in digital service ecosystems. Practically,

the findings suggest that Foodpanda and similar platforms should prioritize operational strategies that safeguard food quality during last-mile delivery. This includes investing in temperature-preserving packaging, improving rider training, and implementing real-time tracking systems to enhance reliability (Abekoon et al., 2024; Malik et al., 2023). Additionally, service recovery mechanisms and transparent communication can further strengthen customer trust and loyalty in competitive OFD markets (Ali et al., 2025).

From a policy perspective, the results underscore the need for regulatory frameworks that address rider safety and delivery standards, as these factors indirectly influence service reliability and customer satisfaction (Sunway University, 2023). Given Klang Valley's high traffic density and gig-economy dynamics, such measures are critical for sustaining service quality in urban OFD operations.

Despite its contributions, the study is limited by its non-probability sampling and geographic focus on Klang Valley, which may restrict generalizability. Future research should explore moderating effects of trust, perceived value, and usability, as well as comparative analyses across different regions and platforms (Teo et al., 2024; Mansor et al., 2025). Incorporating qualitative insights could also enrich understanding of consumer expectations and behavioral drivers in Malaysia's evolving OFD landscape.

In conclusion, food quality remains the cornerstone of customer satisfaction in online food delivery, complemented by reliable service execution. By addressing these critical factors, Foodpanda and similar platforms can enhance customer experience, foster loyalty, and maintain competitive advantage in Malaysia's rapidly growing OFD market.

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PERCEIVED RISK AND HEALTHY EATING DETERMINANTS: A STUDY AMONG STUDENTS IN SHAH ALAM

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Abstract: *This study examines the relationship between perceived risk and the determinants of healthy eating behaviours among students at Management and Science University (MSU), Shah Alam. It explores key factors influencing students' dietary practices, including the social environment, physical environment, social media exposure, and individual perceptions of health risks. University students are particularly susceptible to unhealthy eating patterns due to academic pressures, financial constraints, and environmental influences, making them an important population for health behaviour research. A quantitative research design was employed, and data were collected from 300 students using structured questionnaires distributed across the campus. The study aimed to evaluate how social influences, accessibility, media exposure, and perceived health risks shape students' healthy eating behaviours. The findings from the multiple regression analysis revealed that all examined variables significantly influenced healthy eating behaviours, with perceived risk emerging as the strongest predictor. Social media and the social environment also demonstrated significant positive effects, while the physical environment showed a smaller yet meaningful contribution. Overall, the results highlight the combined importance of individual perceptions and environmental factors in promoting healthy eating among university students. These findings provide valuable insights for the development of campus-based health interventions, policy initiatives, and educational programmes aimed at fostering healthier dietary habits.*

Keywords: *Healthy Eating, Physical Environment, Social Environment, Perceived Risk, Social media*

Introduction

University students are particularly vulnerable to unhealthy dietary patterns due to the widespread availability of appealing yet nutritionally poor food options, limited access to cooking facilities, and insufficient nutritional knowledge. Given the unique food environment and demographic characteristics of higher education institutions, universities are well-positioned to develop and implement targeted interventions aimed at improving students' eating behaviours.

The concept of "healthy eating" is often subjective and shaped by individual understanding of food content. For instance, products labelled as low-fat, organic, or low-sugar are commonly perceived as healthier choices, although these perceptions may not always align with nutritional guidelines (Schultchen et al., 2019). Several key factors influence students' food choices,

including sensory appeal, hygiene standards, cost, availability, and time constraints. Social influences, particularly from family, friends, and peers also play a significant role in shaping dietary habits (Huatangari et al., 2023). Among these, food cost has been identified as a major barrier, especially within the physical environment of university settings. Besides, the social environment contributes to students' eating behaviours through both direct and indirect influences.

In addition, family habits established during childhood often persist into university life, and the level of family support can either encourage or hinder healthy eating practices. Similarly, peer influence can affect meal timing and food choices, which may lead students to feel compelled to align their eating habits with prevailing social expectations or peer-related status norms" (Alshehri et al., 2023). Promoting proper eating habits and regular physical activity is essential for preventing chronic non-communicable diseases, many of which stem from behavioural and non-modifiable risk factors. A balanced approach to diet and exercise can significantly enhance quality of life and reduce the risk of long-term health complications (Cerqueira Sousa et al., 2022).

In today's digital age, social media plays a prominent role in shaping students' food consumption patterns. It serves as a primary source of information and inspiration, influencing dietary choices through visually appealing content and trends. While social media can be a powerful tool for promoting culinary exploration and awareness, it also has the potential to negatively impact students' perceptions and behaviours related to healthy eating (Patwardhan et al., 2024).

Literature Review

Healthy Food

Healthy food is increasingly viewed as a fundamental human right, requiring accessibility, cultural relevance, affordability, and sustainable production while reflecting principles of balance, variety, moderation, and enjoyment (Cerqueira Sousa et al., 2022). Consumer perceptions of food healthiness extend beyond nutritional content to include sensory pleasure, satisfaction, and beliefs in purity and naturalness, which contribute to the preference for organic foods perceived as minimally processed and free from additives or chemical residues (Ditlevsen et al., 2019). Scientific evidence shows that plant-based dietary patterns, such as the Mediterranean diet, play a significant role in reducing chronic non-communicable diseases through higher intake of fruits, vegetables, legumes, whole grains, and nuts, and lower consumption of processed meats (Cena & Calder, 2020). Growing interest in healthy eating has shaped global labelling practices, with countries using terms such as "foods for specific health uses," "functional foods," and "healthy foods," yet consumers across contexts consistently associate healthy eating with balance, moderation, and dietary diversity (Cuesta-Valiño et al., 2020). Additionally, health literacy strongly influences dietary behaviour, as low health literacy is linked to poor health decisions, higher hospitalization rates, and inadequate preventive practices, demonstrating that general literacy does not necessarily translate into effective health literacy, as evidenced in the Philippines (Cecila & Zamora, 2019; WHO, 2013).

Behaviour Towards Healthy Eating Among Students

Healthy eating behaviour involves conscious, repeated, and socially influenced actions that shape students' dietary choices. University students are particularly vulnerable to unhealthy eating due to stress, limited time and rest, financial constraints, and lifestyle changes. Although students in nutrition- or culinary-related fields are expected to eat healthier, evidence remains inconsistent regarding whether nutrition knowledge improves eating habits (Medina et al., 2020). Motivations such as weight control and illness prevention also shape behaviour, yet definitions of healthy eating vary widely, while problematic behaviours like food restriction, binge eating, or purging may escalate into clinical eating disorders (Schultchen et al., 2019; Rosen et al., 2023). Social environments strongly influence eating patterns, with family and peer interactions shown to encourage both food intake and healthier choices (Ragavi & Muthu Meenakshi, 2024). Health literacy further mediates associations between sociodemographic factors and health-promoting behaviours, and ecological studies highlight multilevel determinants such as peer support, food prices, taste preferences, and media exposure (Lai et al., 2021). Time constraints remain a major barrier, leading many students to rely on convenient, low-nutrient foods whose long-term health effects may emerge later in life (Wongprawmas et al., 2022).

Physical Environment

The physical environment plays a central role in shaping healthy eating behaviour, as individuals' food choices are influenced by their interactions with family, friends, home, school, workplace, and broader societal structures (Marcone et al., 2020). Research shows that although adolescents and young adults understand what constitutes healthy food, this awareness does not always translate into healthier choices, often due to convenience, temptation, and value-for-money considerations (Neufeld et al., 2022). Home food availability, accessibility, and the growth of online food delivery further shape dietary habits, frequently promoting energy-dense, low-nutrient foods over healthier options (Ragavi & Muthu Meenakshi, 2024). University settings also present barriers, as healthier foods tend to be less available and more expensive, whereas appealing unhealthy options are widely accessible (Li et al., 2022). Additional constraints such as limited cooking facilities, inadequate storage, and shared kitchen conditions further restrict students' ability to prepare nutritious meals (Hafiz et al., 2023). Besides, based on the demographic factor of respondents, the habits of choosing healthy foods are increasing as it has been known that the majority of Malaysians are obese. (Jamaludin et al., 2021). These findings highlight that the physical environment significantly influences students' ability to practice healthy eating.

Social Environment

The social environment plays a critical role in shaping students' eating behaviours, as food choices are strongly influenced by family practices, peer norms, cultural beliefs, and daily social interactions (Mollaei et al., 2023). Students often adopt eating habits that mirror those within their immediate social circles, making it difficult to recognise the benefits of healthy eating when unhealthy norms are normalised. Family and peer influence can encourage healthier choices, but can also promote negative behaviours that contribute to weight gain and

poor diet quality, particularly when social pressure reinforces unhealthy eating patterns (Amore et al., 2019). Social–cultural values transmitted through family traditions and peer groups further shape perceptions of what is considered acceptable or “normal” food, creating long-lasting habits that are difficult to change (Oljans et al., 2024). Research highlights that poor eating habits formed during adolescence can persist into adulthood, increasing risks of nutrition-related diseases and negatively affecting long-term wellbeing and productivity, underscoring the need for awareness programmes and interventions targeting adolescent dietary behaviour (Ragavi & Muthu Meenakshi, 2024). In addition, emotional and psychological factors such as guilt, body image, and food-related attitudes contribute to students’ decisions to eat healthily, while limited parental control during university years increases independence and may expose young adults to more unhealthy food choices (Huang & Liu, 2021; Deliens et al., 2014). Overall, the social environment significantly shapes students’ behaviour toward healthy eating through the combined influence of social norms, family practices, peer networks, and cultural values.

Perceived Risk

Perceived risk strongly shapes university students’ healthy eating behaviours, as their daily routines and reliance on convenient food outlets often lead to poor dietary choices (Cerqueira Sousa et al., 2022). Students frequently consume high-calorie, high-sugar, and high-fat foods, increasing their risk of chronic non-communicable diseases such as obesity and diabetes. Emotional factors—such as stress, mood fluctuations, and reward-seeking—also contribute to overeating and preference for unhealthy foods (Kent et al., 2024). Research shows that the transition to university is associated with higher intake of fast food and snacks and lower consumption of fruits, vegetables, and essential nutrients, which may lead to metabolic disorders, cardiovascular diseases, and reduced academic performance (Antwi et al.). Despite these risks, many students underestimate the health consequences of their eating habits, believing they have control over their diets. Obesity remains a major perceived risk, driven by inadequate nutrient intake and excessive sugar and fat consumption (Huang & Liu, 2021).

Social Media

Social media has become a major influence on students’ eating behaviour due to constant exposure to food images, recipes, and influencer-driven content. Research shows that widespread use of platforms such as Instagram, YouTube, and food-related channels shapes students’ taste preferences, food choices, and awareness of dietary trends (Keser et al., 2020; Khayrina Kamarudzaman et al., n.d.). Viewing food content is linked to increased desire to eat, higher calorie intake, and even higher BMI. Studies also show associations between food-related social media exposure and body image concerns, eating disorders, and unhealthy consumption patterns (Wu et al., 2024). At the same time, influencers play an important role in promoting healthy eating by serving as informal nutrition educators who shape followers’ dietary decisions (Pilař et al., 2021). Evidence further indicates that nutrition-focused content can motivate young adults to adopt healthier choices, highlighting both positive and negative impacts of social media on eating behaviour (Klassen et al., 2018). Social media serves as an essential communication platform for both individuals and businesses, and it functions as a

significant source of user-generated big data that supports customer analysis processes. (Mazme et al., 2022).

Research Methodology

A cross-sectional design collects data at a single point in time and is commonly used to examine differences or associations across subgroups sharing similar characteristics. Unlike experimental or longitudinal studies, it does not track changes over time but allows researchers to analyse multiple variables—such as age, gender, education, or location—simultaneously (Allen, 2017). In this study, a cross-sectional approach was used to target a specific population of young Generation Z individuals aged 12–27, who have internet access and provided direct consent to participate (Keser et al., 2020). This design enables the observation and comparison of variables across different demographic groups relevant to the research objectives.

Population and Sampling

In this study, the population consists of students at Management and Science University (MSU), specifically Generation Z individuals aged 12–27. Furthermore, the sample size follows recommended guidelines, where a minimum ratio of 5 respondents per variable is required, although a higher ratio of 15:1 or 20:1 is encouraged for more robust analysis (Hair et al., 2018; Tbachnick & Fidell, 1989). Based on these recommendations, approximately 300 respondents were targeted (Ali Memon et al., 2020). Moreover, a non-probability convenience sampling technique was used due to its practicality, cost-effectiveness, and suitability for quantitative studies, despite its limitations in generalisability. To minimise bias, diverse participants were selected and an adequate sample size was ensured (Golzar & Tajik, 2022). Similarly, previous studies using convenience sampling, such as Goerke et al. (2024), also targeted young participants aged 12–27 through survey questionnaires.

Data Collection

Data were collected using an online survey developed through Google Forms and distributed via QR code across social media platforms accessible to Management and Science University (MSU) students. This approach enabled efficient dissemination and supported wide reach through platforms such as WhatsApp and Instagram, aligning with students' digital habits. The Google Form allowed respondents to complete the questionnaire easily using their mobile devices, while the QR code provided quick and convenient access. This method ensured greater accessibility and increased the likelihood of obtaining a diverse and representative sample of MSU students. The survey employed a five-point interval scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) to measure respondents' level of agreement with each statement. Closed-ended questionnaires are commonly used to obtain quantitative data and typically incorporate several of the “seven basic question types,” which include quantity or information, category, list or multiple choice, scale, ranking, complex grid or table, and open-ended formats (Benkharafa, 2013). In this study, closed-ended questions were employed to facilitate straightforward responses and ensure efficient data collection from university students. This approach enables each item to align clearly with the study variables, allowing the information to be gathered systematically and analysed more easily.

Data Analysis

Multiple regression analysis is a statistical technique used to examine the relationship between two or more independent variables (predictors) and a single dependent variable. It is particularly useful for identifying how multiple factors simultaneously influence an outcome, as well as determining the strength and direction of each variable's effect. Through this method, researchers can assess which predictors contribute most significantly to the dependent variable and whether these relationships are positive or negative. Rather than relying on assumptions, multiple regression provides an evidence-based approach for making predictions and understanding complex variable interactions. Owing to its ability to offer comprehensive insights into multifactor relationships, this technique is widely applied across disciplines such as education, psychology, business, economics, and healthcare (Akinwande et al., 2015).

Research Analysis and Findings

Table 1: Summarized of Demographic Profile

Items	Frequency	Percentage (%)
Gender		
Male	137	45.1%
Female	167	54.9%
Total	300	100%
Qualification		
Foundation	39	12.8%
Diploma	92	30.3%
Bachelor	173	56.9%
Total	300	100%
Living		
Family	142	46.7%
Alone	113	37.2%
Friends	49	16.1%
Total	300	100%

As shown in Table 1, the sample comprised 300 respondents, of which 54.9% were female ($n = 167$) and 45.1% were male ($n = 137$). In terms of educational attainment, most respondents were pursuing a Bachelor's degree (56.9%), followed by Diploma (30.3%) and Foundation studies (12.8%). Regarding living arrangements, 46.7% lived with family, 37.2% lived alone, and 16.1% lived with friends. These demographic patterns provide a clear overview of the respondents' backgrounds and support the interpretation of how socio-demographic factors may influence students' healthy eating behaviour.

Descriptive statistics were used to summarise and interpret the data collected from respondents. This statistical technique provides an overview of the distribution, central tendencies, and variability of the variables measured in the study. Although descriptive statistics do not allow for prediction or inferential comparisons, they are essential for organising large datasets into meaningful summary measures and preparing the data for subsequent analyses. The descriptive

results for each construct are presented in Tables 2 to 6. Across the variables—healthy eating behaviour, physical environment, social environment, perceived risk, and social media—mean scores indicate the general tendencies of Generation Z students at MSU. These summaries highlight how students perceive their eating habits, the availability of healthy food options, the social influences surrounding their diet, their awareness of health risks, and the role of social media in shaping food choices.

Table 2: Descriptive Results Behaviour Healthy Eating Toward Students

Variables	Items	Mean	Std. deviation
Behavior healthy eating towards students	Often, I engage in a particular eating behavior to achieve a healthier lifestyle.	3.33	1.125
	My eating behavior is only influenced by the immediate consequences of my actions.	3.47	1.089
	My convenience eating habits is a big factor in the food I choose or my eating behavior.	3.41	1.183
	I am willing to sacrifice the immediate happiness or well-being I get from my eating behavior.	3.26	1.190

Table 3: Descriptive Results Physical Environment

Variables	Items	Mean	Std. deviation
Physical environment	Cooking healthy food is easier than unhealthy food	3.51	1.244
	There are many healthy foods in my university	3.36	1.231
	Fast foods are easily and quickly available around me	3.98	1.092
	There are many high cost of healthy foods around me	3.82	1.049

Table 4: Descriptive Results Social Environment

Variables	Items	Mean	Std. deviation
Social environment	My families and friends always eat healthy foods	3.39	1.062
	My families and friends encouraged me to buy healthy foods	3.48	1.086
	My families and friends gave me ideas to eat more healthy foods	3.53	1.172
	My peers praised the advantages of eating healthy foods	3.53	1.122

Table 5: Descriptive Results Perceived Risk

Variables	Items	Mean	Std. deviation
Perceived Risk	I consider how my health risk might be in the future with my day to day eating behaviors	3.57	1.147
	I am well informed about the long term consequences of a healthy diet	3.69	1.143
	Consuming healthy food helps reduce health risk	3.77	1.115
	I think it's risky to develop health related issues if I do not consume healthy food	3.65	1.134

Table 6: Descriptive Results Social Media

Variables	Items	Mean	Std. deviation
Social Media	I search healthy food related topic on social media	3.46	1.154
	I regulate my diet according to shared news/photos/videos about the foods/dishes that I see on social media	3.18	1.304
	I think foods/dishes with more like/share on social media are healthier	3.12	1.243
	The more I spend my time on social media, my desire to eat increases and I eat more	3.55	1.166

A reliability test was conducted on a preliminary sample of 300 Generation Z students at MSU to assess the internal consistency of the questionnaire items. Cronbach's alpha was used as the primary indicator of reliability, as it measures how closely related a set of items are in representing a single construct. A value of $\alpha \geq 0.70$ is generally considered acceptable, indicating that the items reliably measure the intended variable. As shown in Table 7, all constructs in the study are healthy eating behaviour, physical environment, social environment, perceived risk, and social media. In this research was recorded Cronbach's alpha values above 0.70. These results confirm that each variable achieved satisfactory reliability, and the instrument is suitable for further statistical analysis.

Table 7: Reliability Test of 300 Respondents

No	Variable	Total items	$\alpha \geq 0.7$
1	Behaviour Healthy Eating Toward Students	4	0.720
2	Physical Environment	4	0.708
3	Social Environment	4	0.802
4	Perceived Risks	4	0.705
5	Social Media	4	0.730

Multiple regression analysis was employed to examine the relationship between the independent variables are physical environment, social environment, perceived risk, and social media and the dependent variable, healthy eating behaviour among students. This statistical method allows researchers to determine how strongly each predictor contributes to the outcome variable and whether the relationships are positive or negative. To ensure the validity of the model, several assumptions were assessed, including sample size adequacy, multicollinearity, and normality (Akinwande et al., 2015).

Assumption 1: Sample Size

A total of 300 respondents were included, meeting the recommended ratio of 15 respondents per item as suggested by Hair et al. (2018). This sample size is sufficient for conducting multiple regression analysis.

Assumption 2: Multicollinearity

Tolerance and Variance Inflation Factor (VIF) values were examined to assess multicollinearity. All predictors showed tolerance values above 0.70 and VIF values below 2, indicating no multicollinearity concerns and confirming that the independent variables were distinct.

Assumption 3: Normality

Normal P–P plots and scatterplots were reviewed to evaluate the distribution of residuals. The data points were closely aligned with the reference line, suggesting that the residuals followed a normal distribution with minimal deviations. Scatterplots also showed that most points fell within the acceptable range, further supporting the normality assumption. Overall, the regression model met all required assumptions, allowing for accurate interpretation of the relationship between variables.

The hypothesis testing results are presented using the model summary, ANOVA, and coefficient outputs from the multiple regression analysis. The overall model explains 29.2% ($R^2 = 0.292$) of the variance in students' healthy eating behaviour (Table 4.9), indicating a modest explanatory power. The ANOVA results confirm that the model is statistically significant, $F(4, 295) = 30.391$, $p < 0.001$, demonstrating that the set of predictors collectively influences healthy eating behaviour (Table 4.10).

The regression coefficients show that all four independent variables exert significant positive effects on healthy eating behaviour among MSU students (Table 4.11). The physical environment significantly predicts healthy eating behaviour ($\beta = 0.054$, $t = 2.083$, $p = 0.038$), supporting H1. The social environment also shows a significant relationship ($\beta = 0.050$, $t =$

3.431, $p < 0.001$), confirming H2. Similarly, perceived risk demonstrates the strongest effect ($\beta = 0.057$, $t = 5.340$, $p < 0.001$), supporting H3. Lastly, social media is also a significant predictor ($\beta = 0.050$, $t = 3.573$, $p < 0.001$), confirming H4.

Overall, the findings indicate that the physical environment, social influences, perceived health risks, and social media usage each play a meaningful role in shaping students' healthy eating behaviour. All four hypotheses are therefore accepted (Table 4.12).

Table 10: ANOVA Test Result

Model		Sum of Squares	df	Mean Square	F	Sig
1	Regression	998.803	4	249.701	30.391	<0.001
	Residual	2423.793	295	8.216		
	Total	3422.597	299			

Table 11: Summarized Results of Hypotheses Testing

Hypothesis	Variables	B	t	p	Results
H1	Physical environment -> Behaviour healthy eating toward students	0.054	2.083	0.04	Accepted
H2	Social environment -> Behaviour healthy eating toward students	0.050	3.431	0.01	Accepted
H3	Perceived risk-> Behaviour healthy eating toward students	0.057	5.340	0.01	Accepted
H4	Social media -> Behaviour healthy eating toward students	0.050	3.573	0.01	Accepted

Significant at $p < .05$

Discussion

Healthy eating is essential for maintaining wellbeing, and students who understand its importance are more likely to adopt positive eating habits. The findings of this study show that the social environment is the strongest predictor of healthy eating behaviour among MSU students. Students are highly influenced by family, friends, and peers, whose habits and encouragement shape their daily food choices. As stated by Mollaei et al. (2023), the eating behaviours learned at home and practiced within social circles continue to influence students throughout university life and beyond.

Social media also shows a significant positive impact on healthy eating behaviour. Students gain motivation, awareness, and encouragement from online content, and social platforms can serve as tools for peer education and health promotion (Watanabe-Ito et al., 2020). This suggests that social media can effectively support healthy eating practices among students.

Although the physical environment showed the weakest correlation, it still significantly affects eating behaviour. Factors such as food accessibility, pricing, transportation, and available cooking facilities influence students' ability to make healthy choices. Without supportive

environmental conditions, maintaining healthy habits becomes challenging (Mollaei et al., 2023).

Lastly, perceived risk also demonstrated a significant effect, even though many students underestimate the long-term health consequences of unhealthy eating. As noted by Huang and Liu (2021), young individuals often overlook nutritional risks because they believe adverse health outcomes will not affect them at their age. This lack of awareness contributes to unhealthy eating patterns, making perceived risk an important predictor of healthy eating behaviour.

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STAKEHOLDER READINESS IN MUSLIM FRIENDLY CULTURAL TOURISM

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Abstract: *Islamic tourism is embedded within the socio-cultural fabric of society, requiring development strategies that reflect both tangible and intangible cultural dimensions. This study aims to assess stakeholder readiness to comply with Muslim-Friendly Cultural Tourism (MFCT) guidelines in Malaysia, thereby evaluating the feasibility of integrating Muslim-Friendly Tourism (MFT) principles into cultural tourism practices. A quantitative research design was employed, drawing on descriptive statistical analysis and ANOVA. Data were collected from 200 tour operators to examine their awareness, preparedness, and compliance with MFCT guidelines. The results indicate that MFCT implementation is feasible in Perlis, supported by strong stakeholder awareness and readiness. Readiness was categorised into five dimensions: syariah compliance, provision of halal food, availability of prayer facilities, delivery of Islamic services, and gender separation measures. These categories highlight the extent to which tourism stakeholders are prepared to align with MFCT principles. The findings underscore the potential for MFCT to enhance Malaysia's positioning as a leading global destination for Muslim-Friendly Tourism. Effective implementation requires addressing governance challenges, particularly the fragmented issuance of fatwas by State Mufti Departments, improving service provider knowledge of MFT principles, and ensuring the maintenance of cultural heritage sites. This study concludes that MFCT guidelines can be effectively implemented among tourism stakeholders in Perlis, contributing to Malaysia's broader aspiration to strengthen its global reputation in Muslim-Friendly Tourism. By situating cultural tourism within the framework of Islamic values, MFCT offers a strategic pathway for sustainable tourism development and enriches the cultural experience for Muslim travellers.*

Keywords: *Muslim Friendly Tourism, Cultural Tourism, Islamic Tourism*

Introduction

Tourism has long been recognized as a catalyst for socio-economic growth, cultural exchange, and national identity formation (UNWTO, 2023). Within this broad domain, Islamic tourism has emerged as a significant niche, reflecting the values, practices, and cultural heritage of Muslim communities worldwide. Unlike conventional tourism, Islamic tourism emphasizes both tangible and intangible cultural dimensions, ensuring that travel experiences are aligned with syariah principles while simultaneously preserving cultural authenticity (Battour &

Ismail, 2016). This dual emphasis positions Muslim-Friendly Tourism (MFT) as a strategic pathway for destinations seeking to attract the expanding global Muslim travel market, which is projected to reach USD 225 billion by 2028 (Mastercard-CrescentRating, 2023).

Cultural tourism, defined as travel motivated by the desire to experience and engage with a destination's cultural assets, intersects closely with MFT (Richards, 2018). The integration of cultural heritage and Islamic values creates opportunities for destinations such as Malaysia to strengthen their appeal to Muslim travellers. Malaysia, with its rich cultural diversity and Islamic identity, has actively promoted itself as a hub for Muslim-Friendly Tourism and Hospitality (MFTH). The Islamic Tourism Centre (ITC) has initiatives to position Malaysia as a global model, collaborating with industry associations and international partners to enhance stakeholder capacity and awareness (Islamic Tourism Centre, 2023).

Despite these efforts, challenges persist in the governance and implementation of Muslim-Friendly Cultural Tourism (MFCT). At the federal and state levels, governance is complicated by the independent issuance of fatwas by State Mufti Departments, which often results in fragmented policy application (Hashim et al., 2020). Moreover, service providers frequently lack adequate understanding of MFT principles, while the maintenance and preservation of cultural sites remain inconsistent, undermining the overall tourist experience (Samori, Md Salleh, & Khalid, 2016). These issues highlight the need for systematic evaluation of stakeholder readiness to comply with MFCT guidelines.

Stakeholders such as tour operators play a pivotal role in translating guidelines into practice, ensuring that services meet the expectations of Muslim travellers. Assessing their readiness is therefore crucial to determine the feasibility of MFCT implementation. This study investigates stakeholder preparedness across five dimensions: syariah compliance, halal food provision, prayer facilities, Islamic services, and gender separation. By employing a quantitative approach with descriptive analysis and ANOVA, the research provides empirical insights into stakeholder awareness and capacity.

Ultimately, this study contributes to the discourse on Muslim-Friendly Tourism by highlighting the readiness of tourism stakeholders in Malaysia, particularly in Perlis, to adopt MFCT guidelines. The findings aim to inform policy, enhance service delivery, and support Malaysia's aspiration to position itself as a leading global destination for Muslim-Friendly Tourism.

Literature Review

Islamic Tourism and Muslim-Friendly Tourism

Islamic tourism has gained prominence as a niche market within global tourism, driven by the increasing demand for travel experiences that align with syariah principles (Battour & Ismail, 2016). The concept extends beyond religious obligations to encompass lifestyle preferences, including halal food, prayer facilities, modest services, and gender-sensitive arrangements (Samori, Md Salleh, & Khalid, 2016). Muslim-Friendly Tourism (MFT) thus represents a holistic approach to tourism development, integrating religious values with cultural authenticity to enhance the travel experience for Muslim visitors.

Cultural Tourism and Its Intersection with MFT

Cultural tourism, defined as travel motivated by engagement with a destination's cultural assets, has been recognised as a major driver of sustainable tourism development (Richards, 2018). The intersection of cultural tourism and MFT creates opportunities for destinations to leverage heritage, traditions, and Islamic identity as unique selling points. Malaysia, with its diverse cultural landscape and Islamic governance framework, is well-positioned to integrate cultural tourism with Muslim-friendly principles (Islamic Tourism Centre, 2023). However, challenges remain in ensuring that cultural heritage sites are adequately maintained and that service providers are equipped with knowledge of MFT standards (Mohamad et al, 2025).

Governance and Policy Challenges in Malaysia

Governance plays a critical role in the implementation of MFCT. In Malaysia, tourism governance is complicated by the decentralized issuance of fatwas by State Mufti Departments, which often results in fragmented policy application (Hashim, Murphy, & Hashim, 2020). This fragmentation can hinder the standardization of Muslim-friendly practices across states, creating inconsistencies in service delivery. Effective governance requires coordination between federal and state authorities, alongside capacity-building initiatives for tourism stakeholders.

Stakeholder Readiness and Theoretical Frameworks

Stakeholder theory emphasizes the importance of engaging diverse actors in tourism development, including government agencies, tour operators, service providers, and local communities (Freeman, 1984). In the context of MFCT, stakeholder readiness is critical to ensuring compliance with guidelines and delivering consistent Muslim-friendly services. Previous studies highlight that stakeholder awareness and preparedness significantly influence the success of tourism initiatives (Byrd, 2007). Assessing readiness across dimensions such as syariah compliance, halal food provision, prayer facilities, Islamic services, and gender separation provides a framework for evaluating feasibility and identifying gaps in implementation (Diton et al., 2023)

Towards Sustainable Muslim-Friendly Cultural Tourism

The integration of MFCT into Malaysia's tourism strategy aligns with broader goals of sustainable tourism development. By embedding Islamic values within cultural tourism, Malaysia can enhance its competitiveness in the global Muslim travel market while preserving cultural heritage (Diton et al, 2025). Addressing governance challenges, strengthening stakeholder capacity, and ensuring site maintenance are essential steps toward realizing Malaysia's aspiration to be a leading destination for Muslim-Friendly Tourism.

Research Methodology

This study employed a quantitative research design to assess stakeholder readiness for the implementation of Muslim-Friendly Cultural Tourism (MFCT) guidelines in Malaysia. A

quantitative approach was selected to provide measurable insights into stakeholder awareness, preparedness, and compliance across multiple dimensions. The design integrates descriptive statistical analysis and Analysis of Variance (ANOVA) to evaluate differences in readiness levels among tourism stakeholders.

Population and Sampling

The population of this study comprised tourism stakeholders, specifically tour operators registered in Malaysia. A sample of 200 tour operators was selected using purposive sampling, as these stakeholders play a central role in delivering tourism services and ensuring compliance with MFCT guidelines. The sample size was deemed sufficient to generate reliable statistical outcomes and to reflect stakeholder perspectives within the study context (Creswell & Creswell, 2018).

Data Collection

Data were collected through a structured questionnaire survey, designed to capture stakeholder perceptions and readiness across five dimensions:

- Syariah compliance
- Halal food provision
- Prayer facilities
- Islamic services
- Gender separation

The questionnaire employed a Likert scale to measure levels of agreement and readiness, ensuring consistency and comparability across responses. Prior to distribution, the instrument was validated through expert review and pilot testing to ensure clarity, reliability, and alignment with MFCT principles (Sekaran & Bougie, 2019).

Data Analysis

Collected data were analysed using descriptive statistics to summarize stakeholder readiness levels and identify patterns. ANOVA was employed to test for significant differences in readiness across stakeholder categories, providing insights into variations in compliance and preparedness. Statistical analysis was conducted using SPSS software, ensuring accuracy and reliability in data interpretation.

Research Analysis and Findings

Table 1: Descriptive Statistics of Stakeholder Readiness by Category

Stakeholder Group	N	Mean Readiness	Std. Deviation
Accommodation	28	4.12	0.41
Travel Agents	55	4.25	0.38
Food & Beverage	41	3.89	0.44
Tour Operators	45	4.31	0.36
Homestay	10	3.78	0.47

Others	21	3.95	0.42
Total	200	4.08	0.42

The descriptive statistics presented in Table 1 provide valuable insights into the levels of readiness among various tourism stakeholders to implement Muslim-Friendly Cultural Tourism (MFCT) guidelines. The analysis reveals notable differences across stakeholder categories, highlighting both strengths and areas requiring targeted intervention.

Tour operators and travel agents emerged as the most prepared groups, with mean readiness scores of 4.31 and 4.25 respectively. These high scores suggest that these stakeholders are more familiar with MFCT principles and are better equipped to deliver services that align with Muslim-friendly standards. Their operational roles often involve direct engagement with Muslim tourists, which may explain their heightened awareness and compliance with syariah-based tourism practices.

In contrast, homestay operators and food and beverage providers recorded the lowest readiness scores, at 3.78 and 3.89 respectively. These findings indicate that while these groups contribute to the tourism ecosystem, they may lack sufficient exposure to MFCT guidelines or face practical challenges in implementing them. The lower scores are particularly concerning in areas such as gender management and staff attire, where cultural sensitivity and religious compliance are critical. This suggests a need for structured training programs and clearer operational guidelines tailored to these sectors.

Standard deviation values across stakeholder groups ranged from 0.36 to 0.47, indicating moderate variability in responses. Notably, homestay operators exhibited the highest variability (SD = 0.47), suggesting inconsistent practices and understanding within this category. This inconsistency may stem from the informal nature of homestay operations or limited access to formal tourism training.

Overall, the total mean readiness score across all stakeholders was 4.08, reflecting a generally high level of preparedness. This supports the conclusion that MFCT implementation is feasible within Malaysia's tourism landscape. However, the uneven distribution of readiness underscores the importance of targeted capacity-building efforts to ensure uniform adoption of Muslim-friendly practices across all stakeholder types.

Table 2: ANOVA Summary for Stakeholder Readiness

Construct	df (Between)	df (within)	f	Sig. (p)
Shariah	5	194	3.21	.02*
Compliance				
Prayer Facilities	5	194	2.87	.03*
Ethical	5	194	1.12	.34
Operations				
Gender	5	194	4.02	.01**
Management				
Staff Attire	5	194	2.15	.06

Seasonal Services	5	194	0.94	.45

Note: $p < .05$ = significant; $p < .01$ = highly significant

To examine whether stakeholder readiness for Muslim-Friendly Cultural Tourism (MFCT) implementation varies across different categories of tourism providers, a one-way Analysis of Variance (ANOVA) was conducted for each readiness construct. The results, as presented in Table 2, reveal significant differences in several key areas, offering insights into the uneven adoption of MFCT principles across stakeholder groups.

The construct of Shariah compliance yielded a statistically significant result ($F(5, 194) = 3.21$, $p = .02$), indicating that stakeholders differ in their adherence to activities and services aligned with Islamic principles. Tour operators and travel agents, who are more directly involved in itinerary planning and guest interaction, likely demonstrate higher readiness in this area compared to food and beverage providers or homestay operators. This suggests that core service providers are more attuned to syariah-based expectations, possibly due to greater exposure to Muslim traveller needs.

Similarly, prayer facilities showed significant variation across stakeholder groups ($F(5, 194) = 2.87$, $p = .03$). This construct includes the provision of prayer spaces, time allocation for religious duties, and washroom facilities equipped with bidets. The results imply that while some stakeholders, such as accommodations and travel agents, have integrated these facilities into their operations, others particularly homestay and food service providers may lack the infrastructure or awareness to do so effectively.

The construct of gender management produced the most significant result ($F(5, 194) = 4.02$, $p = .01$), highlighting substantial differences in how stakeholders handle gender-sensitive arrangements. These include gender-segregated performances, accommodations, and restroom facilities. The findings suggest that tour operators are more likely to implement gender-sensitive practices, whereas homestay and food and beverage providers may struggle due to operational constraints or limited understanding of religious expectations.

In contrast, ethical operations ($F(5, 194) = 1.12$, $p = .34$) and seasonal services ($F(5, 194) = 0.94$, $p = .45$) did not show statistically significant differences across stakeholder groups. This indicates a relatively uniform approach to ethical conduct such as honest marketing, cleanliness, and courteous communication and a shared lack of emphasis on seasonal offerings like Ramadan-specific services. These findings suggest that while ethical standards are broadly upheld, seasonal services remain underdeveloped across the tourism sector.

The construct of staff attire approached significance ($F(5, 194) = 2.15$, $p = .06$), suggesting some variation in how stakeholders enforce modest dress codes and accommodate religious obligations among staff. Although not statistically conclusive, the trend points to potential disparities that merit further investigation, especially in sectors with less formalized dress policies.

Overall, the ANOVA results confirm that stakeholder readiness for MFCT implementation is not uniform. Significant differences in Shariah compliance, prayer facilities, and gender management underscore the need for targeted interventions and capacity-building efforts. These findings reinforce the importance of stakeholder-specific training, clearer guidelines on FATWA clauses, and coordinated governance to ensure consistent adoption of Muslim-friendly practices across Malaysia's tourism ecosystem.

Table 3: Post-Hoc Comparisons (Tukey's HSD)

Construct	Significant Group Differences ($p < .05$)
Shariah Compliance	Tour Operators > Food & Beverage
Prayer Facilities	Travel Agents > Homestay, Accommodation
Gender Management	Tour Operators > Homestay, Food & Beverage
Staff Attire	No significant differences
Seasonal Services	No significant differences

Following the significant results identified through ANOVA, a post-hoc analysis using Tukey's Honestly Significant Difference (HSD) test was conducted to determine which specific stakeholder groups differed in their readiness to implement Muslim-Friendly Cultural Tourism (MFCT) guidelines. The results, presented in Table 3, offer a more granular understanding of the disparities across stakeholder categories and highlight areas requiring targeted intervention.

In the construct of Shariah compliance, tour operators demonstrated significantly higher readiness compared to food and beverage providers. This suggests that tour operators are more familiar with syariah-aligned practices such as promoting halal products and organizing activities that conform to Islamic principles. Their operational role, which often involves direct engagement with Muslim tourists, may contribute to their heightened awareness and implementation of religiously appropriate services. In contrast, food and beverage providers may lack comprehensive understanding or structured guidelines, particularly in environments where halal certification and syariah-based operations are not uniformly enforced.

For prayer facilities, travel agents showed significantly greater readiness than homestay and accommodation providers. This indicates that travel agents are more proactive in ensuring the availability of prayer spaces, time allocation for religious duties, and washroom facilities equipped with bidets. The lower readiness among homestay and accommodation providers may reflect infrastructural limitations or a lack of standardized expectations regarding religious accommodations, especially in informal or budget-oriented settings.

The construct of gender management revealed that tour operators were significantly more prepared than both homestay and food and beverage providers. Gender-sensitive arrangements, such as segregated performances, accommodations, and restrooms, are critical components of MFCT. The disparity suggests that tour operators are more attuned to these requirements, possibly due to their exposure to international Muslim travelers and formal training. Conversely, homestay and food service providers may face challenges in implementing gender separation due to spatial constraints or limited awareness of religious sensitivities.

In contrast, no significant differences were found among stakeholder groups for the constructs of staff attire and seasonal services. This uniformity suggests that all groups share a similar level of readiness moderate in these areas. The lack of differentiation may indicate a general underdevelopment of policies related to modest dress codes and seasonal offerings such as Ramadan-specific services. These findings point to a broader need for awareness campaigns and operational guidelines that address these dimensions across the tourism sector.

Overall, the post-hoc analysis reinforces the conclusion that MFCT implementation is feasible but uneven across stakeholder categories. Tour operators and travel agents consistently demonstrate higher readiness, particularly in core religious and operational constructs. Meanwhile, homestay and food and beverage providers exhibit lower preparedness, especially in gender management and Shariah compliance. These insights underscore the importance of stakeholder-specific training, infrastructure support, and policy alignment to ensure consistent and effective adoption of Muslim-friendly tourism practices throughout Malaysia's tourism ecosystem.

Discussion

The findings of this study provide important insights into the readiness of tourism stakeholders in Malaysia to implement Muslim-Friendly Cultural Tourism (MFCT) guidelines. Overall, the descriptive statistics revealed a relatively high level of preparedness, with a total mean readiness score of 4.08. This suggests that MFCT implementation is feasible within Malaysia's tourism ecosystem. However, the results also highlight uneven adoption across stakeholder categories and constructs, underscoring the need for targeted interventions.

Tour operators and travel agents consistently demonstrated the highest readiness levels, particularly in Shariah compliance and prayer facilities. Their operational roles, which involve direct engagement with Muslim travellers, likely contribute to their stronger alignment with syariah principles and religious service provision. These groups appear to be more familiar with MFCT guidelines and better equipped to deliver Muslim-friendly services, reflecting their central role in shaping the tourist experience. In contrast, homestay operators and food and beverage providers recorded lower readiness scores, especially in constructs such as gender management and staff attire. These findings suggest that while core religious dimensions are relatively well integrated, operational aspects remain inconsistently applied across sectors.

The ANOVA results confirmed significant differences in stakeholder readiness for Shariah compliance, prayer facilities, and gender management. Post-hoc comparisons further revealed that tour operators scored significantly higher than food and beverage providers in Shariah compliance, while travel agents outperformed homestay and accommodation providers in prayer facilities. Similarly, tour operators demonstrated greater readiness in gender management compared to homestay and food and beverage providers. These highlight the uneven distribution of MFCT practices, with certain stakeholder groups leading in compliance while others behind.

Interestingly, no significant differences were observed in ethical operations and seasonal services, suggesting a relatively uniform approach across stakeholders. Ethical practices such

as honest promotion, cleanliness, and courteous communication appear to be consistently upheld, while seasonal services, including facilities for Ramadan, remain underdeveloped across the tourism sector. Staff attire showed marginal differences, indicating potential variation but not strong enough to confirm statistical significance.

Meanwhile, these findings underscore the importance of stakeholder-specific strategies in advancing MFCT implementation. While tour operators and travel agents demonstrate strong readiness, homestay and food and beverage providers require greater support through training, infrastructure development, and clearer operational guidelines. Addressing these gaps is critical to ensuring consistency in Muslim-friendly practices and enhancing Malaysia's competitiveness as a global destination for Muslim-Friendly Tourism.

From a theoretical perspective, the results align with stakeholder theory, which emphasizes the need to engage diverse actors in tourism development. The disparities observed across stakeholder groups highlight the importance of coordinated governance and capacity-building initiatives to achieve uniform compliance. Furthermore, the findings contribute to the discourse on sustainable tourism by demonstrating how the integration of Islamic values within cultural tourism can strengthen Malaysia's positioning in the global Muslim travel market while preserving cultural heritage.

In conclusion, the discussion highlights both the strengths and challenges of MFCT implementation in Malaysia. While the overall readiness is high, uneven adoption across stakeholder categories calls for targeted interventions. By addressing governance issues, enhancing stakeholder capacity, and clarifying FATWA clauses, Malaysia can move closer to its aspiration of becoming a leading destination for Muslim-Friendly Tourism.

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THE IMPACT OF BRAND IDENTIFICATION, CORPORATE STRATEGY AND VISUAL BRANDING ON CUSTOMER LOYALTY IN AIRLINE SERVICE

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Abstract: *The airline industry is a very competitive market. This makes strong airline brand appeal important to foster loyalty. The objective of the study is to see what is the influence between brand identification, corporate strategy and visual branding towards customer loyalty in airline service. To employ the study, quantitative research is done using an online survey to distribute questionnaires. Using the G-calculator and the population size of the airlines in KLIA1 and KLIA2, 385 sample sizes are gathered to measure the variable of the study. The data is analyzed using SPSS and having reliability analysis and multiple regression. Findings showed that all variables have significant influence towards customer loyalty in the airline industry. Thus, this urges airlines to strengthen their brand identification, corporate strategy and visual branding to improve customer loyalty in airline service.*

Keywords: *Airline Industry, Customer Loyalty, Corporate Strategy, Visual Branding, Brand Identification.*

Introduction

The aviation industry is rapidly growing and many different airline companies have been struggling to keep up with rapidly changing trends of competition in the aviation market. Having a loyal customer is a crucial role for airlines to remain in the aviation market. Airline industry performance is dependent on loyalty programmes done by airlines showing how important customer loyalty is towards airline performance. (Vilkaite-Vaitone & Papsiene, 2016). Ragab et al. (2024) described brand identification in the aviation industry as how customers perceive the airline and feeling how the airline connected to them emotionally. The problem regarding the study of brand identification influencing customer loyalty is the limited study of the problem in the context of the airline industry. For example, there is a study that aims to analyze the influence of brand identification and influencing customer loyalty, however the study is aimed towards the fashion industry (Blazquez-Resino et al., 2024).

Corporate strategy in the airline industry is referring to how airlines plan and adapt to achieve their goal and competitive advantage. In the airline industry, there are many aspects that could be incorporated in corporate strategy such as routing, aircraft model and customer service. A well-thought corporate strategy can lead a company to a long-lasting influence on financial and non-financial effects (Poretti et al., 2024). There is very limited study on how corporate level strategy affects customer loyalty in the airline industry. Most prior studies neglect how

corporate strategy like long-term branding campaigns affect customer loyalty (Gurler, 2024; Shin et al., 2020).

Visual branding of the airline industry refers to the use of visual elements like colour and logo in order to push their brand to the eyes of potential passengers. The visual may include the airline logo, the cabin design and the uniform wear by airline cabin crew (Boubker & Naoui, 2022). Passenger perceptions of these services vary greatly due to factors like flight attendants' uniforms and professional attitudes, contributing to a differentiated brand experience. Subtle but significant elements like flight attendants' moods and clothes have an impact on this customer loyalty towards airlines (Aslan et al., 2025).

Literature Review

Customer Loyalty

Customer loyalty is proven by repeat purchases, purchasing frequency, recommend to other potential customers, price tolerance and positive review (Mohamad, 2022). Previous finding found on the comparison service quality and relationship-based approach significantly influences loyalty. For example, one study found that good website service has a very significant influence towards loyalty (Aiyub et al., 2025). This means that smooth and reliable services are able to make customers attach to the brand and stay loyal to it. Another study found that loyalty is developed by having a repeatedly positive experience with the brand to make customers keep coming back again (Dávila Espuela et al., 2023). This means that loyalty may be influenced by the mix of good service quality and relationship-based approach in airline services.

Moreover, past findings found that loyalty is influenced by corporate strategy and brand identification. One strategy used to increase customer emotional connection in airline services is by employing Customer Relationship Management strategy (CRM). This corporate level strategy increases customer satisfaction and then influences customer loyalty (Salah & Abou-Shouk, 2020). What it means is that corporate strategy like CRM may indirectly influence loyalty. Meanwhile, another study found brand experience and brand identification affects customer satisfaction which then improves customer loyalty in the airline service industry (Tian & Mohd Arif, 2023). This shows that corporate strategy and brand attachment are important aspects for an airline to foster loyalty among its passengers.

However, most past findings insist that brand identification is the main factor of customer loyalty in the airline industry. For example, one study found high service quality able to make customers loyal by making customers perceive the brand easily and associate themselves to the brand (Gürler, 2024). Not only that, corporate strategy is like a loyalty program, making customers identify the brand as part of themselves which in turn affects their loyalty to the brand (Shin et al., 2020. According to Zailani & Abdullah (2025), hotels and other hospitality operators with empathy, responsiveness, and respect in their service delivery methods are likely to enjoy patron loyalty, positive word of mouth, and repeat patronage. This suggests that brand identification and corporate strategy may together influence customer retention of airlines. This also gives an insight that emotional attachment like brand identification makes people keep coming back to the same airline.

Brand Identification

Brand identification and customer retention are strongly related in the aviation industry. Past studies support the idea that brand identification has a significant influence on customer loyalty. For example, creative branding strategies and effective service recovery enhance brand identification and customer trust to enhance loyalty (Tian & Mohd Arif, 2023). Similarly, another study also found that positive brand experiences trigger emotional attachment through identification which in turn foster loyalty (Harjadi et al., 2023). Not only that, but brand identification is also shown to be the connector or the center of two elements towards customer loyalty. Finding found that loyalty programs rely on brand identification to strengthen customer commitment although they can act independently (Shin et al., 2020).

Cultural factors and personal factors are always associated with brand identification based on past findings. One example of personal factors is a sense of belonging where people feel that they are part of the environment and the environment must have them. Having a sense of belongings and shared sentimental value improve passengers' perceptions of loyalty towards an airline (Yoshida et al., 2021). However, not all personal factors are influential in the airline service industry such as social prestige is proven to be less influential to brand identification compared to shared values (Yoshida et al., 2021). In terms of cultural factors, the tendency of passengers to adjust their daily habits like changing their preference to adjust to social norms also influence brand identification and foster their loyalty (Büyükdag & Kitapci, 2021). For example, if society in one country prefers one airline, most other people will follow suit as well. This aligns with another study that found national pride influences brand identification and fosters their loyalty (Alexander & Kennedy, 2023).

Mohamad (2025) mentioned digital media significantly shapes how destinations are marketed and how travellers engage with brands. Brand identification also aligned with service quality, trust and emotional attachment of passengers to an airline. Service quality that is exceptional to passengers improved their perceived value towards an airline and perceived value made them return back to the same airline (Gürler, 2024). This is closely related to another finding where positive travel experiences build their association of self to the airline (Siqueira et al., 2023). The positive interactions with the crew and the great service of an airline make people feel valuable and special. This aligned with another study that focused on the emotional attachment towards an airline improving the tendency of loyalty to the airline (Ragab et al., 2024). Thus, it can be said that service quality and emotional attachment can align together to shape proper brand identification toward a brand.

Furthermore, there are findings from another industry that aligned with the other findings on airlines and some contrasting findings of brand identification. Some findings in other industries like the fashion industry shows that brand identification is a strong predictor to improve loyalty (Blázquez-Resino et al., 2024). This means that the findings of brand identification are consistent even at the lens of different industries. However, the factors may be differed different in markets such as the airline market in Korea found that brand identification having lesser influence compared to practical benefit towards loyalty (Chung et al., 2022). Examples of practical rewards are discounts, loyalty benefits and so on. Despite this, corporate initiatives

like corporate social responsibility (CSR) may improve loyalty by building attachment through acts of kindness (Chung et al., 2022).

H1: There is a significant influence between brand identification and customer loyalty in the airline industry.

Corporate Strategy

Corporate strategy plays an important role in shaping customer retention based on past research. Most corporate strategies from past research focus towards Frequent Flyer Programs (FFPs). FFPs are designed to reward passengers that are loyal to the airline brand by giving discounts on next purchase or upgrade service. FFP is a great strategy to improve customer retention as it makes customers feel valued and the need to feel the loyalty points making them keep using the same brand (Şahin et al., 2021). This is because FFP provides real value to customers by giving them valuable experience and then increasing their tendency to stay loyal with the same airline brand (Sarpong, 2021). The FFP strategy might be useful but these past findings do not fully represent corporate strategy as a whole, just on specific strategy only.

So, by combining all past studies on different types of strategies, the study is able to picture how corporate strategy works as a whole. Balanced Scorecard (BSC) is a strategy implemented by airlines to ensure corporate objectives and strategy aligned with outcomes. Some studies on this study found that BSC strategy is able to directly impact customer loyalty (Ahmed & Ali, 2025). Another corporate strategy by airlines like Low Cost Carrier (LCC) also found that it directly impacts the decision of passengers to use the same airline. LCC are strategies where airlines sell tickets with low price but with minimum service for price sensitive passengers. Airlines with LCC strategy are able to attract and retain their passengers based on previous studies. Moreover, adaptive corporate strategies that are implemented by the airlines have also shown to be very effective to influence loyalty among airline passengers (Poretti et al., 2024). All these findings can be used to further prove the strong ties of corporate strategy to customer loyalty.

Findings on other industries also further support the correlation between corporate strategy and airlines. For example, the closest to the airline industry is the airport service industry able to improve their customer retention by applying technology adoption strategies at the corporate level (Ayodeji et al., 2023). This aligns with another study that found that market focus strategies are able to classify their clients properly and are able to improve loyalty through satisfaction in the electrical industry (Syafiq et al., 2023). Coffee shop that adopts entrepreneurial marketing strategy to adjust price sensitivity able to influence price conscious consumers to keep coming to the same shop (Basha et al., 2023). Similarly, automotive industries that adopt the same strategy are also able to improve their customer loyalty (Nyosino et al., 2021). These findings show that corporate strategies affecting loyalty are fairly consistent even across different industries.

However, there are some discrepancies where the studies are not aligned with the past findings. For example, some studies stated that corporate strategies can't be measured, thus it must only be measured by service factors only in airline context (Gürler, 2024). This makes the other

findings not aligned with the finding. Similarly, other past research suggested that strategies like FFP are just marketing tools and can not be classified as corporate strategies (Shin et al., 2020). These mix of different definitions from different researchers make the research on corporate strategy towards loyalty much complex and urge the need for further examination.

H2: There is a significant influence between corporate strategy and customer loyalty in the airline industry.

Visual Branding

Visual branding plays an important role in shaping customer loyalty. Visual elements such as logos, colors, and overall airline image help passengers recognize and remember a brand which can later influence their attachment and loyalty (Olson, 2024). In the airline context, visual branding has been shown to increase emotional attachment and brand love which leads to stronger customer loyalty (Boubker & Naoui, 2022). This happens especially when airline visuals are consistent and meaningful. Similar findings also show that professional and attractive visual designs help build trust, which is a key factor in long-term customer loyalty (Girma, 2021). These findings are evident that visual branding is able to shape people's emotion then affects their loyalty towards the airline brand.

Beside logos and colors, visual branding is also expressed through cabin crew appearance and presentation. Distinctive uniforms and professional behavior can enhance perceptions of reliability and service quality. This indirectly encourages customers to remain loyal to the airline (Aslan et al., 2025). Uniforms that are distinctive make passengers able to differentiate one airline to another making the branding stronger. However, not all visual elements have the same impact. Visuals that focus on showing professionalism influence loyalty better compared to visuals that only use aesthetics (Oh & Park, 2020). This means that the airline must make an image of safety and reliability to make its passengers feel safe every time they fly with the airline.

Visual branding is correlated with airline positioning and consistency based on past findings. Airlines visual branding effectiveness is different according to where the market segment of the airline is. For example, bright colors are effective towards LCC airlines and dark colors suitable for full service carriers (Liu et al., 2024). These colors are important to change passengers' perception of the airline. Moreover, consistent visual branding like using the same logo and color palette is important to make it easy to recall a certain brand and improve tendency to loyalty (Yasa & Wijayanti, 2023). Similarly, visual branding improves the tendency of customer repurchase even in a non-airline industry like retail industry. (Kurniawan & Tanujaya, 2024).

There are some limitations and contextual differences in past findings. The Small Medium Enterprise (SME) industry found that visual branding can't bring people to stay loyal to the same brand (Rahman & Haydati, 2023). This is understandable because SME visual branding is not needed, but customers want practical use. However, studies on the banking industry found that visual branding is an important aspect to show a symbol, making people know which brand they prefer the most. (Ab Hamid et al., 2022) As for the limitations, past study found

some limitations on the brand image towards loyalty where customers will not come back to the same airline even with a good brand image if their service fail to perform based on expectation (Boonchunone et al., 2021).

H3: There is a significant influence between visual branding and customer loyalty in the airline industry

Methodology

This study adopts a correlational research design to examine the impact of brand identification, corporate strategy, and visual branding on customer loyalty in the airline industry. The target population consists of frequent flyers with data collected through a combination of random intercept surveys at KLIA1 and KLIA2, convenience sampling, and online recruitment via aviation communities and social media. A sample size of 385 respondents is determined using Cochran's method. The research tool is a closed ended, structured questionnaire made with Google Forms that has four sections that are in line with the goals of the study and a 7-point Likert scale. The survey is distributed both in person and online via QR codes, with an emphasis on voluntary participation and anonymity. Multiple regression analysis utilizing SPSS, a statistical program compatible with Google Forms that facilitates effective data management, analysis, and visualization making it ideal for large scale correlation studies like this one will be used to examine the quantitative data that was gathered.

Population and Sample

Passengers who regularly travel and exhibit brand loyalty are the study's target demographic; there is no minimum age restriction. These respondents were chosen because they may offer valuable insights on the elements that maintain customer loyalty due to their experience and frequent use of airline services. A combination of online and in person methods will be used to collect the data. Respondents using the online method will be contacted via online forums of followers for commercial aviation who actively participate in

conversations regarding airlines and flying. Data will be gathered for the face-to-face approach at Kuala Lumpur International Airport 1 (KLIA1) and Kuala Lumpur International Airport 2 (KLIA2)

Questionnaire Design

Convenience sampling, a non-probability sample method, was employed in this investigation. This is due to the fact that it is useful and appropriate for a hectic airport setting. The main research tool used in our study to determine the influence of brand identification, visual branding and corporate strategy on customer loyalty in the airline industry is by using closed-ended questions. The online-structured questionnaire is made by using Google Forms as it is user-friendly and easy to access by many people just through their phone. Google Forms is chosen because of its cost-effectiveness as the application is free to use by all users whether respondents or the one doing the questions. All items in the questionnaire except demographic section will use a 5-point Likert scale where 1 = Strongly Disagree to 5 = Strongly Agree. This

scale is able to provide a better understanding of their opinion that is aligned to our study for data collection.

Data Analysis

Data was analysed using Statistical Package for Social Science (SPSS) version 25.0. The data will be analysed through reliability analysis to ensure the reliability of item. Then, the data collected will be analyzed through multiple regression analysis where it is able to analyze the value of a variable through two or more other variables. This method is suitable for quantitative research as it emphasizes statistical and numbering to provide insights towards a variable use in our study.

Findings and Analysis

Demographic of the Respondents

The demographic profile of the respondents shows a well-balanced representation across gender, age, flight frequency, and airline preference. In terms of gender, the sample was almost evenly distributed, with 50.3% male and 49.7% female respondents. This shows minimal gender bias in this study. The age distribution reflects a strong presence of Millennials formed the largest group at 47.7%, followed by Generation Z at 27.3% and Generation X at 25%,. This shows a diverse age mix of airline passengers in this study. Regarding travel behaviour, a substantial majority of respondents (78.6%) had flown with the same airline more than twice in the past 12 months, suggesting a high level of customer loyalty, while 21.4% did not demonstrate repeat usage. In terms of airline preference, Malaysian Airlines emerged as the most preferred carrier at 37.5%, followed by Firefly at 31.9% and AirAsia as the third choice, while Maswings and other international airlines collectively accounted for 13.3% of preferences. This reflects different consumer choices based on service offerings and brand perception.

Table 1: Demographic Profile for the Respondent

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	199	50.3
	Female	193	49.7
Age Group	Generation X (45 years and above)	98	25.0
	Millennials (29–44 years)	187	47.7
	Generation Z (13–28 years)	107	27.3
Frequency of Flight	Flown with same airline more than twice	308	78.6
	Not flown with same airline more than twice	84	21.4

Preference of Airline	Malaysia Airlines	147	37.5
	Firefly	125	31.9
	AirAsia	52	13.3
	Other Airlines	68	17.3

Source: Developed from Google Forms

Reliability Analysis

The reliability test demonstrated excellent reliability, with all variables scoring above 0.8, allowing the study to confidently proceed with full data collection without removing current variables. A total of 392 respondents participated in the main survey, and the results presented in table below confirm that all constructs achieved Cronbach's Alpha values above the acceptable threshold of 0.7. This indicates strong internal consistency across all variables measured. The reliability analysis was conducted using SPSS, ensuring that the data collected is dependable and suitable for further statistical examination within the study.

Table 2: Result of Reliability of Each Variable

Variable	Number of Items	Cronbach Alpha
Customer Loyalty	6	.900
Brand Identification	6	.899
Corporate Strategy	6	.818
Visual Branding	6	.840

Source: Developed from SPSS

Hypothesis Testing

The model summary shows a strong relationship between the independent variables and customer loyalty. The R value of .858 indicates that the variables used in this study are closely related to customer loyalty. The R Square value of .736 means that about 73.6% of the changes in customer loyalty can be explained by brand identification, corporate strategy, and visual branding. The Adjusted R Square of .733 is very close to the R Square value. This shows that the model remains reliable even after considering the number of variables used. In addition, the F-value of 358.754 with a significance level of $p < .001$ shows that the regression model is statistically significant overall. For additional study, this model generally matches the data quite well.

Table 3: Model Summary of Multiple Regression

Model	R	R Square	Adjusted R Square	F	Sig. (p)
1	.858	.736	.733	358.754	< .001

Source: Developed from SPSS

Table 4: Multiple Regression Analysis and Hypothesis Result

Hypothesis	Standardized Beta (β)	t-value	Sig. (p)	Accepted / Rejected
H1	.255	6.171	< .001	Accepted
H2	.324	6.697	< .001	Accepted
H3	.354	7.819	< .001	Accepted

Source: Developed from SPSS

Customer loyalty is positively impacted by brand recognition. An increase in brand recognition is indicated by the standardized beta value ($\beta = .255$) associated with an increase in customer loyalty. This association is statistically robust and dependable, as indicated by the high t-value of 6.171. This indicates that the association is meaningful and not the result of coincidence. Therefore, Hypothesis 1 (H1) is accepted.

Next, customer loyalty is positively and significantly impacted by corporate strategy. The standardized beta value ($\beta = .324$) shows that changes in customer loyalty are significantly influenced by business strategy. This implies that higher levels of consumer loyalty are linked to more effective corporate strategy. The t-value of 6.697 shows that this relationship is statistically strong and not due to random chance. Therefore, Hypothesis 2 (H2) is accepted.

Furthermore, customer loyalty is positively and significantly impacted by visual branding. According to the standardized beta value ($\beta = .354$), visual branding has a significant impact on consumer loyalty. The statistical strength and reliability of this link are confirmed by the t-value of 7.819, which indicates that the effect is not the result of chance. Therefore, Hypothesis 3 (H3) is accepted.

Discussion

Major Findings

The study concludes that passengers are more likely to remain loyal and select the same airline over and over again when they feel an emotional connection to the airline and regard it as an integral part of their identity. Customers can relate to airlines more easily when they are transparent about their values. For instance, travellers' loyalty to a certain airline is influenced by the airline's cultural identity. Customers tend to support businesses that they believe reflect their values and lifestyle, which contributes to the favourable outcome.

Furthermore, the study found that airlines with clear, well-planned strategies are more successful in keeping customers loyal. For example, pricing strategies by airlines making end of year discounts promotion or having good service recovery strategy. When passengers see that an airline is consistent and well managed, they will develop more trust and confidence in the brand. Long term loyalty and recurring business are encouraged by this trust. This explains why the analysis of business strategy has a substantial positive result.

Lastly, the study found that passengers' interactions with airlines are greatly impacted by what they see and feel visually. Thus, there is a substantial correlation between increased consumer loyalty and improvements in visual components such airline logos and crew uniforms.

Customers are better able to identify the airline and view it as reliable and professional when it has a strong and consistent visual brand. Customers are more likely to choose the same airline again and stick with it over time when visual branding is in accordance with brand values and service quality.

Limitations

It should be mentioned that this study has certain limitations. Because the data was only collected from passengers using KLIA Terminals 1 and 2, it might not fairly represent airline passengers from other regions or airports. Furthermore, employing an online Google Form survey relies on self-reported responses, which may lead to inaccurate or biased reporting. Additionally, the results' relevance to other age groups was restricted because the study's primary focus was on Millennial and Generation Z respondents. The study only examined a few branding characteristics, brand recognition, corporate strategy, and visual branding; it ignored other factors that can influence loyalty, such as pricing or digital experience. These limitations suggest that the results should be interpreted with caution and may require additional research for broader applicability.

Recommendation

Future researchers are encouraged to expand this study by using a bigger and more diverse sample from different airports, regions, or countries in order to improve the generalizability of the findings. Future study may consider engaging age groups other than Generation Z and Millennials in order to obtain a more complete view of customer loyalty across other passenger categories. Future research should examine additional factors that influence airline customer loyalty, such as ticket costs, digital services, reward programs, and user experience technologies. Combining surveys with mixed research methods, such as focus groups or interviews, can also offer deeper insights into passengers' thoughts and attitudes.

Conclusion

In conclusion, this study examined the effects of corporate strategy, visual branding, and brand identification on customer loyalty in the airline service industry. The findings confirm that passengers' satisfaction, trust, and inclination to remain with the same airline are significantly impacted by these branding related factors. Strong brand identification helps airlines build emotional connections with customers, while ethical and successful business operations increase credibility and long-term trust. Visual branding, which includes unified brand presentation and cabin crew appearance, further reinforces positive consumer views. Overall, the study highlights that airlines need to use integrated branding strategies and go beyond basic service quality to achieve long term competitive advantage and sustained customer loyalty in the highly competitive airline business.

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DIGITAL MARKETING ROLES IN CREATING AWARENESS IN PRESERVING CULTURAL HERITAGE SITES

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Abstract: Digital marketing is now an important tool for preserving and promoting cultural heritage sites. It helps increase global visibility and engagement using social media, content marketing and search engine optimization. However, cultural heritage sites frequently struggle to attract visitors, generate revenue, and adapt to modern management practices. Digital marketing has risen to the forefront of tourism promotion, while content marketing, social media and search engine optimization are critical for cultural heritage site preservation. Despite the increasing importance of digital platforms in modern communications, there remains a gap in knowledge regarding how these tools can be optimally utilized to raise awareness among visitors and foster a sense of responsibility towards cultural heritage preservation. This research aims to shed light on digital marketing roles in creating awareness in preserving cultural heritage sites in the context of content marketing, social media and search engine optimization. This study was conducted among Shah Alam and Kuala Lumpur population using online questionnaires. 385 students responded to the questionnaire. A quantitative approach is used for this research by distributing online questionnaires to collect data from respondents. The findings showed that there are significant relationships between content marketing, social media and search engine optimization in creating awareness in preservation of cultural heritage sites. These findings are hoped to help all the generations to preserve cultural heritage sites.

Keywords: Digital Marketing, Cultural Heritage, Social Media, Preservation

Introduction

Cultural heritage sites serve as vital repositories of history, preserving traditions, values, and the accomplishments of past civilizations. Yet their sustainability and visibility face increasing challenges in today's rapidly evolving technological landscape. The increase in the use of digital marketing as a tool for communication, contribution and awareness, changes the way how cultural heritage sites promotes and protects its properties. Digital platforms now offer heritage sites the ability to engage broad audiences, foster appreciation, and reshape visitor expectations through immersive and customized experiences (Liu, 2020; Mitova et al., 2021).

By leveraging digital marketing, heritage sites can highlight the importance of cultural assets while building enduring relationships with locals, visitors, and academics. Ibrahim (2022) emphasizes that diverse digital channels allow heritage sites to nurture awareness and strengthen community ties. This highlights that preserving these heritage sites is not only on

the existence of the physical building but also the cultivation of social responsibility as well as showcasing the identity through digital interaction. Therefore, this study investigates the roles of digital marketing, specifically content marketing, social media, and search engine optimization, in creating awareness and sustaining cultural heritage sites.

Literature Review

Creating Awareness in Preserving Cultural Heritage Sites

Heritage places are essential for maintaining cultural identities, promoting tourism, and advancing socioeconomic growth. Yet they face increasing challenges such as urban development, environmental degradation, and inadequate preservation efforts. These pressures highlight the need for strategies that extend beyond physical conservation, emphasizing the role of communities in sustaining heritage values. Academicians strongly believe that through direct community engagement, preservation efforts are more effective, because this creates the feeling of ownership, responsibility and pride in cultural identity.

Awareness serves as the critical link between community involvement and effective preservation. Mohamad et al. (2021) define awareness as the intellectual or intuitive recognition of heritage significance, ensuring that preservation is not only a technical process but also a social commitment. Hu et al. (2022) argue that community empowerment is a prerequisite for meaningful engagement, while Nicolaides (2020) stresses that ethical tourism principles are necessary to balance economic benefits with cultural and environmental preservation. Alves et al. (2024) further demonstrate that community-based tourism practices, encourage environmental-friendly behaviours and strengthen local responsibility. The involvement of local communities in these awareness campaigns, mobilise communities, increase recognition of heritage significance and instil responsibility of conservation as a team.

Recent studies reinforce this perspective. Firew (2025) shows that heritage conservation initiatives promote belonging and pride, encouraging communities to take ownership of preservation efforts. Roosevelt Vanderbilt (2025) adds that awareness initiatives are most effective when paired with transparent and inclusive community engagement, leading to stronger advocacy and volunteerism. Collectively, these findings demonstrate that community involvement and awareness are mutually reinforcing drivers of heritage preservation, providing a strong foundation for integrating digital marketing strategies.

Content Marketing

Website content plays a crucial role in shaping tourist perceptions and sustaining heritage destinations. Zhang et al. (2019) highlight that visual content analysis of tourist images provides insights into visitor behaviour, while Desai (2019) emphasizes that online content creation and dissemination increase awareness and visitor numbers. Li et al. (2020) further demonstrate that community-based strategies embedded in digital platforms strengthen the connection between socioeconomic growth, urban planning, and cultural heritage management. More recent studies expand this view: Anevlavis et al. (2025) argue that integrating intangible cultural heritage into marketing strategies enhances authenticity and cultural identity, while Ibrahim (2022) emphasizes that diverse digital channels allow heritage sites to build enduring

relationships with locals and visitors. As a result, besides promoting awareness, reinforcement of cultural identity and long-term sustainability are also guaranteed. Thus, supporting the formulation of following hypothesis:

H1: There is a significant relationship between content marketing and creating awareness in preserving cultural heritage sites.

Social Media

Social media platforms have transformed tourism marketing by enabling interactive dialogue and immediate feedback. Kilipiri et al. (2023) demonstrate that Instagram and influencer marketing effectively promote sustainable tourism destinations, while Samarakoon et al. (2023) highlight the participatory nature of new media compared to traditional one-way communication. Sharma (2021) identifies Facebook, Instagram, and review platforms such as TripAdvisor as highly effective tools for tourism promotion. Beyond promotion, Kasemsarn and Nickpour (2025) argue that digital storytelling through social media engages younger audiences and fosters emotional connections with heritage sites, ensuring long-term sustainability. Zins and Adamu (2024) further show that narrative-driven destination marketing enhances destination image and visitor engagement. Therefore, leading to the following hypothesis to be formulated:

H2: There is a significant relationship between social media and creating awareness in preserving cultural heritage sites

Search Engine Optimization (SEO)

Search engine optimization (SEO) is another critical digital marketing strategy for increasing visibility and engagement. Lewandowski and Schultheiß (2022) note that public awareness of SEO practices shapes attitudes toward online discoverability, while Mazzoli (2020) emphasizes that keyword optimization and content governance are essential for prominence in search results. Kalappan and Tham (2025) highlight the role of promotional tools in digital media for strengthening brand resilience, suggesting that SEO can be adapted to heritage contexts to attract prospective visitors. Implementing the usage of relevant keyword and enrichment of the content, heritage sites can improve search rankings, brings in more number of searches as well as maintaining the interest of the audience, indirectly leading to the formulation of this hypothesis:

H3: There is a significant relationship between search engine optimization and creating awareness in preserving cultural heritage sites.

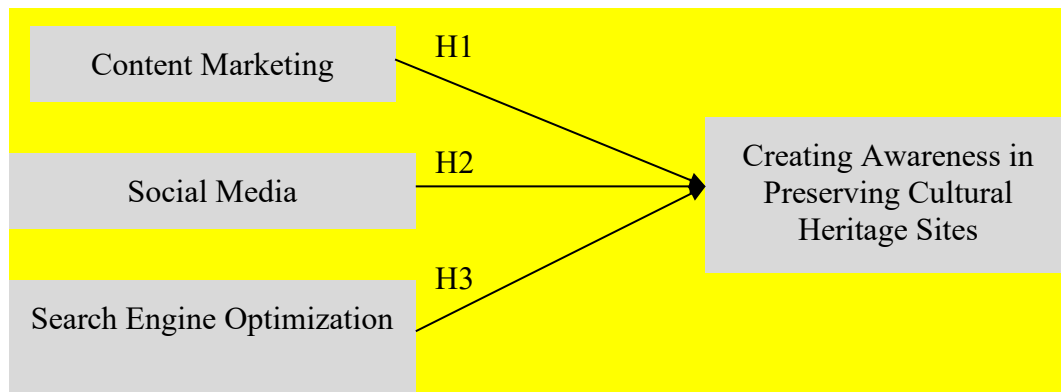


Figure 1: Framework

Methodology

Quantitative approach was used to identify the relationship between independent variables; content marketing, social media and SEO against dependent variable, creating awareness in preserving cultural heritage sites. Sample population was selected from Kuala Lumpur and Shah Alam. Based on the World Population Review's Website, the population in Shah Alam and Kuala Lumpur was identified. Using the Krejci & Morgan (1970) table sampling, only 385 respondents were needed for this study, and a random sampling method was used for this study. A set of questionnaire which consists of five sections: Section A: demographic profile of respondents, Section B: content marketing and awareness in preserving cultural heritage sites, Section C: emphasized on social media and awareness in preserving cultural heritage sites, Section D: which assessed SEO and awareness in preserving cultural heritage sites and Section E: digital marketing roles and awareness in preserving cultural heritage sites was used as the study's research instrument. The data collection was collected by using nominal scale ranging from 1(strongly disagree) to 5 (strongly agree). Before the actual study was conducted, a reliability analysis was performed in the pilot study data for 30 respondents.

Table 1: Summary of Hypothesis Testing

Hypotheses	Findings	P Value	Strength	Result
H1: There is a significant relationship between content marketing and creating awareness in preserving cultural heritage sites.	.647	<.001	Moderate	Accepted
H2: There is a significant relationship between social media and creating awareness in preserving cultural heritage sites.	.735	<.001	Strong	Accepted

H3: There is a significant relationship between search engine optimization and creating awareness in preserving cultural heritage sites.	.622	<.001	Moderate	Accepted

Discussions

The findings of this study showed the three independent variables; content marketing, social media and search engine optimization (SEO) have significant relationships in creating awareness in preservation of cultural heritage sites. Heritage groups can reach a wide audience by distributing interesting information through the creation of high-quality content. Storytelling works especially well because it highlights cultural significance, historical relevance, and personal tales through narratives that elicit strong emotional responses. This engages people deeply and motivates them to support preservation initiatives. Meanwhile, in digital marketing techniques, social media plays a key role in raising awareness about the importance of protecting cultural heritage assets. Selecting the right platform is essential; visual-focused sites like Tik Tok and Instagram work well for displaying heritage through photos, but Facebook and Twitter are more appropriate for larger participation and conversations. Using interactive marketing techniques like virtual tours, quizzes, and picture contests can greatly increase audience engagement. Effective hashtag use can help these campaigns reach a wider audience. All these strategies help to create a more knowledgeable and involved public, which is essential to the success of initiatives that focus on preserving cultural assets. Finally, in digital marketing strategies that focus on promoting awareness of cultural heritage preservation, search engine optimization, or SEO, is crucial. To improve search engine ranks and exposure, keyword optimization which includes appropriate keywords related to the preservation of cultural heritage into the text of websites, blog posts, and social media updates are important, as it draws in customers searching for surrounding historical places, boosting foot traffic and local interaction. This approach maintains and increases public awareness and engagement by informing the audience as well as making sure the website stays relevant and ranks highly in search engine results.

Conclusion

Digital marketing has become indispensable in promoting awareness and encouraging the preservation of cultural heritage sites. The findings of this study confirm that content marketing, social media, and search engine optimization each play significant roles in shaping visitor perceptions, fostering engagement, and strengthening community involvement. Content marketing helps to spread knowledge and strengthens authenticity, social media encourage interactive storytelling and emotional connections, and finally SEO allows easy access to everyone as well as visibility.

The practical implications are clear: heritage managers should integrate these strategies into preservation initiatives to maximize outreach and participation. Different age group answers

differently to different forms of content which further enhances targeted approaches that have the combination of textual, visual and interactivity in a material. Social media platforms provide opportunities for community-building and dialogue, while SEO ensures that heritage sites remain discoverable and relevant in the digital space.

Ultimately, digital marketing is not merely a promotional tool but a mechanism for cultivating awareness, empowering communities, and ensuring the long-term sustainability of cultural heritage sites. This study underscores the importance of aligning digital strategies with preservation goals, thereby bridging tourism growth with cultural identity and heritage conservation.

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INFLUENCE OF NEW MEDIA ON LANGKAWI AS A HERITAGE DESTINATION

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Abstract: *This study examines the influence of new media on tourists' intention to visit Langkawi as a heritage destination. Specifically, it investigates the effects of social media, online travel reviews (OTRs), and short video platforms on tourists' decision making and emotional engagement. A quantitative approach was employed, with data collected from tourists who have visited or plan to visit Langkawi and have interacted with new media. Multiple regression analysis indicates that all three digital platforms significantly enhance travel intention, with OTRs showing the strongest effect. The model explains 45.9% of the variance in travel intention, and no multicollinearity issues were detected. These findings suggest that new media play a critical role in shaping tourists' travel decisions to heritage destinations.*

Keywords: *Tourists' intention, social media, online travel review, short video platforms*

Introduction

The rapid development of new media has profoundly transformed the tourism industry, influencing how destinations are promoted and experienced. Platforms such as social media, online travel reviews (OTRs), and short video platforms provide tourists with real time information, user generated content, and visually engaging narratives, thereby shaping perceptions and decision-making processes (Lin & Rasoolimanesh, 2023). Heritage destinations increasingly rely on digital media to communicate their cultural and ecological value to a diverse audience. Langkawi, a UNESCO Global Geopark in Malaysia, is renowned not only for its natural landscapes but also for its rich cultural heritage, including traditional Malay architecture, folklore, and ancient geological formations (Ling & Chan, 2020). Tourism authorities and local stakeholders actively employ digital marketing campaigns to highlight these features, aiming to attract both domestic and international visitors (Tan et al., 2020).

This study addresses this gap by investigating how social media, OTRs, and short video platforms influence tourists' intention to visit Langkawi. Using a quantitative approach and survey data collected from visitors or prospective tourists who have engaged with new media content, the research examines both the direct effects of these platforms on travel intention.

The findings of this study are expected to make both theoretical and practical contributions. Practically, it provides insights for destination marketers and policymakers to design targeted, inclusive, and effective digital campaigns that enhance tourist engagement and satisfaction. By

addressing the intersection of new media in heritage tourism, this study contributes to more nuanced and evidence-based strategies for promoting destinations like Langkawi.

Literature Review

Tourist Intention

Tourist intention refers to an individual's willingness or plan to visit a particular destination, shaped by perceptions, motivations, and external information sources (Azhar et al., 2023). Heritage destinations, including historical, cultural, and natural sites, attract tourists seeking authentic experiences and deeper cultural understanding. Tourists' intention is influenced not only by the intrinsic characteristics of the site but also by digital content and information dissemination, which affect their decision-making processes (W. Yang et al., 2022; Lim et al., 2023).

New Media

New media encompasses digital platforms that allow real time, interactive communication, including social media, online travel reviews (OTRs), and short video platforms (Zhang, 2023; Ait Hattani & Khoumssi, 2020). Unlike traditional media, new media facilitates multidirectional interactions, offering personalized, immersive, and accessible content (Samarakoon, Johar & Khatibi, 2023). In tourism, new media enhances destination promotion, engagement, and decision making, making heritage sites more attractive and interactive for a global audience. New media also plays an important part in creating an established brand image to tourists (Kalappan, & Tham, 2025).

Social Media

Social media provides a dynamic platform for users to share experiences, access information, and engage with tourism content (Xu et al., 2022; Wang & Yan, 2022). It influences tourists' perceptions, emotional connections, and travel intentions by offering visually rich and interactive content. High quality and credible social media content strengthens tourists' engagement and serves as a key tool for heritage destination marketing (Amir et al., 2022a, 2022b; Cui et al., 2023).

Online Travel Reviews (OTRs)

OTRs are user generated evaluations of destinations, services, and experiences shared on digital platforms, forming an important source of electronic word-of-mouth (eWOM) (Marine-Roig, 2021; Su et al., 2022). They provide authentic insights, reduce uncertainty, and influence tourists' perceptions, trust, and decision making. In heritage tourism, OTRs enhance the perceived authenticity and cultural value of destinations, thereby strengthening travel intentions (Anubha et al., 2025a; Tunjungari et al., 2025).

Short Video Platforms

Short video platforms are emerging digital tools characterized by brief, visually engaging content and high user interactivity (Han, 2022; Wu & Ding, 2023). These platforms enhance destination visibility, provide immersive experiences, and shape tourists' perceptions and emotional responses. Campaigns utilizing short videos, such as those by Langkawi tourism authorities, demonstrate their effectiveness in promoting heritage and cultural sites and motivating potential visitors (Tourism Malaysia, 2023).

Conceptual Framework

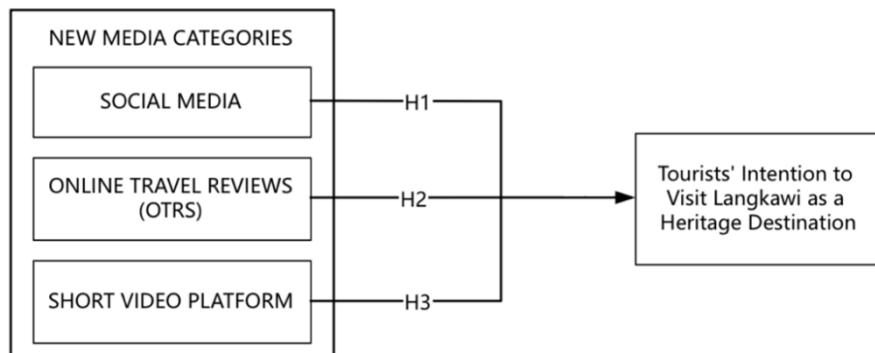


Figure 1: Framework

Research Hypothesis

H1: Social media positively influence tourists' intention to visit Langkawi as a heritage destination.

H2: Online Travel Reviews (OTRs) positively influences tourists' intention to visit Langkawi as a heritage destination.

H3: Short video platform positively influences tourists' intention to visit Langkawi as a heritage destination.

Methodology

Research Design

This study employs a descriptive quantitative research design to examine how new media influences tourists' intention to visit Langkawi as a heritage destination. A structured questionnaire was used to collect measurable data, allowing statistical analysis of relationships among variables. This approach ensures objectivity, facilitates hypothesis testing, and supports the analysis of patterns across a large population (Howard & Henderson, 2023).

Population and Sample

The target population consists of tourists who have visited or plan to visit Langkawi and have engaged with new media content related to the destination. The planned sample size is

approximately 300 respondents, including both male and female participants (Ali Memon et al., 2020).

Sampling Technique

A convenience sampling method was employed to collect data efficiently from accessible participants. This approach, commonly used in tourism research, allows for practical and diverse sampling (Saidon et al., 2024).

Research Instrument

A structured questionnaire served as the primary research instrument, including sections on demographic information, perceptions of Langkawi as a heritage destination, and engagement with new media platforms. The questionnaire consisted mainly of closed ended items to ensure consistency of responses and facilitate statistical analysis.

Data Collection

Data were collected through the structured questionnaire over two months period, targeting tourists who interacted with new media platforms. Surveys enable standardized data collection from a large sample, allowing generalization between male and female respondents and supporting quantitative analysis of trends and relationships (Coffey et al., 2024).

Data Analysis

Collected data were analysed using SPSS. Multiple regression analysis examined the effects of social media, online travel reviews, and short video platforms on tourists' intention to visit Langkawi. (Pratap Singh Kaurav et al., 2021).

Reliability Test

Cronbach's Alpha was used to assess the internal consistency of the questionnaire, measuring the reliability of items within the same construct. A value of 0.70 or higher was considered acceptable, ensuring that the instrument consistently measured the intended variables across respondents.

Table 1: Result of Reliability Test

Variable	Number of items	Cronbach's Alpha
Social media	5	0.739
Online travel review (OTRs)	5	0.827
Short travel video (STV)	5	0.828
Travel Intention	4	0.833

Findings

Demographic Profile

The survey collected responses from 332 participants, with 44% male and 56% female. Most respondents were under 25 years old (77.1%), followed by 25–30 (16.3%). Nationals included 51% Malaysians and 49% from other countries. Regarding Langkawi visits, 79% had never been, 16% visited 1–3 times, and 5% more than 3 times. TikTok was the most used social media (48.8%), followed by Instagram (14.8%), Facebook (4.8%), X (3.6%), and other platforms (28%).

Table 2: Result Demographic Profile

	Category	N=332	percentage
Gender	Male	146	44%
	Female	186	56%
Age	Below 25	256	77.1%
	25-30	54	16.3%
	31-35	9	2.7%
	36-40	7	2.1%
	41-45	5	1.5%
	45 Above	1	0.3%
Nationality	Malaysian	170	51%
	Non-Malaysian	162	49%
Frequency of travelling to Langkawi	Never	262	79%
	1-3 times	53	16%
	4-6 times	7	2%
	More than 6	10	3%
Most used social media platform	TikTok	162	48.8%
	Instagram	49	14.8%
	Facebook	16	4.8%
	X	12	3.6%
	others	93	28.0%

Findings and Discussion

Model Summary

Table 3: Model Summary^b

Model	R	R Square	Adjusted Square	RStd. Error of the Estimate
1	.678 ^a	.459	.454	1.97090

Coefficients

Table 5: Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients		Sig.	Collinearity Statistics	
	B	Std. Error	Beta	t		Tolerance	VIF
(Constant)	1.387	.667		2.079	.038		
Social media	.139	.041	.174	3.353	.001	.614	1.629
OTRs	.279	.044	.350	6.335	.000	.542	1.846
Short travel video	.253	.050	.270	5.085	.000	.588	1.700

Pearson Correlation

Table 7: Result Of Pearson Correlation

		Correlations			
			Online Travel Review (OTR)	Short travel video (STV)	Travel intention
social media	Pearson Correlation	1	.580**	.532**	.524**
	Sig. (2-tailed)		.000	.000	.000
	N	332	332	332	332
OTR	Pearson Correlation		1	.603**	.613**
	Sig. (2-tailed)			.000	.000
	N			332	332
short ravel video	Pearson Correlation			1	.576**
	Sig. (2-tailed)				.000
	N				332
travel intention	Pearson Correlation				1
	Sig. (2-tailed)				
	N				

** . Correlation is significant at the 0.01 level (2-tailed).

Hypothesis Result

HYPHOTHESIS	β VALUE	t VALUE	P VALUE	STATUS
H1: Social media positively influence tourists' intention to visit Langkawi as a heritage destination.	0.274	3.353	p = .001	ACCEPTED
H2: Online Travel Reviews (OTRs) positively influences tourists' intention to visit	0.350	6.335	p < .001	ACCEPTED

Langkawi as a heritage destination.

H3: Short video platform positively influences tourists' intention to visit Langkawi as a heritage destination. 0.270 5.085 $p < .001$ ACCEPTED

Histogram

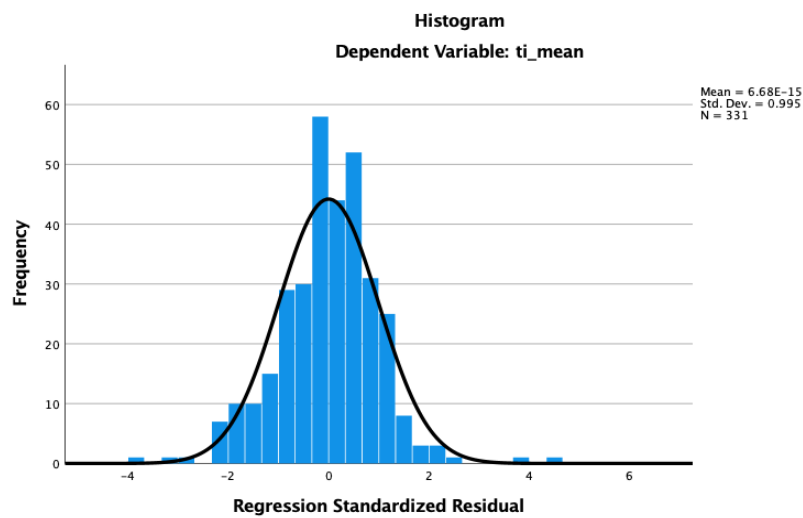


Figure 2: Histogram

Normal P-P Plot

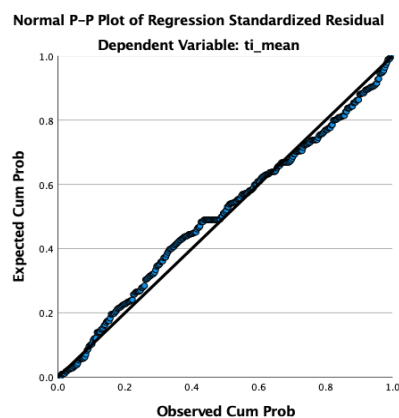


Figure 3: Normal P-P Plot of Regression Standardized Residual

Residuals vs. Predicted Values

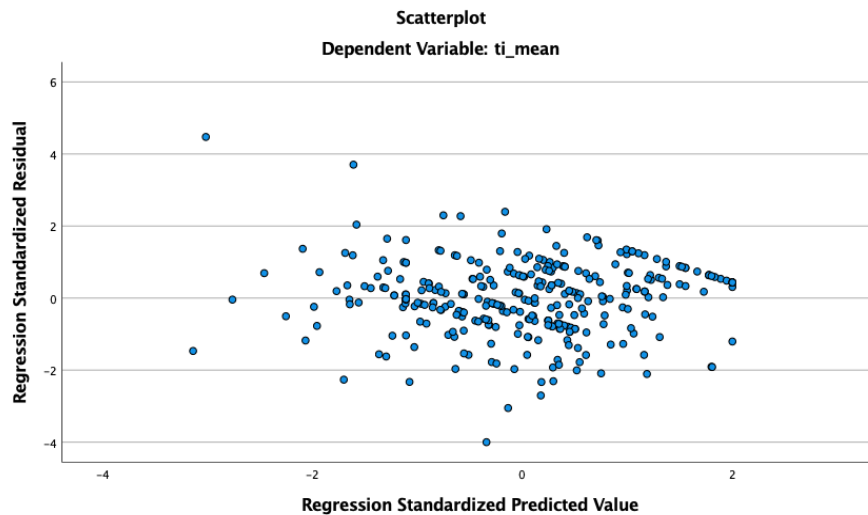


Figure 4: Scatterplot Of Standardised Residuals Vs Predicted

Conclusion

Major Findings

The study found that social media, online travel reviews (OTRs), and short travel videos significantly influence tourists' intention to visit Langkawi as a heritage destination. OTRs emerged as the strongest predictor, highlighting the importance of credible, experience based information for travel decisions. Short travel videos were also highly influential due to their visual appeal and ability to quickly convey destination experiences. Social media contributed positively to destination awareness, though its effect was moderate. The demographic profile showed a diverse sample of young, digitally active participants from both Malaysia and other countries, supporting the generalizability of the findings to international and domestic audiences.

Recommendations for Future Research

Future studies should consider using probability-based sampling methods to improve representation across age, gender, nationality, and digital literacy. Expanding the range of new media channels, such as travel blogs, livestreams, VR/AR experiences, and AI powered tools, could provide a more comprehensive view of digital influence on tourism. Researchers should also examine additional demographic, psychological, and cultural factors, including nostalgia, perceived authenticity, and emotional engagement, which may moderate tourists' travel intentions more effectively than gender. Mixed method and longitudinal designs can offer richer insights into evolving media trends, tourist behaviour, and cross destination comparisons, enhancing the practical relevance for tourism planning and marketing strategies.

Conclusion

This study demonstrates that digital media plays a critical role in shaping tourists' intentions to visit Langkawi as a heritage destination. OTRs, short travel videos, and social media collectively influence travel decisions, with OTRs being the most impactful. Academically, the research fills a gap in understanding new media's role in heritage tourism in Malaysia. Practically, it provides insights for tourism authorities and marketers to enhance Langkawi's appeal through credible reviews, engaging visual content, and strategic social media promotion. Overall, digital media is a powerful tool that can support sustainable tourism development while reinforcing Langkawi's identity as a unique heritage destination.

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THE INFLUENCING OF SOCIAL MEDIA ADVERTISING AND CONSUMER ENGAGEMENT ON CONSUMER PURCHASE INTENTION OF SANHE LIUBAO TEA IN GUANGXI, CHINA

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Abstract: *This study aims to explore the influence of social media advertising and consumer engagement on the consumer purchase intention of Sanhe Liubao tea in Guangxi, China. The quantitative research employed a questionnaire as the primary research tool and collected data from 461 people who plan to buy Sanhe Liubao tea in Guangxi, China. Descriptive statistics, including Frequency, Percentage, Mean, and Standard Deviation, were used to analyze the data, along with inferential statistics such as Independent Samples t-test, One-way ANOVA, LSD, and Multiple Linear Regression at a statistical significance level of 0.05. The results show that the credibility, informativeness, entertainment, and information access of social media advertising have a significant impact on consumers' purchase intention, among which information access is considered the most important factor. At the same time, the three dimensions of attractiveness, symbolism, and centrality of consumer engagement also have a positive impact on purchase intention, with the influence of attractiveness on purchase intention being the most significant. In addition, differences in age, gender, income, education, and occupation do not affect purchase intention.*

Keywords: *Social Media Advertising, Consumer Engagement, Purchase Intention, Sanhe Liubao Tea*

Introduction

With the ongoing economic development and rising demand for a high-quality lifestyle, tea has become the first choice for many consumers. According to statistics from the International Tea Committee, the world's tea plantation area grew slowly in 2022, reaching 5.32 million hectares. The total world tea production in 2022 was 6.477 million tons. From a global perspective, there were still 6 countries with tea plantations of more than 100,000 hectares in 2022. Among them, China's tea plantation area is 3.33 million hectares, ranking first in the world and accounting for 62.6% of the global total (Mei and Liang, 2024). According to statistics from the International Tea Committee, total world tea consumption in 2022 was 6.209 million tons, and consumption remained stable.

With the rise of social media advertising, even Sanhe Liubao tea has a rich aroma and a mellow taste, yet it still faces challenges, such as sales, and its brand is not as well-known as other famous tea brands (Li, 2023). More and more customers are paying attention to the marketing introduction of tea, and they tend to choose marketing methods that fully reflect Sanhe Liubao tea. The advantage of social media advertising is its wide reach. More consumers can recognize local brands with distinct characteristics online, and the brand reputation of local brands can

also be transmitted to other consumers, increasing the likelihood that they will purchase local brands.

Most of the current literature on consumers' willingness to buy tea products focuses on product design and brand value. However, the key to product marketing is to let consumers know about Sanhe Liubao tea. Social media, as software consumers frequently use, allows them to learn about Sanhe Liubao tea quickly. Social media advertising is the fastest way. However, the existing literature still lacks research on whether social media advertising affects the willingness to buy Sanhe Liubao tea. This study can investigate how factors such as demographic variables, social media advertising and consumer engagement influence the willingness to buy Sanhe Liubao tea, providing insights into the further development of the Sanhe Liubao tea industry.

Research Hypotheses

H1: The difference in demographic factors generate difference in consumer purchase intention of Sanhe Liubao Tea in Guangxi, China.

H2: Social media advertising influence on consumer purchase intention of Sanhe Liubao Tea in Guangxi, China.

H3: Consumer engagement influence on consumer purchase intention of Sanhe Liubao Tea in Guangxi, China.

Research Objectives

(1) To study the differences in demographic factors that generate differences in the purchase intention of Sanhe Liubao Tea among consumers in Guangxi, China.

(2) To study the influence of social media advertising on the purchase intention of Sanhe Liubao Tea consumers in Guangxi, China.

(3) To study the influence of consumer engagement on the purchase intention of Sanhe Liubao Tea consumers in Guangxi, China.

Literature Review

Demographic Factors

The foundation of demographic can be traced back to Malthus (1986) "An essay on the principle of population (1798)", which explored the relationship between population and resources. Hauser (1959) first applied demographic factors to social science in "Demographic Research: An Evaluation and Overview". Oliver (1999) examined how demographic variables affect customer loyalty in his research. Lu (2023) found that male consumers pay more attention to the functionality and value of products or services. Zhang et al. (2024) found that consumers of Generation Z are more sensitive to emerging innovative products in the market and have a significantly higher willingness to purchase than older groups. Cao (2024) found that young consumers are more inclined to try new products, while older consumers also show a higher willingness to purchase when brand loyalty and credibility are guaranteed. Lu and Wu (2020) found that high-end and luxury goods are more sensitive to product quality and brand reputation, while low-income groups are more inclined to be influenced by promotional discounts. Li et al. (2019) found that consumers with higher levels of education tend to pay

more attention to environmental attributes and product sustainability and show a stronger willingness to make green purchases. The higher the level of education, the more consumers pay attention to the impact of products on individual health. Ouyang and Chen (2019) found that gender directly affects the willingness to purchase organic tea, and that age and occupation affect consumer trust, which, in turn, affects consumer purchasing intention.

Social Media Advertising

Arens et al. (2009) conducted earlier research on advertising. In "Contemporary Advertising", he defined advertising as a non-personal communication method for disseminating information to a specific audience, usually implemented through paid media, to promote sales, enhance brand image or convey specific information. Liu and Ding (2017) believe that advertising is an interactive communication method initiated by identifiable brands, using all media forms to reach consumers and provide valuable information services, aiming to influence consumers' current or future cognition, emotions and behaviors. More and more media have led to the diversification of advertising channels. The diversification and ambiguity of advertising's boundaries and forms have enriched its connotation. Based on the research on the factors affecting social media advertising, it is found that different factors are used as elements of advertising. In this study, we selected four factors as elements of advertising. Each of the following factors will influence consumer purchase intention: credibility (Boateng and Okoe, 2015); informativeness (Lee and Hong, 2016); entertainment (Kujur and Singh, 2017); and information access (Anderson et al., 2014). Liu (2023) found that social media advertising can enhance the purchasing intention of female consumers. Bilal et al. (2021) found that consumer purchasing intention increased significantly after watching social media advertising. Wang (2024) found that social media advertising can affect consumer purchase intention. Li and Yang (2024) found that social media advertising can affect consumer purchase decisions. Zhang et al. (2024) found that the more product or service information contained in social media advertisements, the more likely they are to attract consumer attention and increase consumer purchasing intention.

Consumer Engagement

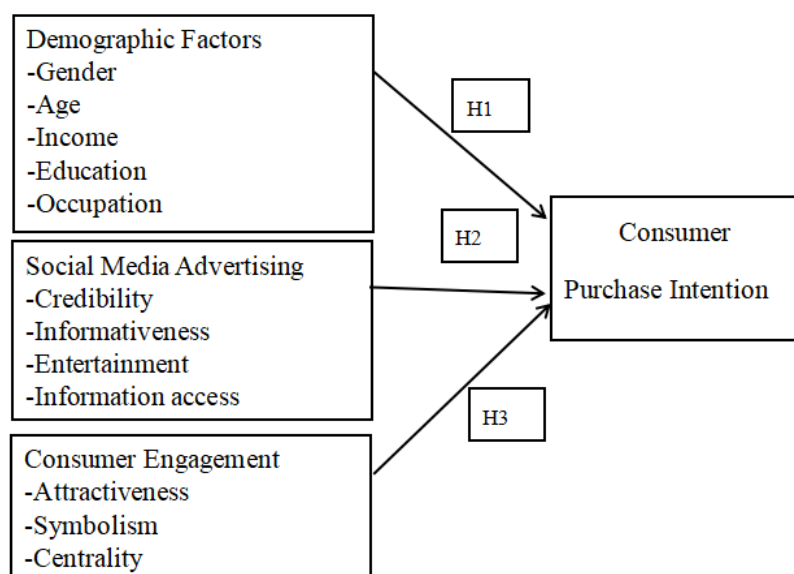
The theory proposed by Ames and Cantril (1948) can be regarded as the origin of the concept of engagement. Ames and Cantril (1948) believed that engagement occurs when personal domains are linked to social goals. The most widely used definition of engagement theory was proposed by Zaichkowsky in 1985. Zaichkowsky (1985) believed that engagement is the degree of leisure each individual devotes to an objective based on their inner needs, values, world outlook, outlook on life and interests. The core of consumer engagement lies in consumers' interest in the product, that is, the product's attractiveness to them. Consumers can perceive the product's attractiveness and gradually increase their attention and interest in it. Products also have social attributes and use a self-centered judgment mechanism to determine whether they can meet their own needs. This means that the product can confer Symbolic status to consumers, so the measurement of consumer engagement can be divided into three dimensions: attraction, symbolism and centrality (Tang and Wei, 2023). Zhang and Wang (2023) found that consumers' consumption engagement can positively affect their purchasing intention. Bilal et al. (2021) found that consumer engagement can positively enhance their

willingness to purchase products. Liu and Xu (2022) found that consumer engagement is positively correlated with purchase intention. Al-Haddad et al. (2022) studied the purchase intention of social media advertising consumers and found that consumer engagement can have a significant positive impact on purchase intention. Ao et al. (2023) found that social media advertising can increase consumer engagement; the higher the engagement, the stronger the consumer's willingness to buy.

Purchase Intention

Fishbein and Manfredo (1992) defined purchase intention as the size of consumers' desire to buy, as reflected in the process of purchasing products or services in daily life. Dodds et al. (1991) proposed that consumer purchase intention is the probability of consumers buying a certain product and the idea of promoting the product. Joachimsthaler and Aaker (1997) noted that the dimensions of consumer purchase intention can be organized around psychological states, economic pressures and usage scenarios. If consumers have a positive impression of a product, the external manifestation of their psychological state after evaluation is their willingness to buy. Ji et al. (2021) found that consumers make subjective judgments about existing information, based on their decision-making mechanisms, regarding whether to buy a product or service. Lian and Fu (2022) noted that, when taking tea consumers as the research object, consumer purchasing intention is the specific action taken after making a comprehensive judgment of product information when selecting tea, and it is a psychological activity of consumers. The analysis of consumer purchase intention can be seen as a "psychology-willingness-action" model, which divides purchase intention into three dimensions: psychological state, preference level, and external behavior control (Kim et al., 2010). The focus of consumer behavior analysis is to predict consumers' psychological activities. Consumer purchase intention can be reflected in specific behaviors, so it is divided into internal and external driving forces (Li, 2023).

Research Framework



Methodology

Population

The population of this study comprises people who will buy Sanhe Liubao tea in Guangxi, China, and its size is unknown.

Samples

The sample size determination in this study followed the Yamane formula, a recognized statistical method for determining the required sample size (Samar et al., 2017). According to the Taro-Yamane sample size formula for an infinite population, the probability of error is 0.05 (5%) at a 95% confidence level, and the minimum sample size is 400. Considering potential distribution errors and non-responses, the researchers collected 461 questionnaires from respondents.

Sampling Method

The sample strategy used in this study is non-probability sampling, which is particularly convenient given the infinite population.

Data Collection

The researcher collected the data from : (1) The people who live in Guangxi; (2) The people who are willing to buy Sanhe Liubao Tea; (3) The people who can access the Wenjuanxing platform—a customized questionnaire created on the Wenjuanxing platform for Sanhe Liubao tea consumers in Guangxi Autonomous Region. The questionnaire can be customized to the research needs and include a variety of question types and branching logic to effectively collect the necessary data on social media advertising, consumer Engagement, consumer purchase intention, and demographic variables such as age, gender, income level, education, and occupational field. Distributing questionnaires through the online platform "Wenjuanxing" is an efficient, convenient and beneficial method to collect data from the target population.

Research Instrument

Part I: Demographic factors: This section includes the basic personal information of the participants, such as gender, age, income, educational, and occupation. The questionnaire is closed-ended.

Part II: Social Media Advertising: This section collected the participants' opinions on social media advertising. The questionnaire uses a 5-point Likert scale to collect the respondents' opinions, ranging from 1 (strongly disagree) to 5 (strongly agree).

Part III: Consumer Engagement: This section collected the participants' opinions on consumer Engagement. The questionnaire uses a 5-point Likert scale to collect the respondents' opinions, ranging from 1 (strongly disagree) to 5 (strongly agree).

Part IV: Purchase Intention: The purpose of this section was to determine the participants' purchase intention towards Sanhe Liubao Tea. The survey used a 5-point Likert scale to elicit respondents' opinions on their purchase intention for Sanhe Liubao Tea.

Reliability and Content Validity

The questionnaire's validity was assessed using IOC (Item Objective Congruence), a quantitative measure of expert judgment of item content that assesses the fit between the test items and the research objectives. Three experts in research tool development evaluated the content and measurement of the questions to address and resolve the research concerns. The IOC index of all questions is greater than 0.67.

The reliability test for this study will be administered to 30 participants to assess the consistency and stability of the questionnaire. The constructs related to the Social media advertising exhibited high reliability. The Cronbach's alpha values for Credibility, Informativeness, Entertainment, and Information Access were 0.955, 0.858, 0.964, and 0.944, respectively. Similarly, Consumer Engagement showed Cronbach's alpha values of 0.910 for Attractiveness, 0.925 for Symbolism, and 0.904 for Centrality. Finally, the constructs measuring Consumer Purchase Intention achieved Cronbach's alphas of 0.934. As all Cronbach's alpha coefficients surpass the criterion of 0.70, the questionnaire exhibits robust reliability and is deemed suitable for the compilation of subsequent empirical data.

Data Analysis ***Descriptive Statistics***

The researcher uses frequencies and percentages to analyze the demographic data of the respondents, including age, gender, income and educational attainment. This summary also include the independent variables, namely social media advertising and consumer engagement, and the dependent variable, purchase intention. The statistical summary included indicators such as the mean, standard deviation, and range to fully describe various aspects of the study.

Inferential Statistics

The following inferential statistics were used for data analysis and hypothesis testing at the 0.05 significance level.

H1: Differences in demographic factors generate differences in consumer purchase intention of Sanhe Liubao Tea in Guangxi, China. An independent sample t-test (gender) and One-way ANOVA (age, income, education, and occupation).

H2: Social media advertising influence on consumer purchase intention of Sanhe Liubao Tea in Guangxi, China (Multiple Linear Regression Analysis).

H3: Consumer engagement influence on consumer purchase intention of Sanhe Liubao Tea in Guangxi, China (Multiple Linear Regression Analysis).

Result and Analysis ***Descriptive Analysis*** ***Demographic Factors***

Table 1: Frequency and Percentage of the Respondents

		Frequency	Percent
Gender	Male	235	51
	Female	226	49
Age	20-25	100	21.7
	26-35	113	24.5
	36-45	106	23
	46-55	92	20
	56 and above	50	10.8
	Less than 5,000	128	27.8
Income	5,000-10,000	212	46
	10,001-20,000	76	16.5
	More than 20,000	45	9.8
	Below Undergraduate	123	26.7
Educational	Undergraduate	259	56.2
	Above Undergraduate	79	17.1
	Government officer	49	10.6
Occupation	Freelance	59	12.8
	Private Company	243	52.7
	Student	42	9.1
	Other	68	14.8

Table 1 presents the study's examination of demographic factors and their influence on consumer purchase intention. A total of 461 valid responses were collected. In terms of gender, the most respondents were male (51%). The majority of participants were aged 26-35 years, accounting for 24.5%. Regarding income, 46% of respondents earn 5,000-10,000 yuan per month. In terms of education level, 56.2% of respondents are those with a Undergraduate education. Moreover, among the participants, the majority were from a private company (52.7%).

Social Media Advertising

Table 2: The Descriptive Statistics of Social Media Advertising

	Mean	SD	Meaning	Rank
Credibility	3.6189	0.98203	Agree	2
Informativeness	3.5973	0.96759	Agree	3
Entertainment	3.5495	0.97766	Agree	4
Information Access	3.6782	0.93476	Agree	1
Social Media Advertising	3.6110	0.74461	Agree	

Table 4.2 presents the descriptive statistics for the Social Media Advertising constructs. Information Access has the highest mean score of 3.6782 (SD=0.93476), indicating that consumers' opinions on Information Access are at the agree level. Credibility with a mean of 3.6189 (SD= 0.98203), indicating that consumers' opinion on the credibility is at agree level. Informativeness with a mean of 3.5973 (SD = 0.96759), indicating that consumers' opinion on

informativeness is at the agree level. Entertainment ranks lowest, with a mean of 3.5495 (SD=0.97766), indicating that consumers' opinions on entertainment are at the agree level. The total Social Media Advertising value's mean is 3.6110 (SD=0.74461), indicating that consumers' opinions on Social Media Advertising are at the agree level.

Consumer Engagement

Table 3: The Descriptive Statistics of Consumer Engagement

	Mean	SD	Meaning	Rank
Attractiveness	3.6529	0.93976	Agree	1
Symbolism	3.6298	0.92305	Agree	3
Centrality	3.6385	0.95322	Agree	2
Consumer Engagement	3.6404	0.75639	Agree	

Table 4.3 presents the descriptive statistics for the Consumer Engagement constructs. Attractiveness has the highest mean score of 3.6529 (SD=0.93976), indicating that consumers' opinions on Attractiveness are at the agree level. Centrality with a mean of 3.6385 (SD=0.95322), indicating that consumers' opinion on the Centrality is at agree level. Symbolism ranks lowest, with a mean of 3.6298 (SD=0.92305), indicating that consumers' opinion on Symbolism is at the agree level. The total Consumer Engagement value's mean is 3.6404 (SD=0.75639), indicating that consumers' opinion on Consumer Engagement is at the agree level.

Purchase Intention

Table 4: The Descriptive Statistics of Purchase Intention

	Mean	SD	Meaning
Purchase intention	3.65	0.86167	Agree

Table 4.4 presents the descriptive statistics for the Purchase intention. The mean score of 3.65 (SD=0.86167), indicating that consumers' opinion on purchase intention is at the agree level.

Inferential Statistic

Statistical hypothesis testing was employed with a significance level of 0.05 to analyze the influence of the independent variable on the dependent variables under the following hypotheses:

Part 1: Demographic factors generate differences in consumer purchase intention for Sanhe Liubao Tea in Guangxi, China.

Part 2: Social media advertising's influence on consumer purchase intention for Sanhe Liubao Tea in Guangxi, China.

Part 3: Consumer engagement's influence on consumer purchase intention for Sanhe Liubao Tea in Guangxi, China.

The Demographic Factors' Influence on the Purchase Intention

Part 1: Demographic factors generate differences in consumer purchase intention for Sanhe Liubao Tea in Guangxi, China.

H1a: The difference in the purchase intention of Sanhe Liubao Tea in Guangxi, China, based on gender.

$H_0: \mu_1 = \mu_2$

$H_1: \mu_1 \neq \mu_2$

Table 5: The Analysis Results on Gender Differences Influence on Purchase Intention

purchase intention	Gender	N	Mean	SD	t	df	Sig
	Male	235	3.634	0.86197	0.965	459	0.685
	Female	226	3.6667	0.86296			

From Table 5, the analysis of the influence of gender differences on purchase intention utilized a t-test with a significance level of 0.05. This study reveals no significant difference in consumer purchase intention by gender ($t(461) = 0.965$, $p = 0.685$).

H1b: The difference in the purchase intention of Sanhe Liubao Tea in Guangxi, China, based on age.

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$

$H_1: \mu_i \neq \mu_j$ at last one Pair

Table 6: The Analysis Results on the Influence of Age Differences on Purchase Intention

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.19	4	0.548	0.736	0.568
Within Groups	339.349	456	0.744		
Total	341.539	460			

From Table 6, the analysis of age differences influencing purchase intention used a one-way ANOVA at the 0.05 significance level. This study found that age ($F = 0.736$, $p = 0.568$) did not differ significantly in consumer purchase intention.

H1c: The difference in the purchase intention of Sanhe Liubao Tea in Guangxi, China, based on income.

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$

$H_1: \mu_i \neq \mu_j$ at last one Pair

Table 7 The Analysis Results on Income Differences Influence on Purchase Intention

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.091	3	0.364	0.488	0.691
Within Groups	340.448	457	0.745		
Total	341.539	460			

From Table 4.7, the analysis of the influence of income differences on purchase intention used One-way ANOVA at a significance level of 0.05. This study found that income ($F = 0.488$, $p = 0.691$) did not differ significantly in purchase intention.

H1d: The difference in the purchase intention of Sanhe Liubao Tea in Guangxi, China, based on education.

$H_0: \mu_1 = \mu_2 = \mu_3$

$H_i: \mu_i \neq \mu_j$ at last one Pair

Table 8: The Analysis Results on Education Differences Influence on Purchase Intention

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.776	2	0.388	0.521	0.594
Within Groups	340.763	458	0.744		
Total	341.539	460			

In Table 8, the analysis of the influence of educational differences on purchase intention used a One-Way ANOVA at a significance level of 0.05. This study found that education ($F = 0.521$, $p = 0.594$) did not have a significant effect on purchase intention.

H1e: The difference in the purchase intention of Sanhe Liubao Tea in Guangxi, China, based on occupation.

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$

$H_i: \mu_i \neq \mu_j$ at last one Pair

Table 9: The Analysis Results on Occupation Differences Influence on Purchase Intention

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.908	4	0.227	0.304	0.875
Within Groups	340.632	456	0.747		
Total	341.539	460			

From Table 4.9, the analysis of the influence of occupation differences on purchase intention used One-way ANOVA at a significance level of 0.05. This study found that occupation ($F = 0.304$, $p = 0.875$) did not differ significantly in purchase intention.

Social Media Advertising Influence on the Purchase Intention

Part 2: Social media advertising's influence on consumer purchase intention for Sanhe Liubao Tea in Guangxi, China.

In hypothesis 2, Y =purchase intention, X_1 , X_2 , X_3 and X_4 are Credibility, Informativeness, Entertainment and Information access.

Table 10: Summary of the Model of Social Media Advertising Influences on Purchase Intention

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate
4	0.800	0.641	0.637	0.51890

Table 10 summarizes the multiple linear regression results, showing that social media advertising constructs: Credibility, Informativeness, Entertainment and Information access significantly influence purchase intention with a multiple correlation coefficient (R) of 0.800 at a significant level of 0.05; the predictive analysis equation's capability is 63.7%.

Table 11: The Multiple Linear Regression Coefficients for the Influence of Social Media Advertising on Purchase Intention

Model	Unstandardized Coefficients		Standardized Coefficient		
	B	Standard Error	Beta	T	Sig.
(Constant)	0.291	0.121		2.414	0.016*
Credibility	0.217	0.030	0.247	7.323	0.000*
Informativeness	0.260	0.032	0.291	8.235	0.000*
Entertainment	0.180	0.031	0.204	5.715	0.000*
Information access	0.272	0.031	0.295	8.912	0.000*

Dependent variable: Purchase intention

Equation 1: $Y = 0.291 + 0.217X_1 + 0.260X_2 + 0.180X_3 + 0.272X_4$
(0.016*) (0.000*) (0.000*) (0.000*) (0.000*)

For: Y =Purchase intention

X_1 =Credibility, X_2 =Informativeness, X_3 =Entertainment, X_4 =Information access

From Table 11, the Standardized Coefficients indicate that Information Access is the most crucial variable influencing purchase intention, with a regression coefficient of approximately

0.295. The following closely follow Informativeness, Credibility, and Entertainment, with coefficients of 0.291, 0.247, and 0.204, respectively.

Consumer Engagement Influence on Purchase Intention

Part 3: Consumer engagement influence on consumer purchase intention of Sanhe Liubao Tea in Guangxi, China.

In hypothesis 3, Y = purchase intention, and X1, X2 and X3 are Attractiveness, Symbolism and Centrality.

Table 12: Summary of the Model of Consumer Engagement Influences on Purchase Intention

Model	R	R Square	Adjusted Square	R	Std. Error of the Estimate
3	0.788	0.62	0.618		0.53264

Table 12 summarizes the multiple linear regression results, showing that consumer engagement constructs: Attractiveness, Symbolism and Centrality significantly influence purchase intention with a multiple correlation coefficient (R) of 0.788 at a significant level of 0.05; the predictive analysis equation's capability is 61.8%.

Table 13: The Multiple Linear Regression Coefficients for the Influence of Consumer Engagement on Purchase Intention

Model	Unstandardized coefficients		Standardized coefficient		
	B	Standard Error	Beta	T	Sig.
(Constant)	0.386	0.122		3.160	0.002*
Attractiveness	0.273	0.031	0.298	8.716	0.000*
Symbolism	0.352	0.032	0.377	10.865	0.000*
Centrality	0.271	0.031	0.300	8.619	0.000*

Dependent variable: Purchase intention

Equation 2: $Y = 0.386 + 0.273X_1 + 0.352X_2 + 0.271X_3$
(0.002*) (0.000*) (0.000*) (0.000*)

For: Y=Purchase Intention

X1=attractiveness, X2=symbolism, X3=centrality

From Table 13, the Standardized Coefficients indicate that Symbolism is the most crucial variable influencing purchase intention, with a regression coefficient of approximately 0.377. The following closely follow Centrality and Attractiveness, with coefficients of 0.300 and 0.298, respectively.

Conclusion

Demographic Factors

A total of 461 valid questionnaires were collected in this survey. According to the analysis, the demographic variables include gender, age, income, education, and occupation of the respondents. In terms of gender, the most respondents were male (51%). The majority of participants were aged 26-35 years old (24.5%). Regarding income, 46% of respondents earn 5,000-10,000 yuan per month. In terms of education level, 56.2% of respondents are those with a Undergraduate education. Furthermore, among the participants, the majority were from a private company (52.7%).

Social Media Advertising

Based on the analysis results, the four components of social media advertising constructs: Credibility, Informativeness, Entertainment and Information access significantly influence on consumer purchase intention with a multiple correlation coefficient (R) of 0.800 at a significant level of 0.05; the predictive analysis equation's capability is 63.7%.

From the standardized coefficient, it can be seen that Information Access is the most crucial variable influencing consumer purchase intention, with a regression coefficient of approximately 0.295. The following closely follow Informativeness, Credibility and Entertainment, with coefficients of 0.291, 0.247 and 0.204, respectively.

Consumer Engagement

Based on the analysis results, the three components of consumer engagement constructs: Attractiveness, Symbolism and Centrality significantly influence consumer purchase intention with a multiple correlation coefficient (R) of 0.788 at a significant level of 0.05; the predictive analysis equation's capability is 61.8%.

From the standardized coefficient, it can be observed that Symbolism is the most crucial variable influencing consumer purchase intention, with a regression coefficient of approximately 0.377. The following closely follow Centrality and Attractiveness, with coefficients of 0.300 and 0.298, respectively.

Discussion

Demographic Factors

The findings show that demographic factors had no significant influence on the consumer purchase intention for Sanhe Liubao Tea in Guangxi, China. This result contradicts previous studies found that differences in demographic factors generate differences in consumer purchase intention (Lu, 2023; Zhang et al., 2024; Cao, 2024; Lu and Wu, 2020; Li et al., 2019; Ouyang and Chen, 2019)

Social Media Advertising

The results of this study found that Social Media Advertising influence on consumer purchase intention. It is consistent with Liu (2023), who conducted a study on the purchasing intention of female consumers and found that social media advertising can enhance it. It is consistent with the research conclusions of Bilal et al. (2021), who explored the impact of social media advertising elements on consumer purchasing intention and found that consumer purchasing intention increased significantly after watching social media advertising. This finding aligns with Wang's (2024) study on tobacco consumers, which found that social media advertising can affect consumer purchase intention. The result matches that of Li and Yang (2024), who investigated the influence of social media advertising on the purchase intention of young consumer groups and found that social media advertising can affect consumer purchase decisions. Furthermore, consistent with Zhang et al. (2024), who conducted research on social media advertising, found that the more product or service information contained in social media advertisements, the more likely they are to attract consumer attention and increase consumer purchasing intention.

Consumer Engagement

The study shows that consumer engagement significantly influences purchase intention. The research results are the same as those of Zhang and Wang (2023), who found that consumer engagement can arouse consumers' interest and that consumers' consumption engagement can positively affect their purchasing intention. It is consistent with Bilal et al. (2021), who explored the impact of consumer engagement on consumer purchasing intention and found that consumer engagement can positively enhance their willingness to purchase products. This finding aligns with Liu and Xu's (2022) experiment, which focused on measuring the impact of online shopping consumer engagement level on purchase intention, and found that consumer engagement is positively correlated with purchase intention. The result aligns with Al-Haddad et al. (2022), who studied the purchase intention of social media advertising consumers and showed that consumer engagement can have a significant positive impact on purchase intention. And also consistent with Ao et al. (2023), the research aims to study the impact of social media advertising characteristics on consumer engagement and purchase intention. It shows that social media advertising can increase consumer engagement; the higher the consumer engagement, the stronger the consumer's willingness to buy.

Implication for Practice

The results of this study provide significant insights into the factors influencing consumer purchase intention for Liubao tea, particularly the roles of Credibility, Informativeness, Entertainment, Information Access, Attractiveness, Symbolism, and Centrality. This insight can guide Liubao tea companies in formulating marketing strategies to improve sales and the brand.

Information Access is the most influence factor on consumer purchase intention, so companies should prioritize optimizing information dissemination channels to ensure that consumers can easily obtain relevant knowledge about Liubao tea. Through social media advertising, companies can effectively showcase Liubao tea's cultural charm and brand story, and enhance consumers' interest in and awareness of it. The way customers obtain information about Liubao tea can enhance their interest in and awareness of the brand, foster brand loyalty and strengthen their purchase intention.

Symbolic factors have the most significant influence on consumer purchase intention for Liubao tea. As a cultural carrier, the Symbolism meanings of Liubao tea, such as tradition, history, and regional characteristics, have a profound impact on consumer purchase intention. Therefore, companies should focus on building and strengthening the Symbolism value of Liubao tea to stimulate consumers' identification with the product and their desire to purchase it. This Symbolism reinforcement can not only enhance the product's market competitiveness but also cultivate consumers' long-term loyalty to the brand.

Suggestions for Future Research

Although this study analyzes the purchase intention of Liubao tea consumers and its influencing factors, the results may differ across cultural and regional contexts. Future research can be extended to consumer groups across different regions and cultural backgrounds to explore differences in their cognition, attitudes and purchasing behaviors regarding Liubao tea. This will help Liubao tea brands' market positioning and product promotion strategy in the context of globalization.

This study found that various dimensions of social media advertising have a significant impact on purchase intention, but whether these effects can be sustained in the long term and translated into brand loyalty has not been explored in depth. Future research can further examine the impact of social media advertising on brand loyalty and consumer repeat purchase behavior over the long term, and investigate the mechanisms by which different types of advertising content shape consumers' long-term attitudes and behavioral changes.

Although this study examines the influence of social media advertising, consumer engagement and demographic factors on purchase intention, the psychological motivations, emotional responses and social identities behind consumer purchase decisions still require further research. Future research can build more complex multidimensional models, combine consumers' emotions, attitudes, motivations and other internal psychological factors and explore in depth how these factors affect consumers' purchasing decisions and brand loyalty.

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FACTORS AFFECTING USER STICKINESS OF WEBCAST PLATFORM: A CASE STUDY ON TIK TOK LIVE STREAM

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Abstract: *This research explores the factors influencing user engagement and retention on live webcast platforms. It aims to analyze the impact of demographic factors, perceived value, interactivity, satisfaction, and social presence on user stickiness. The study uses a quantitative approach, distributing questionnaires to webcast users to collect data for statistical analysis. Key research hypotheses include the positive effects of perceived value, interactivity, satisfaction, and social presence on user stickiness. The research highlights the evolution of live webcasting from professional media-driven content to user-generated content, emphasizing the growing importance of personalized, interactive, and immersive experiences in retaining users. The findings are expected to provide insights for webcast platforms on how to enhance user retention by improving content quality, leveraging social engagement features, and leveraging emerging technologies such as AR, VR, and 5G. The research also contributes to academic discussions by addressing the limitations of traditional models, such as the Technology Acceptance Model (TAM), and by focusing on emotional and social factors in user engagement.*

Keywords: *User Stickiness, Webcast Platform, Perceived Value, Perceived Interaction, TIKTOK Live Stream*

Introduction

In the era of mobile and intelligent media, audience research is facing transformational challenges, and understanding user experience has become the key to the development of communication studies. The "experience economy" emphasizes the need for media to provide immersive experiences that evoke emotional resonance, a crucial factor in a fiercely competitive media environment.

The live streaming industry is developing rapidly. In the early days, due to technological and financial limitations, it was dominated by professional media and content was limited to sports and political news. In 2007, Justin.tv launched personal live streaming and interactive features, ushering in the era of user-generated content (UGC). With the popularization of smartphones and high-definition cameras, live broadcasting has moved to mobile devices, and the content is increasingly rich. The market is concentrated on advantageous platforms. TikTok stands out through e-commerce live broadcasts and personalized content. The integration of AR and VR technologies in 2016 brought immersive experiences to live streaming, indicating the potential of metaverse applications, and interactivity became increasingly crucial in user retention.

As an interactive multimedia entertainment form on the Internet, live broadcasting differs from traditional video. It focuses on two-way interaction and can enhance user experience and stickiness. With the popularity of live streaming, it is urgent to explore the factors that affect user stickiness. This study focuses on three key areas: demographic background, perceived value, and perceived interaction, aiming to gain a deeper understanding of the interaction mechanism between users and live streaming platforms, and provide a basis for platforms to enhance user retention.

Moreover, emotional attachment acts as a mediating factor between perceived interaction and user stickiness. As users interact more deeply with content creators and other participants, they develop stronger emotional ties to the platform. This attachment not only enhances user satisfaction but also reduces the likelihood of user abandonment of the platform in favor of alternatives (Yue et al., 2023). Such emotional investments in the platform are critical to maintaining high user stickiness in the long run.

In conclusion, demographic background, perceived value, and perceived interaction are all significant factors influencing user stickiness on live webcasting platforms. These elements shape the user experience by tailoring platform features to individual needs and preferences, encouraging long-term engagement. Understanding these relationships is essential for platforms seeking to improve user retention and enhance the overall user experience.

To guide this inquiry, three core research questions were formulated:

RQ1: How do demographic factors (gender, age, education level, occupation and monthly income) affect the stickiness of TikTok live stream users?

RQ2: How does perceived value (perceived usefulness, perceived ease of use) affect the stickiness of TikTok live stream users?

RQ3: How does perceived interactivity (perceived control, perceived response, perceived personalization) affect the stickiness of TikTok live stream users?

The objectives of this research are threefold.

RO1: To investigate the influence of demographic factors (gender, age, education level, occupation and monthly income) on the stickiness of TikTok live stream users.

RO2: To study the influence of perceived value (perceived usefulness, perceived ease of use) on the stickiness of TikTok live stream users.

RO3: To study the influence of perceived interactivity (perceived control, perceived response, perceived personalization) on the stickiness of TikTok live stream users.

Literature Review

According to Levinson, each new media product builds on and seeks to address the limitations of its predecessors. A live webcast is a prime example of this theory. It evolved from traditional radio and television broadcasts, leveraging the technological advancements in live streaming that originated with network television (Lu & Wang, 2022).

Historically, live broadcasting has been dominated by professional media teams and companies, such as radio and television stations, due to its high cost and technical demands.

These entities used live broadcasting to disseminate significant news and information to the public. However, with the advent of mobile Internet technology, the barriers to live broadcasting have been significantly reduced. This has democratized the medium, moving beyond elite control, simplifying access and facilitating the proliferation of diverse online live content and broadening its use (Song et al., 2023).

As a relatively new media phenomenon, live webcast has not yet achieved a universally accepted definition within academic circles. This study defines a live webcast as a media product that uses mobile streaming technology to broadcast information in real time, enabling simultaneous interaction among users (Xu, 2023). With advancements in mobile Internet technology, live webcast platforms have become more sophisticated, allowing users to share their activities in real time and engage interactively through various devices, including smartphones, tablets, and computers (Chen, 2022).

Demographic Factors

Demographic variables are a critical area of study for user engagement, as understanding the behavioral characteristics of different user groups can help businesses and platforms design more effective engagement strategies. Here are some key points from research on the correlation between demographic variables and user engagement:

Perceived Value

Perceived value stems from the fairness theory of psychologist Adams, which considers both users' inputs and the products/services provided by providers (Deng & Luo, 2024). On this basis, Wu & Huang (2023) provided a discretionary definition of perceived value, stating that it is "the overall evaluation for the utility of a product made by users based on perceived gains and losses". In other words, perceived value is the user's comparative judgment of the perceived gain and perceived pay from consuming a product (Wu & Huang, 2023). Several relevant research studies focus on both the quality and the price of the product. Of course, some scholars argued that the concept of perceived value should be viewed from an integrated perspective (Arifah et al., 2025).

Perceived Interactivity

Newhagen et al. (1995) first proposed the concept of perceived interactivity and identified "psychological feeling of efficacy" and "feeling of media system interactivity" as its two dimensions. Sjöblom (2017), in the research of the Twitch platform, divided the perceived interactivity into perceived control, perceived response and perceived personalization. This definition fully considers two aspects of interaction in the process of website use: interaction between people and the system, and interaction between people.

The feature perspective, process perspective and perception perspective are three common perspectives currently used in the research on interactivity. The perspective of process interactivity mainly focuses on the control process of information (Li & Zhu, 2023). The

scholars cannot emphasize it due to the infallibility of research. The feature perspective focuses on the research of the characteristics of interactive media.

User Stickiness

In 2000, Dr. Davenport from Harvard University argued in his book *The Attention Economy* that the Internet is the simplest form of all attention economy models, and that the attention economy has performed most fully and notably in this regard. The Internet economy is also an attention economy. The core of website value lies in the attention it receives, which determines an Internet company's future development (Dhar et al., 2025). After the Internet became widely used, attracting attention effectively has become the ultimate challenge for websites, and it has also driven each website to constantly seek breakthroughs and strive for better solutions. The number of traffic or registered users does not indicate the attention each website receives, but the "stickiness" mentioned by Davenport does. The "stickiness" of a website is also known as User Stickiness, an important concept similar to user viscosity, website viscosity, etc. (Xiong, 2019). There is no generally accepted definition of User Stickiness. Generally, it refers to a website's ability to attract and retain users. The current academic definition of stickiness is mainly based on the perspective of websites and users (Yue et al., 2023).

Research Methodology

The study adopts a quantitative research design grounded in an extensive literature review and employs a structured questionnaire as the primary data collection instrument. The target population comprises webcast platform users across diverse demographic backgrounds who actively engage in online streaming for entertainment and social interaction. Given the infinite population, the sample size is determined using Yamane's (1967) formula, which simplifies to $n = 1 / (e^2)$. With an allowable error of 5% (0.05), the required sample size is calculated as 400 respondents. A convenience sampling method is applied to ensure that participants have prior experience with webcast platforms. Data are collected through online channels, including social media, email, and streaming platforms, focusing on users in China to capture diverse technological and economic contexts. The questionnaire consists of four sections: demographic factors, perceived value, perceived interactivity, and user stickiness.

To ensure measurement quality, validity is established through literature-based scale development and the Item-Objective Congruence (IOC) method. At the same time, reliability is assessed using Cronbach's Alpha, with a threshold of 0.70 indicating acceptable internal consistency. Descriptive statistics, including frequencies, percentages, means, and standard deviations, are used to summarize demographic characteristics and key variables. Inferential statistics are employed to test the research hypotheses: the independent-samples t-test examines differences based on binary variables, the one-way ANOVA analyzes differences across multiple groups, and the multiple linear regression assesses the effects of perceived value and perceived interactivity on user stickiness.

Research Findings

The Demographic Factors

Table 1: Frequency and Percent Distribution of Respondents by Demographic Factors

	Category	Frequency	Percent (%)
Gender	Male	196	48.3
	Female	210	51.7
Age	20-30	158	38.9
	31-40	107	26.4
	41-50	75	18.5
	More than 50	66	16.3
	High school and below	155	38.2
Education Level	Junior college	88	21.7
	Undergraduate	81	20
	Postgraduate and above	82	20.2
	Student	135	33.3
Occupation	Office worker	177	43.6
	Self-employed	35	8.6
	Freelancer	28	6.9
	Others	31	7.6
Monthly income	Below 5000¥	103	25.4
	5001-10000¥	100	24.6
	10001-15000¥	86	21.2
	15000¥ or more	117	28.8

In this survey, a total of 406 people participated in this survey. 196 are male (48.3%), and 210 are female (51.7%). Since game live webcasts occupy a significant share of the overall live webcast industry, live webcast users are more male than female.

The age structure of the survey samples is as follows: people under 20 and over 50 are relatively few, accounting for 0% and 16.3% of the total samples, respectively. Among the survey samples, 158 people aged 20 - 30 account for 38.9% (the largest group), and those aged 31 - 40 account for 26.4%. From the survey data, it is found that the number of respondents aged 20-40 is the largest, indicating that live webcast users are mainly young and middle-aged. This conclusion aligns with the current trend among younger mobile Internet users.

Among the survey samples, users with high school education or below are the least (38.2%), users with an undergraduate degree are the most (20%), and users with a postgraduate degree or above account for 20.2%. According to the survey results, the number of users with higher education is higher than in the previous study, indicating that the average educational level of live webcast users is increasing.

From the respondents' occupations, it can be seen that office workers account for the largest share (43.6%). It is concluded that most live webcast users are employed and have regular

incomes, which provides an economic foundation for giving tips while watching live webcast programs.

Hypothesis Testing Result (The Inferential Statistics)

H1: Differences in Demographic Factors generate differences in the Stickiness of TikTok Webcast Users

Table 2: Variance Analysis of Background Variables (Gender) on User Stickiness on TikTok (t-test)

Variable	Category	Frequency	Percent (%)	Mean (User Stickiness)	SD	t/F Value	p Value	Significance
Gender	Male	196	48.3	3.877	0.4602	-0.634	0.527	Not significant
	Female	210	51.7	3.906	0.4672			

Table 2 shows that, for Gender, the t-test results indicate that there is no significant difference in user stickiness between male and female users on TikTok ($p = 0.527$). This suggests that gender does not strongly influence users' engagement levels. The lack of significance might be because TikTok's features—such as short, visually engaging videos and interactive elements—appeal broadly to both genders.

Table 3: Variance Analysis of Background Variables on User Stickiness on TikTok (ANOVA)

Variable	Category	Frequency	Percent (%)	Mean (User Stickiness)	SD	t/F Value	p Value	Significance
Age	20-30	158	38.9	4.073	0.4801	19.960	0.001	Significant
	31-40	107	26.4	3.893	0.4381			
	41-50	75	18.5	3.659	0.3398			
	Above 50	66	16.3	3.718	0.4046			
Education Level	High school and below	155	38.2	4.017	0.4102	7.298	0.001	Significant
	Junior college	88	21.7	3.755	0.4144			
	Undergraduate	81	20	3.869	0.4818			
	Postgraduate and above	82	20.2	3.824	0.5337			
Occupation	Student	135	33.3	3.902	0.421	8.025	0.001	Significant
	Office worker	177	43.6	3.995	0.4927			
	Self-employed	35	8.6	3.606	0.3865			
	Freelancer	28	6.9	3.75	0.3835			
	Others	31	7.6	3.703	0.4095			
Monthly Income	Below 5000¥	103	25.4	3.825	0.4599	1.195	0.311	Not significant
	5001-10000¥	100	24.6	3.884	0.4655			
	10001-15000¥	86	21.2	3.942	0.5086			
	Above 15000¥	117	28.8	3.92	0.4276			

Table 3 shows that the Age: One-way ANOVA analysis reveals significant differences in user stickiness across age groups ($p < 0.001$). Users aged 18-30 show the highest stickiness, followed by those aged 31-40. Younger users' higher engagement could be due to their familiarity with technology and preference for short, entertaining content, which TikTok

specializes in. Older users, however, may have different platform preferences or seek content with more practical value, leading to slightly lower stickiness on TikTok.

Table 3 shows that Education Level also has a significant impact on user stickiness on TikTok ($p < 0.001$). Interestingly, users with lower levels of education (high school or below) have higher stickiness than those with higher levels of education. This may indicate that lower-educated users find more entertainment value in TikTok's content. In contrast, higher-educated users may use other platforms for more information-rich content, reducing their overall stickiness on TikTok.

Table 3 showed that Occupation: ANOVA results indicate a significant effect of occupation on user stickiness ($p < 0.001$). Office workers demonstrate the highest engagement, likely due to stable incomes that enable them to participate in platform activities like tipping or purchasing virtual items. Students also show high engagement, likely because they have more flexibility in their schedules and use TikTok as a social and entertainment outlet.

Table 3 showed that Monthly Income: The ANOVA test for monthly income does not reveal a significant difference in user stickiness on TikTok across income levels ($p = 0.311$). This suggests that income does not substantially affect users' engagement on TikTok. One explanation could be TikTok's widespread accessibility and free content, which allows users from different income levels to engage similarly.

Table 3 shows that age, education level, and occupation are significant factors influencing user stickiness on TikTok, while gender and monthly income have a lesser effect. Hypothesis "H1: Differences in Demographic Factors generate differences in the Stickiness of TikTok Webcast Users" is partially proved.

H2: Perceived Value has a significant positive impact on Users' Stickiness to the TikTok Webcast.

$$H_0: \beta_i = 0$$

$$H_a: \beta_i \neq 0 (i=1, 2)$$

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2$$

Where Y = Users' Stickiness of TikTok

X_1 = Perceived Usefulness

X_2 = Perceived Ease of Use

The results from the study are shown in Table 4.14 and are expressed in terms of equation (1).

$$Y = 1.212 + .438X_1 + .195X_2$$

$$\text{Adjusted } R^2 = 0.163$$

Table 4: The Multiple Linear Regression Analysis of Perceived Value on Users' Stickiness of TikTok

Model	Coefficient		T	p-value
	Unstandardized Coefficients	Standardized Coefficients		
	B	Std.Error	Beta	
Constant	1.212	.336		.000
X1=Perceived Usefulness	.438	.077	.325	.000
X2=Perceived Ease of Use	.195	.098	.113	.049

a. Dependent variable Y: Users' Stickiness of TikTok

In this study on the user stickiness of TikTok live webcasts, two key hypotheses were put forward. The first is the null hypothesis, which holds that the two factors, perceived usefulness and perceived ease of use, have no impact on the user stickiness of TikTok live webcasts. The other is the alternative hypothesis, which states that at least one factor has a significant effect on user stickiness.

From the research results, when neither perceived usefulness nor perceived ease of use is present, TikTok still shows a certain level of basic user stickiness. When perceived usefulness increases while perceived ease of use remains constant, user stickiness will rise accordingly. Similarly, when perceived ease of use increases and perceived usefulness remains unchanged, user stickiness will also increase. However, these two factors together can only explain about 16.3% of the changes in user stickiness, and 83.7% is due to other factors not included in the study. Based on a comprehensive analysis of various data, it can be concluded that both perceived usefulness and perceived ease of use have a significant positive impact on user stickiness for TikTok live webcasts. The test results for the relevant data indicate that the effects of these two factors are significant, allowing us to reject the null hypothesis and confirm that they play an important role in enhancing TikTok's user stickiness.

H3: Perceived Interactivity has a significant positive impact on the Stickiness of TikTok Webcast Users.

$$H_0: \beta_i = 0$$

$$H_a: \beta_i \neq 0 (i=1, 2)$$

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$$

Where Y = Users' Stickiness of TikTok

X₁ = Perceived Control

X₂ = Perceived Response

X₃ = Perceived Personalization

The results from the study are shown in Table 4.14 and are expressed in terms of equation (1).

$$Y = 1.305 + .181X_1 + .005X_2 + .426X_3$$

$$\text{Adjusted } R^2 = 0.335$$

Table 5: The Multiple Linear Regression Analysis of Perceived Interactivity on Users' Stickiness of TikTok

Model	Coefficient			T	p-value
	Unstandardized Coefficients		Standardized Coefficients		
	B	Std.Error	Beta		
Constant	1.305	.206		6.347	.000
X1=Perceived Control	.181	.038	.201	4.773	.000
X2=Perceived Response	.005	.037	.007	.147	.883
X3=Perceived Personalization	.426	.039	.497	11.044	.000

a. Dependent variable Y: Users' Stickiness of TikTok

In the research on TikTok live streaming, a hypothesis was proposed that perceived interactivity has a significant positive impact on user stickiness. The study thoroughly analyzed the multiple dimensions of perceived interactivity, including perceived control, perceived response, and perceived personalization, and their relationship with TikTok live streaming user stickiness.

When the three dimensions of perceived control, perceived response, and perceived personalization are all at zero level, TikTok still has a certain degree of basic user stickiness, with a value of 1.305. This data indicates that even in the absence of these perceived interactive factors, TikTok can still maintain a certain level of user retention through its other characteristics.

From the perspective of the impact of various factors on user stickiness, for every unit increase in perceived control, TikTok live streaming user stickiness is expected to increase by 0.181 units. This means that as users increasingly feel they can control live-streaming operations on TikTok, such as independently selecting content to watch and flexibly adjusting live-streaming settings, their willingness to continue using TikTok live streaming will increase accordingly.

In terms of perceived response, for every unit increase, user stickiness only increases by 0.005 units. Although this growth rate is relatively low, it also indicates that perceived response has played a positive role in user stickiness. When users watch live streams, if they can feel that the host or platform responds to their feedback promptly, such as replying to comments, answering questions, etc., although the impact is limited, it will still increase the likelihood of users continuing to use TikTok live streams to a certain extent.

The impact of perceived personalization is more pronounced, with an expected increase of 0.426 units in user stickiness per unit increase. This indicates that when TikTok live streaming can accurately push live content of interest to users based on personalized factors such as their interest preferences and viewing history, or when it provides personalized interface settings, user stickiness will be significantly improved.

From a statistical perspective, the p-values for perceived control and perceived personalization are both 0.000, well below 0.05, indicating that these two factors have a significant positive impact on user stickiness. The p-value for perceived response is 0.883, which is greater than 0.05, indicating that, compared to perceived control and perceived personalization, perceived response has a relatively weak impact on user stickiness at the 0.05 level of statistical significance. However, this does not mean that perceptual response has no effect at all; it is just that, in this research model, its impact has not reached the same level of significance as the other two factors.

Overall, the combined effects of perceived control, perceived response, and perceived personalization explain 33.5% of changes in TikTok live-streaming user stickiness. This means that about one-third of user stickiness fluctuations can be understood through these three dimensions of perceived interactivity. However, the remaining 66.5% of user stickiness changes are due to other factors not yet addressed in this study. These unknown factors require further exploration and research to gain a more comprehensive understanding of the mechanism underlying TikTok live-streaming user stickiness.

Conclusion and Discussion

Through the empirical analysis of the TikTok live broadcast platform, this study identified the key factors affecting user stickiness. Age, education level, and occupation have a significant impact on user stickiness, with younger users (18-30 years old) having higher stickiness, thanks to their familiarity with digital technology and love for platform content; Users with lower education levels have higher stickiness than those with higher education levels, reflecting the attractiveness of entertainment content on the platform; Students and office staff have high stickiness due to ample time and economic stability, respectively. Gender and income have little impact on user stickiness, reflecting the broad appeal of platform content.

Perceived value plays a key role in user stickiness. Perceived usefulness enables platforms to surpass entertainment functions, such as live streaming and e-commerce, allowing users to access shopping information, engage in social interaction, and increase platform value. Perceived ease of use lowers the threshold for users, while simple operations and intuitive interface design enhance the user experience and promote long-term use.

Perceived interactivity is equally important. The user's sense of control over the live streaming experience, the platform's timely response, and personalized recommendations can all enhance user stickiness. Users gain satisfaction through personalized settings and the selection of interactive content; real-time feedback from the platform on user behavior creates a participatory atmosphere; accurate content recommendations increase the probability of users discovering interesting content and deepen the emotional connection between users and the platform.

The findings from this study highlight specific demographic, value-based, and interactive elements that impact user engagement and retention on TikTok's live-streaming commerce platform. Understanding these elements enables management teams to design targeted strategies that reinforce user stickiness. This section discusses key implications for platform

design, user experience enhancement, and long-term engagement strategies. The suggestion can be to tailor content and engagement strategies based on demographic insights, enhance perceived value to strengthen user loyalty, leverage interactivity to foster user engagement, build a robust framework for content creator partnerships, and encourage community building and social engagement.

In the future, research on the factors influencing user stickiness on the TikTok live streaming platform can be deepened and expanded from multiple aspects. In studying variables, in addition to exploring new variables such as innovative live-streaming content and social atmosphere creation, it is also necessary to delve into the complex relationships among variables, such as the moderating effect of demographic factors on perceived value, perceived interactivity, and user stickiness. In terms of research methods, a mixed-methods approach was adopted, combining qualitative in-depth interviews and focus groups with quantitative methods. At the same time, a longitudinal research design was used to track user behavior over the long term to understand the dynamic changes in stickiness. In terms of research objects, segmenting user groups, analyzing differences between users of different types of live streaming content, and conducting cross-platform comparative research can also be carried out. In the research context, focus on the impact of content changes driven by special events, such as large-scale platform events and hot events, on user stickiness, as well as differences in influencing factors across different cultural backgrounds, to provide targeted suggestions for global platform operations.

While this study provides valuable insights into factors influencing user stickiness on TikTok's live-streaming platform, some limitations should be noted. Firstly, the survey sample may not fully represent TikTok's global user base, as it focused on a limited demographic, potentially affecting the generalizability of the results. Expanding future studies to include a broader range of geographic and cultural backgrounds could provide a more comprehensive view.

Secondly, the cross-sectional survey design captures user perceptions at a single point in time, limiting insights into how engagement evolves over time. A longitudinal approach could offer a deeper understanding of changes in user preferences over time. Lastly, reliance on self-reported data introduces potential biases, such as recall inaccuracies and social desirability effects. Integrating actual behavioral data from platform analytics in future studies would provide a more objective understanding of user engagement.

Future research can build on these findings by exploring several emerging areas. Firstly, investigating how new technologies such as augmented reality (AR) and artificial intelligence (AI) affect user stickiness would be valuable, as these tools offer increasingly personalized and immersive experiences. Secondly, examining the role of emotional and social factors, such as users' connections with influencers or communities, could shed light on deeper drivers of engagement.

Additionally, analyzing competition among platforms and its impact on user loyalty could reveal why users switch or remain loyal to specific platforms. Lastly, future studies could examine the influence of monetization features, such as tipping or virtual gifts, on user retention and loyalty.

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THE IMPACT OF LAW FIRM ENTREPRENEURSHIP AND CAREER ASPIRATION ON LAWYERS' INNOVATIVE BEHAVIOR

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Abstract: *In the increasingly competitive global legal services market, innovation and entrepreneurial spirit have become essential for sustaining law firm performance and adaptability. This study aims to examine the factors influencing lawyers' innovative behavior, with a particular focus on demographic characteristics, entrepreneurial spirit, and career aspirations. Specifically, the study investigates (1) the influence of demographic factors on innovative behavior, (2) the effect of law firm entrepreneurial spirit, and (3) the impact of lawyers' career aspirations on their innovative behavior. A quantitative research approach was employed using survey data collected from legal professionals. Descriptive analysis indicates that respondents generally exhibit moderate to high levels of entrepreneurial spirit and career aspirations, with enterprising spirit emerging as the most dominant dimension. However, innovative behavior scores are relatively lower, suggesting a gap between intention and actual practice. Inferential analysis reveals that age and working position significantly influence innovative behavior, while gender, education, and working experience do not show significant differences. Multiple regression results demonstrate that entrepreneurial spirit significantly affects innovative behavior, particularly through risk-taking and enterprising dimensions, whereas innovative spirit alone is not a significant predictor. Furthermore, career aspirations are found to have a strong and positive influence on innovative behavior. Overall, the findings highlight that practical entrepreneurial traits and strong career motivation play a more critical role in fostering innovation than demographic characteristics or abstract attitudes. This study contributes to the literature on professional service firm innovation and provides practical implications for law firms to enhance innovation by cultivating entrepreneurial capabilities and supporting employees' career development.*

Keywords: *Lawyers' Innovative Behaviors, Entrepreneurial Spirit, Career Aspirations*

Introduction

The global legal services market has undergone a significant transformation, with innovation and entrepreneurial orientation emerging as key drivers of competitiveness and long-term sustainability. In recent years, the industry has experienced steady growth alongside intensifying competition, rapid technological advancement, and increasingly sophisticated client expectations. Law firms are progressively integrating digital technologies—such as artificial intelligence and data analytics—to improve service efficiency, accuracy, and overall client value. However, the sector continues to face critical challenges, including market concentration, competition from international firms, data security concerns, and the need to enhance accessibility to public legal services. Despite these dynamics, many law firms still lack well-defined innovation strategies, and a considerable number of legal professionals

exhibit limited awareness and capability in innovation, which constrains the industry's future development.

Existing literature highlights the crucial role of entrepreneurial spirit and career aspirations in fostering innovative behavior among professionals. Lawyers with a strong entrepreneurial orientation are more likely to recognize emerging opportunities, respond effectively to market changes, and drive service innovation. At the same time, career aspirations serve as an intrinsic motivational force, encouraging individuals to pursue continuous professional development, challenge traditional practices, and adopt innovative approaches. Although prior studies have explored innovation within law firms, there remains a noticeable gap in understanding how organizational entrepreneurship and individual career aspirations jointly influence lawyers' innovative behavior.

Accordingly, this study aims to address this gap by examining the determinants of innovative behavior among lawyers through three key dimensions. First, it investigates whether differences in demographic factors lead to variations in innovative behavior (H1). Second, it analyzes the impact of entrepreneurial spirit within law firms on lawyers' innovative behavior, hypothesizing a significant positive relationship (H2). Third, it explores the effect of lawyers' career aspirations on their innovative behavior and proposes a significant positive influence (H3). By integrating these perspectives, the study advances theoretical understanding of innovation in professional service firms and offers practical insights for enhancing innovation strategies in the legal services industry.

Literature Review

Demographic Factors

Gender is a key demographic variable influencing attitudes, cognition, and behavior. Prior studies suggest notable gender differences in innovative behavior. For instance, Smith (2018) found that males often exhibit higher levels of initiative and competitiveness, while Johnson (2019) highlighted females' strengths in communication, collaboration, and attention to detail. However, Lee (2020) observed that gender differences tend to diminish with experience, indicating that skills and professional exposure may outweigh gender effects over time. Thus, gender should be considered to ensure a comprehensive analysis of innovative behavior.

Age significantly shapes innovative behavior through its relationship with experience and adaptability. Zhou (2019) reported that younger individuals (20–30) demonstrate greater flexibility and openness to new ideas. In contrast, Ng and Feldman (2013) suggested that middle-aged individuals balance experience with creativity, while Simonton (2012) identified a decline in innovative output in later career stages. These findings indicate that innovation varies across age groups, requiring differentiated support strategies.

Education plays a critical role in fostering innovative capacity. Empirical evidence shows a positive relationship between education level and innovation. Kim and Park (2021) found that highly educated individuals are more actively engaged in innovation, while Cui and Zhao (2020) emphasized the role of education in enhancing creative thinking. Similarly, Li and Chen

(2019) noted that higher education increases access to innovation-related resources. Overall, education strengthens both knowledge and innovative capability.

Job tenure influences innovation through experience, role responsibilities, and organizational familiarity. Anderson and West (2022) linked managerial innovation to firm performance, whereas Hammond et al. (2021) emphasized the role of frontline employees. Tierney and Farmer (2023) suggested that tenure can either promote or hinder innovation, and Oldham and Cummings (2024) found that broader responsibilities stimulate innovative behavior. Therefore, tailored organizational support is essential to maximize innovation across tenure levels.

Firm size affects both the capacity and type of innovation. Large firms benefit from greater resources and R&D investment (Cohen & Klepper, 2022), often achieving higher innovation success rates (Griffith et al., 2023). In contrast, small firms exhibit greater flexibility and responsiveness, sometimes achieving higher efficiency (Acs & Audretsch, 2024). These differences imply that innovation strategies should align with firm size.

Firm age shapes innovation orientation and capability. Younger firms tend to focus on short-term and exploratory innovation (Bianchini et al., 2018), while older firms leverage accumulated resources for sustained innovation (Yang et al., 2017). Wu and Tang (2016) further noted that firms adopt different strategies across life stages. Hence, establishment duration is a critical factor in determining innovation approaches.

Entrepreneurial Spirit

Entrepreneurial spirit—encompassing innovativeness, risk-taking, and proactiveness—is widely recognized as a key driver of innovation and competitiveness. It strengthens firms' capacity to identify opportunities, allocate resources creatively, and adapt to dynamic environments. Innovativeness fosters creative problem-solving and idea generation (Amabile, 1997), while supportive organizational cultures further enhance innovation outcomes (Kuratko, 2017). Risk-taking reflects a willingness to pursue uncertain but high-potential initiatives, significantly influencing innovation performance (Lumpkin & Dess, 1996; Miller, 1983), whereas proactiveness enables firms to anticipate and act on market opportunities (Covin & Slevin, 1991; Zahra, 1991).

These dimensions operate synergistically to reinforce innovation capability (Shane & Venkataraman, 2000; Hisrich et al., 2010). Empirical evidence shows that firms with strong entrepreneurial orientation achieve superior innovation and market performance (Rauch et al., 2009), particularly in resource-constrained contexts where entrepreneurial behavior enhances efficiency (Tang et al., 2012). Moreover, entrepreneurial spirit influences innovation both directly and indirectly through leadership, learning, and organizational context. For instance, entrepreneurial leadership promotes innovative behavior via psychological and attitudinal mechanisms (Zhu & Liu, 2020), while organizational and individual learning further strengthen innovation outcomes (Chen et al., 2020; Song, 2020). It also contributes to technological advancement and economic development (Cai, 2022; Nie et al., 2023).

Overall, entrepreneurial spirit plays a vital role in promoting innovation through individual, organizational, and strategic pathways. Cultivating entrepreneurial values is therefore essential for enhancing innovation capability and sustaining competitive advantage.

Career Aspirations

Career aspiration refers to individuals' career goals, expectations, and motivations, which significantly shape their work attitudes and innovative behaviors. Employees with strong career aspirations tend to display higher intrinsic motivation and proactive engagement, making career aspiration a key driver of innovation. Prior studies indicate that individuals with high aspirations are more likely to exhibit innovative tendencies (London, 1983), while enhanced self-efficacy further supports idea generation and implementation (Kanfer, 1990). Additionally, strong career goals encourage continuous learning and development, thereby strengthening innovative capabilities (Noe, 1996; Hall & Mirvis, 1995).

Organizational factors further reinforce this relationship. Supportive environments enable employees with high career aspirations to engage more actively in innovation processes (Aryee & Tan, 1992; Eisenberger et al., 1990). Career aspiration is also linked to greater job satisfaction and effective goal-setting, both of which contribute to innovative behavior (Judge & Bono, 2001; Locke & Latham, 2002). Empirical evidence confirms a direct positive relationship between career aspiration and innovation performance (Wang & Wang, 2012; Li et al., 2017).

Recent research highlights additional indirect and contextual effects. Career aspiration enhances work performance through psychological capital and job crafting (Wang et al., 2023; Chen et al., 2023), while also influencing professional identity, mental health, and resilience (Zhang, 2020; Shi et al., 2023). At the organizational level, employees' career aspirations contribute to overall innovation outcomes and development (Lian et al., 2022). Overall, career aspiration is a significant predictor of innovative behavior, operating through motivation, self-efficacy, learning orientation, and organizational support.

Innovative Behavior

Innovative behavior refers to employees' actions in generating, promoting, and implementing new ideas, processes, or products within the workplace. It is a critical driver of organizational performance, competitiveness, and adaptability in dynamic environments. Extant literature consistently highlights the positive impact of innovative behavior on firm outcomes. At the organizational level, innovation is strongly associated with improved performance, efficiency, and market share (Damanpour, 1991; Ahuja, 2000). It also enables firms to sustain competitive advantage and technological leadership in changing markets (Zahra & Covin, 1993; Porter, 1990). Moreover, innovation enhances firms' responsiveness and adaptability, which are essential in competitive environments (Tidd et al., 2005; Christensen, 1997). Organizational context plays a crucial role in fostering innovative behavior. A supportive culture significantly enhances employees' creativity and innovation capability (Schein, 1985; Martins & Terblanche, 2003). At the individual level, innovative behavior contributes to higher job

satisfaction, motivation, and organizational commitment (Amabile, 1988; Scott & Bruce, 1994).

Recent studies further indicate that multi-level factors, including policy environment, leadership, and individual characteristics, shape innovative behavior. For example, macro-level policies and financing conditions influence corporate innovation (Wang et al., 2023), while organizational climate and leadership styles significantly promote employee innovation (Wei, 2020; Hao et al., 2021). Additionally, psychological factors such as self-efficacy, proactive personality, and motivation mediate innovative behavior (Kong et al., 2020; Zhu et al., 2023). External and contextual factors—including job insecurity, customer participation, and family support—also exert complex effects on innovation outcomes (Ren et al., 2021; Wang et al., 2020; Liu et al., 2021).

In summary, innovative behavior plays a vital role in enhancing organizational performance and sustainability. It is influenced by an interplay of organizational, individual, and environmental factors. Therefore, firms should cultivate supportive cultures, effective leadership, and enabling environments to stimulate and sustain innovative behavior.

Research Methodology

This study employs a quantitative research design to examine the impact of entrepreneurship and career aspirations on lawyers' innovative behavior, while accounting for demographic variables as influencing factors. Data are collected with a structured questionnaire distributed to lawyers across different law firms. The questionnaire consists of four sections: demographic information, entrepreneurial spirit, career aspirations, and innovative behavior. Measurement items are assessed using a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). To ensure representativeness, respondents are selected from diverse backgrounds in terms of gender, age, educational level, occupation, and work experience. A stratified random sampling method is employed, and a minimum of 373 valid responses is targeted to enhance reliability and generalizability. Data collection is conducted through online platforms and professional networks, with strict quality control procedures to ensure accuracy and completeness.

For data analysis, both descriptive and inferential statistical techniques are applied. Descriptive statistics, including frequencies, percentages, means, and standard deviations, are used to summarize respondents' characteristics and key variables. Inferential analysis includes Independent-Samples t-tests and One-Way ANOVA to examine differences across demographic groups, multiple regression analysis to test relationships among entrepreneurship and innovative behavior, and simple regression analysis to test relationships among career aspirations and innovative behavior. The instrument's reliability is assessed using Cronbach's alpha, and content validity is evaluated through expert review and the Content Validity Index (CVI). Additionally, factor analysis (EFA/CFA) is conducted to confirm construct validity. A significance level of 0.05 is applied in hypothesis testing to ensure the robustness and validity of the findings.

Research Findings

The Demographic Factors

The sample is relatively balanced by gender, with a slight majority of males (56.03%). Most respondents are in the 26–45 age range, indicating a concentration of individuals in their prime working years, while fewer are younger or older. This suggests that the sample mainly represents experienced professionals rather than early-career lawyers. In terms of education and position, the respondents are highly educated, with doctoral degree holders forming the largest group. Most participants occupy junior and middle-level managerial roles, reflecting a concentration in mid-level positions. Additionally, the majority have 6–10 years of work experience, indicating moderate professional experience. Overall, the sample represents a well-educated, mid-career group suitable for analyzing innovative behavior in law firms.

Entrepreneurial Spirit

Table 1: The Descriptive Statistics of Entrepreneurial Spirit

Item	N	Mean	Standard Deviation	Meaning	RANK
Innovative spirit	373	3.509	0.940	Agree	3
Risk-taking spirit	373	3.523	1.027	Agree	2
Enterprising spirit	373	4.008	1.024	Agree	1
Overall	373	3.680	0.720	Agree	

Table 1 shows that all dimensions of entrepreneurial spirit are at the "agree" level, indicating a generally positive perception among lawyers. Enterprising spirit ranks highest ($M = 4.008$), suggesting strong ambition and career drive, while risk-taking ($M = 3.523$) and innovative spirit ($M = 3.509$) are moderate. The overall mean ($M = 3.680$, $SD = 0.720$) indicates a consistent, moderately high level. The ranking—enterprising, risk-taking, then innovative—suggests that lawyers prioritize structured career advancement over risk-taking and innovation, likely because of the cautious nature of the legal profession.

Career Aspirations

Table 2: The Descriptive Statistics of Career Aspirations

Item	N	Mean	Standard Deviation	Meaning
Career Aspiration	373	4.048	0.988	Agree

Table 2 indicates that career aspirations have a high mean score ($M = 4.048$, $SD = 0.988$), reflecting that respondents generally possess clear goals and a strong drive for professional advancement. While most lawyers show high ambition, the moderate standard deviation suggests some variation in individual aspirations. This high level of career aspirations may act as a key motivational factor, encouraging lawyers to engage in innovative practices and supporting their positive attitudes toward innovation.

Innovative Behaviors

Table 3: The Descriptive Statistics of Innovative Behaviors

Item	N	Mean	Standard Deviation	Meaning
Innovative Behaviors	373	3.645	0.781	Agree

Table 3 shows that innovative behaviors are at an "agree" level ($M = 3.645$, $SD = 0.781$), indicating that lawyers moderately engage in innovation, such as adopting new methods or technologies. However, compared to entrepreneurial spirit and career aspirations, the lower mean suggests a gap between intention and actual practice. This may be due to constraints within the legal profession, such as regulatory limitations and traditional work practices.

Differences in Gender Generate Differences in Innovative Behaviors

Table 4: The Independent Samples t-test of the Gender Factor

Items	Gender	N	Mean	S.D.	t-value	p-value
Customer Loyalty	Female	164	3.490	0.769	3.452	0.094
	Male	209	3.767	0.771		

As shown in Table 4, female lawyers ($M = 3.767$, $SD = 0.771$, $N = 209$) report slightly higher innovative behavior scores than male lawyers ($M = 3.490$, $SD = 0.769$, $N = 164$). However, the t-test results ($t = 3.452$, $p = 0.094$) indicate that this difference is not statistically significant at the 0.05 level. Therefore, although a numerical difference exists, it cannot be concluded that gender significantly affects innovative behavior, and the null hypothesis ($H_0: \mu_1 = \mu_2$) is retained.

Differences in Age, Education, Working Position, and Working Experiences Generate Differences in Innovative Behaviors

Table 5: The One-Way ANOVA of Age, Education, Working Position, and Working Experiences

Factor	Items	SS	Df	MS	F-value	Sig
Age	Between Groups	9.062	3	3.021	5.113	0.002*
	Within Groups	217.989	369	0.591		
	Total	227.051	372			
Education	Between Groups	4.753	3	1.584	2.63	0.05
	Within Groups	222.297	369	0.602		
	Total	227.051	372			
Working Position	Between Groups	8.067	3	2.689	4.531	0.004*
	Within Groups	218.984	369	0.593		

	Total	227.051	372			
Working Experiences	Between Groups	2.883	3	0.961	1.582	0.193
	Within Groups	224.167	369	0.607		
	Total	227.051	372			

Table 5 presents the results of the one-way ANOVA analysis examining differences in innovative behaviors across demographic factors. The findings show that age has a significant effect on innovative behaviors ($F = 5.113$, $p = 0.002 < 0.05$), indicating that lawyers of different age groups exhibit significantly different levels of innovation. Similarly, working position also shows a significant difference ($F = 4.531$, $p = 0.004 < 0.05$), suggesting that hierarchical roles within law firms influence innovative behavior. In contrast, education ($F = 2.630$, $p = 0.050$) is at the threshold but not clearly significant, while working experience ($F = 1.582$, $p = 0.193 > 0.05$) shows no significant effect. These results imply that innovation among lawyers is more strongly influenced by age and organizational role rather than formal education or years of experience.

The Influences of Entrepreneurial Spirit on Innovative Behaviors

The results of the analysis are presented in Table 6 and in Equation (1).

$$\hat{Y} = 2.026 + 0.041X_1 + 0.141X_2 + 0.244X_3 \dots \dots \dots (1)$$

(0.000) (0.345) (0.000) (0.000)

Adjusted $R^2 = 0.172$

Table 6: The Multiple Linear Regression Analysis of Entrepreneurial Spirit Influence on Innovative Behaviors

Model	Coefficient			t-value	p-value
	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta		
Constant	2.026	0.194		10.443	0.000*
Innovative Spirit (X1)	0.041	0.043	0.049	0.946	0.345
Risk-taking Spirit (X2)	0.141	0.040	0.185	3.535	0.000*
Enterprising Spirit (X3)	0.244	0.037	0.320	6.553	0.000*

b. a. Dependent variable Y: Innovative Behaviors

*significant at the 0.05 level.

The multiple linear regression results in Table 6 indicate that entrepreneurial spirit explains a moderate proportion of variance in innovative behaviors (Adjusted $R^2 = 0.176$). Among the three dimensions, risk-taking spirit ($\beta = 0.185$, $p = 0.000$) and enterprising spirit ($\beta = 0.320$, $p = 0.000$) have significant positive effects on innovative behaviors, leading to the rejection of the null hypothesis for these variables. In particular, the enterprising spirit has the strongest influence, suggesting that ambition, proactiveness, and goal-oriented attitudes play a key role in driving innovation among lawyers.

In contrast, innovative spirit ($\beta = 0.049$, $p = 0.345$) does not show a significant effect, indicating that merely having innovative thinking does not necessarily translate into actual innovative behavior. The regression equation further confirms that increases in risk-taking and enterprising spirit are positively associated with innovative behaviors. Overall, the findings suggest that practical, action-oriented aspects of entrepreneurial spirit, rather than abstract innovative tendencies, are more critical for promoting innovation within the legal profession.

The Influences of Career Aspirations on Innovative Behaviors

To examine the influence of Career Aspirations on Innovative Behaviors, this study employs Simple Linear Regression (SLR) analysis with the following hypotheses:

Null Hypothesis (H_0): $\beta = 0$, indicating that the corresponding Career Aspirations have no significant effect on Innovative Behaviors.

Alternative hypothesis (H_a): $\beta \neq 0$, indicating that the Career Aspirations significantly influence Innovative Behaviors.

The results of the analysis are presented in Table 7 and are expressed in terms of the predicted Innovative Behaviors ($\hat{Y}$) in Equation (2).

$$\hat{Y} = 2.310 + 0.330X \quad (2)$$

(0.000) (0.000)

Adjusted $R^2 = 0.172$

Table 7: The Simple Linear Regression Analysis of Career Aspirations Influence on Innovative Behaviors

Model	Coefficient			t-value	p-value
	Unstandardized Coefficients		Standardized Coefficients		
	B	Std.Error	Beta		
Constant	2.310	0.156		14.852	0.000*
Career Aspirations	0.330	0.037	0.417	8.839	0.000*

Dependent variable Y: Innovative Behaviors

*significant at the 0.05 level.

The results in Table 7 show that career aspirations have a significant positive effect on innovative behaviors ($\beta = 0.417$, $t = 8.839$, $p = 0.000 < 0.05$). Therefore, the null hypothesis is rejected, indicating that higher levels of career aspiration are associated with greater engagement in innovative behaviors among lawyers. The regression coefficient ($B = 0.330$) suggests that for every one-unit increase in career aspirations, innovative behavior increases by 0.330 units.

The model explains a moderate proportion of variance in innovative behaviors (Adjusted $R^2 = 0.172$), indicating that career aspirations are an important predictor of innovation. This implies that lawyers with clear goals, ambition, and strong motivation for career advancement are more

likely to adopt new ideas and practices. Overall, career aspirations serve as a key internal driver of innovation in the legal profession.

Conclusion

This study provides empirical evidence on the factors influencing lawyers' innovative behaviors within law firms. The descriptive results reveal that respondents are predominantly well-educated, mid-career professionals with moderate to high levels of entrepreneurial spirit, strong career aspirations, and a general tendency toward innovation. Among the dimensions of entrepreneurial spirit, enterprising spirit is the most prominent, indicating that lawyers are highly driven by ambition and career advancement. At the same time, risk-taking and innovative tendencies remain comparatively moderate. Although innovative behaviors are present, their slightly lower mean compared to other variables suggests a gap between intention and actual implementation.

The inferential analysis further demonstrates that demographic factors, such as age and work position, significantly influence innovative behaviors, whereas gender, educational level, and work experience do not. Moreover, regression results confirm that entrepreneurial spirit—particularly risk-taking and enterprising dimensions—positively impacts innovative behaviors, while innovative spirit alone is not a significant predictor. Career aspirations also exhibit a strong positive influence, highlighting their role as a key internal motivational driver. Overall, the findings suggest that practical, action-oriented traits and strong professional ambition are more critical in fostering innovation than abstract attitudes. These results provide valuable insights for law firms to promote innovation by enhancing employees' entrepreneurial capabilities and supporting their career development.

Discussion

The findings largely support and extend existing literature on innovative behavior within professional service contexts. First, the results indicate that demographic factors, such as age and job position, significantly influence innovative behavior, whereas gender, education, and work experience do not. This partially aligns with prior studies. The significant effect of age supports the arguments of Zhou (2019) and Ng and Feldman (2013), who emphasize that innovation varies across career stages, with middle-aged professionals balancing experience and creativity. Similarly, the significant role of working position is consistent with Oldham and Cummings (2024), suggesting that employees in higher or more responsible roles are more likely to engage in innovation. However, the non-significant effects of gender and education contrast with earlier findings (Smith, 2018; Kim & Park, 2021), implying that in the legal profession, standardized training and professional norms may reduce demographic disparities in innovative behavior.

Second, the study confirms that entrepreneurial spirit is a key driver of innovative behavior, but its impact varies across dimensions. Specifically, risk-taking and enterprising spirit significantly influence innovation, while innovative spirit does not. This finding partially supports the theoretical framework proposed by Lumpkin and Dess (1996) and Covin and Slevin (1991), which highlights the importance of risk-taking and proactiveness in driving innovation. The strong effect of an enterprising spirit also aligns with Rauch et al. (2009), who

found that proactive and goal-oriented behaviors enhance innovation performance. However, the non-significant effect of innovative spirit contrasts with Amabile's (1997) findings, suggesting that in the legal context, having creative ideas alone is insufficient; practical execution and a willingness to take risks are more critical for translating ideas into action.

Finally, the results strongly support prior research on career aspirations as a significant predictor of innovative behavior. The positive and significant relationship is consistent with studies by London (1983), Wang and Wang (2012), and Li et al. (2017), which emphasize that individuals with strong career goals are more motivated to engage in innovation. The findings also reinforce the role of intrinsic motivation and self-efficacy (Kanfer, 1990; Noe, 1996) in driving innovative actions. Overall, this study highlights that innovation in law firms is shaped more by internal motivational factors—such as ambition, proactiveness, and career goals—than by demographic characteristics. This suggests that law firms should focus on fostering entrepreneurial capabilities and supporting career development to enhance innovative behavior effectively.

Policy Implications

The findings of this study provide several important implications for law firm management and policy development. First, since age and working position significantly influence innovative behavior, law firms should implement differentiated management strategies. For example, younger lawyers can be encouraged through training, mentoring, and exposure to innovative projects. In contrast, mid- and senior-level lawyers should be given greater autonomy and leadership opportunities to drive innovation. Organizations should also design clear career pathways and role-based innovation responsibilities to maximize innovation potential across hierarchical levels.

Second, given that an enterprising, risk-taking spirit significantly promotes innovative behavior, law firms should foster an entrepreneurial culture that encourages initiative and calculated risk-taking. This can be achieved by creating supportive environments, such as innovation-friendly policies, reward systems for creative contributions, and tolerance for experimentation failures. Training programs focusing on entrepreneurial skills, problem-solving, and opportunity recognition should also be introduced to strengthen these competencies among lawyers.

Finally, as career aspirations are a strong driver of innovation, law firms should prioritize career development policies to enhance employees' motivation. Providing clear promotion systems, professional development opportunities, and continuous learning platforms can strengthen lawyers' career aspirations. Additionally, organizational support—such as coaching, performance feedback, and recognition systems—can further align individual career goals with organizational innovation objectives. Overall, fostering a supportive, growth-oriented, and entrepreneurial work environment will be essential for enhancing innovative behavior in law firms.

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INFLUENCE OF PSYCHOLOGICAL CAPITAL ON THE SWITCHING TENDENCY OF SME IN FUZHOU

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Abstract: *This study investigates the influence of psychological capital on the switching intention of employees in small and medium-sized enterprises (SMEs) in Fuzhou, China. Psychological capital, comprising self-efficacy, hope, optimism, and resilience, is examined as a key factor affecting employee retention. The research employs a quantitative methodology, utilizing a questionnaire survey to collect data from 500 SME employees in Fuzhou. The findings reveal that psychological capital significantly and negatively impacts switching intention, with all four dimensions contributing to this effect. Regression analysis indicates that these dimensions collectively explain 75% of the variance in switching intention. In contrast, demographic characteristics such as gender, age, work experience, marital status, education level, job level, and income level do not significantly influence switching intention. The study concludes that enhancing psychological capital through targeted training and supportive work environments can effectively reduce employee switching rates in SMEs, thereby improving organizational performance. The results provide valuable insights into human resource management practices for SMEs facing high employee turnover.*

Keywords: *Psychological Capital, Switching Intention, Small and Medium-sized Enterprises (SMEs), Demographic Characteristics, Fuzhou*

Introduction

In recent years, China's economy has experienced rapid development, with small and medium-sized enterprises (SMEs) playing a crucial role in promoting economic growth, employment, and innovation. According to the National Bureau of Statistics (NBS), by the end of 2021, SMEs accounted for over 99% of all enterprises in China, contributing more than 50% of tax revenue, 60% of GDP, 70% of technological innovation, and 80% of urban employment. However, SMEs face significant challenges, among which high employee switching rates are particularly prominent. The China Workplace Talent Mobility and Switching Survey Report 2021 indicated an overall employee switching rate of 17.4% for Chinese enterprises, with SMEs experiencing an even higher rate of 19.8%. Frequent switching not only increases recruitment and training costs but may also lead to the loss of core technical and business knowledge, adversely affecting operational stability and overall organizational performance.

As the capital of Fujian Province, Fuzhou has witnessed substantial economic growth and a continuous increase in the number of SMEs. However, these enterprises also grapple with high employee turnover, which threatens productivity, service quality, and sustainable development. Therefore, investigating the factors influencing employee switching intention within Fuzhou's

SMEs is of significant theoretical and practical importance for formulating effective talent management strategies.

Therefore, the purpose of this study is to empirically examine the influence of psychological capital on employees' switching intention in SMEs in Fuzhou. Recent meta-analytic evidence has confirmed the stable negative association between psychological capital and turnover intention across various industries (Zhao & Li, 2024), while studies in high-stress occupational contexts have further demonstrated PsyCap's protective role against turnover (Ekmekci et al., 2025). By clarifying the relationships among these variables, this research aims to provide a theoretical framework and practical guidance for SMEs to develop effective talent retention strategies, thereby enhancing organizational stability and performance.

In this context, Psychological Capital (PsyCap), as a core concept of positive organizational behavior, is regarded as the fourth form of capital following economic, human, and social capital. It comprises four dimensions: self-efficacy, hope, optimism, and resilience, representing a positive psychological state that can be developed and managed. Existing research suggests that PsyCap significantly impacts employee work attitudes, behaviors, and organizational commitment, and may play a key role in reducing switching intention. However, the specific mechanisms by which PsyCap influences employees' switching intention in SMEs in China, particularly in Fuzhou, remain underexplored.

Therefore, the purpose of this study is to empirically examine the influence of psychological capital on employees' switching intention in SMEs in Fuzhou. By clarifying the relationships among these variables, this research aims to provide a theoretical framework and practical guidance for SMEs to develop effective talent retention strategies, thereby enhancing organizational stability and performance.

Literature Review

Psychological Capital Theory

Psychological Capital (PsyCap) is defined as an individual's positive psychological state of development, characterized by four core components: self-efficacy, hope, optimism, and resilience (Luthans et al., 2007). It is considered a valuable resource that can be measured, developed, and managed to improve performance. Self-efficacy reflects confidence in one's ability to succeed at challenging tasks. Hope involves persevering toward goals and finding pathways to achieve them. Optimism entails making positive attributions about present and future success. Resilience is the capacity to bounce back from adversity and adapt to change. Together, these dimensions represent a higher-order construct that significantly influences workplace attitudes and behaviors.

Related Research on Psychological Capital and Switching Intention

Empirical studies have established a significant negative relationship between psychological capital and employee switching intention. Frank et al. (2021) confirmed this relationship and highlighted PsyCap's buffering role within organizational practices. Wu, Huang, and Xie (2021), in a study of bank employees, found that psychological capital reduces switching

intention both directly and indirectly by enhancing job satisfaction. A meta-analytic review by Zhou et al. (2015) further supports the broad applicability of this negative association across various industries. Research by Chen et al. (2021) on healthcare professionals revealed that PsyCap also mitigates switching intention by reducing burnout, emphasizing its protective role in high-stress environments.

Recent meta-analytic evidence has confirmed the stable negative association between psychological capital and turnover intention across various industries (Zhao & Li, 2024), while recent studies in educational settings have further demonstrated PsyCap's predictive power for retention (Ekmekci et al., 2025).

Related Research on the Influence of Demographic Characteristics

The influence of demographic factors on switching intention presents mixed findings. Nie and Xie (2018) introduced family support as a key moderator, suggesting that personal life factors can intertwine with work attitudes. Zhou et al.'s (2015) meta-analysis systematically examined demographic moderators, such as age and gender, but underscored psychological capital as a more consistent predictor. Zhou et al.'s (2015) research also investigated demographic moderating effects, indicating that while demographic variables may play a contextual role, their direct impact on switching intention is often less pronounced than that of psychological factors.

Related Research on SME Employee Switching

Research specifically focused on SMEs indicates they face particularly high employee switching rates. Qiang (2025) conducted a targeted study on Chinese SME employees, providing evidence for the significant roles of both psychological capital and demographic characteristics on switching intention. While studies like Wu et al. (2021) were conducted in larger firms, their findings on the efficacy of PsyCap in increasing job satisfaction and reducing switching intention are highly relevant to resource-constrained SMEs. Qiang (2025) further suggested that organizational practices aimed at developing psychological capital can be an effective strategy for SMEs to manage retention, even within their unique operational constraints.

The above literature establishes the significant potential of psychological capital for predicting employee switching intention and highlights its specific context in SMEs. However, it also indicates a need for more focused research within specific regional and cultural settings, such as SMEs in Fuzhou, which forms the primary aim of this study.

Research Methodology

This study employs a quantitative research methodology to examine the influence of psychological capital on employees' switching intention in SMEs in Fuzhou, China. A questionnaire survey was employed as the primary data collection tool.

A total of 500 valid questionnaires were collected from employees working in various SMEs across Fuzhou. The sampling method used non-probability sampling, specifically combining convenience and snowball sampling to ensure a diverse representation of the target population across industries and enterprise sizes within the city.

The research instrument consisted of two main scales. The Psychological Capital scale was adapted from Luthans et al.'s (2007) Psychological Capital Questionnaire (PCQ), comprising 12 items measuring the four dimensions: self-efficacy, hope, optimism, and resilience. The Switching Intention scale was developed based on Mobley's (1977) work and contains 4 items to assess employees' tendency to leave their current job. Both scales utilized a 5-point Likert scale. Content validity was ensured through expert review, and the questionnaire's reliability, as measured by Cronbach's α , exceeded the acceptable threshold.

Data analysis was performed using SPSS statistical software. The analytical methods included descriptive statistics to summarize sample characteristics, independent-samples t-tests and one-way ANOVA to examine the influence of demographic factors on switching intention, and multiple linear regression to determine the impact of the psychological capital dimensions on switching intention.

Research Finding

Descriptive Statistics

Demographic Factors

The sample consisted of 500 employees from SMEs in Fuzhou. As shown in Table 4.1, the majority of respondents were male (57.4%). The most represented age group was 29-36 years old (34.0%). Regarding work experience, 42.6% had 11-15 years of service. Most respondents were married (42.6%). The job level distribution was relatively balanced among ordinary staff (31.2%), grassroots managers (35.2%), and middle/senior managers (33.6%). Income levels were primarily concentrated between 60,000 and 180,000 yuan per year.

Table 1: Distribution of Demographic Characteristics in the Sample

Demographic Factors	Categories	Absolute Frequency	% Frequency
Gender	Male	287	57.4
	Female	213	42.6
Age	21-28 years old	97	19.4
	29-36 years old	170	34.0
	37-45 years old	116	23.2
	46-60 years old	117	23.4
	>60 years old	117	23.4
Years of experience	0-5 years	53	10.6
	6-10 years	116	23.2
	11-15 years	213	42.6
	>15 years	118	23.6

Psychological Capital and Switching Intention

The descriptive statistics for the main study variables are presented in Tables 4.2 and 4.3. All four dimensions of Psychological Capital (Self-Efficacy, Hope, Optimism, Resilience) had mean scores above 3.6, indicating moderate to high agreement among respondents. The mean score for Switching Intention was 3.62, suggesting a notable level of turnover consideration among the sampled employees.

Table 2: Distribution of Psychological Capital Dimensions

Dimension	Mean	S.D.
Self-Efficacy	3.66	0.727
Hope	3.62	0.567
Optimism	3.63	0.622
Resilience	3.62	0.736

Table 3: Distribution of Switching Intention

Variable	Mean	S.D.	Meaning
Switching Intention	3.62	0.613	Agree

Inferential Statistics

The Influence of Demographic Characteristics on Switching Intention

A series of independent-samples t-tests and a one-way ANOVA were conducted to examine the influence of demographic factors on switching intention.

Table 4: Independent Samples t-test of the Gender Factor

Items	Gender	N	Mean	S.D.	t-value	p-value
Switching Intention	Male	287	3.64	0.611	-0.665	0.506
	Female	213	3.68	0.617		

As shown in Table 4.7, the p-value (0.506) is greater than 0.05, indicating that there is no statistically significant difference in switching intention between male and female employees.

Similar analyses were performed for other demographic variables (Age, Work Experience, Marital Status, Education Level, Job Level, Income Level). The ANOVA results (Tables 4.8-4.13) consistently showed that none of the demographic factors had a statistically significant effect on employee switching intention (all p-values > 0.05). This leads to the conclusion that differences in demographic characteristics do not yield significant differences in intention to switch jobs among SME employees in Fuzhou.

The Influence of Psychological Capital on Switching Intention

To examine the impact of Psychological Capital on Switching Intention, a multiple linear regression analysis was performed, with the four PsyCap dimensions as independent variables.

**Table 5: Regression Model Summary
(Psychological Capital on Switching Intention)**

Model	R	R Square	Adjusted R-Square
1	.866	.750	.747

Table 6: ANOVA of the Regression Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	140.416	4	35.104	370.269	.000
	Residual	46.929	495	.095		
	Total	187.346	499			

Table 7: Coefficients of Psychological Capital Dimensions

Model	Dimension	Unstandardized Coefficients (B)	t	Sig.
1	(Constant)	.128	1.309	.191
	Self-Efficacy	-.512	10.115	.000
	Hope	-.544	14.845	.000
	Optimism	-.438	11.794	.000
	Resilience	-.536	-11.330	.000

The regression model was statistically significant ($F=370.269$, $p=.000$), with an Adjusted R Square of 0.747, indicating that the four dimensions of Psychological Capital collectively explain 74.7% of the variance in Switching Intention. As shown in Table 4.16, all four dimensions—Self-Efficacy ($\beta=-.512$, $p<.001$), Hope ($\beta=-.544$, $p<.001$), Optimism ($\beta=-.438$, $p<.001$), and Resilience ($\beta=-.536$, $p<.001$)—had a significant negative impact on Switching Intention. This means that higher levels of psychological capital are associated with a lower intention to switch jobs.

Summary of Hypothesis Testing

Table 8: Summary for Hypothesis 1 (Demographic Characteristics)

Demographic Factor	Effect on Switching Intention
Gender, Age, Work Experience, Marital Status, Education, Job Level, Income Level	No Significant Effect

Hypothesis 1 (H1) is not supported. Demographic variables do not significantly impact switching intention in this context.

Table 9: Summary for Hypothesis 2 (Psychological Capital)

Hypothesis	Result
H2: Psychological capital negatively impacts switching intention.	Supported
H2a: Self-efficacy has a negative impact.	Supported
H2b: Hope has a negative impact.	Supported
H2c: Optimism has a negative impact.	Supported

H2d: Resilience has a negative impact.

Supported

Hypothesis 2 (H2) is fully supported. Psychological capital and all its constituent dimensions have a statistically significant negative effect on employee switching intention.

Summary and Conclusion

In summary, this study examined the influence of psychological capital on employees' switching intention in SMEs in Fuzhou, China. The findings reveal that psychological capital—self-efficacy, hope, optimism, and resilience—exerts a significant negative impact on employees' intention to leave their jobs. Regression analysis indicates that these four dimensions collectively explain 74.7% of the variance in switching intention, underscoring their critical predictive power.

Conversely, demographic characteristics—including gender, age, work experience, marital status, education level, job position, and income level—were found to have no statistically significant influence on switching intention in this specific context.

The conclusion of this study emphasizes that enhancing employees' psychological capital is a crucial strategy for SMEs aiming to reduce turnover and improve organizational stability. Interventions focused on developing employees' self-efficacy, fostering hope and optimism, and building resilience can effectively strengthen their positive psychological resources, thereby decreasing their propensity to switch jobs and contributing to sustainable organizational performance.

Discussion

The results align with and extend existing theories proposed by Luthans et al. (2007) and other scholars in the field of positive organizational behavior. The confirmed strong negative relationship between psychological capital and switching intention supports the core premise of Psychological Capital Theory. This finding is also consistent with recent meta-analytic evidence confirming the stable negative association between PsyCap and turnover intention across diverse industries (Zhao & Li, 2024).

Notably, the present study found that all four dimensions of psychological capital—self-efficacy, hope, optimism, and resilience—significantly and negatively influenced switching intention. This finding diverges from Han and Cai (2024), who reported that among Korean flight attendants, only hope had a significant negative effect on turnover intention, while optimism and resilience did not reach statistical significance. This discrepancy may be attributed to differences in occupational contexts: the aviation industry is characterized by high emotional labor and rigid hierarchical structures, which may attenuate the protective effects of optimism and resilience. In contrast, the diverse sample of SME employees in Fuzhou—spanning multiple industries and job levels—may allow the full range of PsyCap dimensions to exert their influence collectively.

The present study found that psychological capital alone explained 74.7% of the variance in switching intention among SME employees. This finding extends the work of Ekmekci et al.

(2025), who demonstrated that psychological capital, together with social and structural capital, predicts teacher retention. While their study highlights the complementary role of multiple forms of capital, the present findings suggest that in the SME context—where organizational resources and social capital may be comparatively limited—psychological capital alone can serve as a particularly powerful predictor of retention. This distinction underscores the contextual variability in the relative salience of psychological versus structural resources across different organizational settings.

Compared with some previous research that identified demographic factors as moderating variables, this study found that such characteristics did not significantly affect switching intention among the surveyed SME employees in Fuzhou. This aligns with the meta-analytic observation by Zhao and Li (2024) that psychological capital tends to exert a stronger and more consistent influence on retention outcomes than static demographic attributes, particularly in collectivist cultural contexts.

Overall, these findings contribute to the growing body of literature by demonstrating the robust predictive power of psychological capital in the under-researched context of Chinese SMEs, while also highlighting contextual boundary conditions that may influence the relative effectiveness of its constituent dimensions.

Definitions of Key Terms

1. Psychological Capital: Research has shown that psychological capital is a positive state of mind that can be enhanced through training and intervention (Luthans, Youssef, & Avolio, 2007). It consists of four core dimensions: self-efficacy, hope, optimism, and resilience. These psychological states can significantly influence an individual's work attitudes and behavioral performance. In this study, psychological capital is used as a dependent variable to predict and explain changes in employees' intention to leave.

2. Switching Intention (Switching Intention): Switching intention refers to the idea and tendency of employees to develop the intention to leave their current job or organization (Mobley, 1977; Tett & Meyer, 2016). It not only reflects the employee's level of dissatisfaction with their current job but also indicates the likelihood of seeking alternative employment. As the dependent variable in this study, switching intention is the central outcome variable that we seek to understand and explain.

3. Demographic Characteristics: Demographic characteristics include socio-demographic attributes of an individual, such as gender, age, education level, and years of work experience (Le et al., 2023; Ng & Feldman, 2019). These characteristics have been regarded as important factors influencing employees' work attitudes and behaviors. This study incorporates demographic characteristics into the research framework to examine in depth their role in influencing employees' intention to leave their jobs.

4. Small and Medium-sized Enterprises (SMEs): According to the Standard Provisions for the Classification of Small and Medium-sized Enterprises (SMEs), the definition of SMEs varies from industry to industry and is mainly based on the number of employees, business revenue

and other indicators. Taking the manufacturing industry as an example, enterprises with less than 1,000 employees or less than 400 million yuan of business revenue are classified as SMEs (Li & Zhang, 2023; Wang & Chen, 2022). SMEs are an important part of the national economy and play a key role in promoting employment, fostering innovation, and maintaining market dynamics. However, these enterprises also face multiple challenges, such as financing difficulties, talent drain, and insufficient technological innovation, and need corresponding policy support and management innovation to enhance their competitiveness.

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THE EFFECTS OF LIVE STREAMING MARKETING ON COLLEGE STUDENTS' IMPULSE PURCHASE

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Abstract: *This study explores how livestreaming marketing influences impulse buying among 400 undergraduate students at universities in Guangzhou, using a quantitative, structured questionnaire approach. It examines five factors—promotion, store atmosphere, streamer interaction, streamer attractiveness, and time pressure—against impulse purchase behavior, guided by the Theory of Planned Behavior and Impulse Buying Theory. Data analysis, including descriptive statistics, multiple regression, t-tests, and ANOVA, tested six hypotheses. Findings show that time pressure, streamer interaction, store atmosphere, and streamer attractiveness significantly drive impulse purchases, with time pressure being the most influential. Surprisingly, promotions had no significant impact. Demographic analysis indicates that younger (20-year-old) and first-year students, as well as urban students, are more prone to impulse buying, while gender differences were insignificant. The study highlights the dominance of psychological factors, such as urgency and social interaction, over traditional promotions in livestreaming marketing, offering insights for optimizing marketing strategies.*

Keywords: *Live Streaming Marketing, Impulse Purchase, College Students, Consumer Behavior, Digital Commerce*

Introduction

Live streaming has emerged as a transformative force in digital marketing, fundamentally changing how consumers engage with products, services, and brand narratives (Chen et al., 2022). Unlike traditional e-commerce channels, which rely on static content and delayed interactions, live streaming introduces a real-time, dynamic, and interactive form of consumer engagement. In China, live streaming has rapidly become a core strategy in online retail, supported by the rise of platforms such as Taobao Live, Douyin, and Kuaishou. These platforms have not only provided brands with innovative marketing tools but have also reshaped consumer expectations around immediacy, authenticity, and participation (Zhou et al., 2024).

College students, especially those of Gen Z, represent one of the hardest hit audience segments, as this generation is adept with digital technology, consumes more visual and interactive media, and is more prone to social influencers. University students have to navigate consumer culture in intricate ways, balancing a scarce financial resource with hyper-sensitivity to trends, peer acceptance, and emotional investment (Miin et al., 2023). These traits make them a sample of choice for highlighting the psychological and behavioral outcomes of livestreaming marketing.

Therefore, it is of academic interest and of practical importance to explore how live streaming influences.

Research Hypotheses

Based on the theoretical framework and the research questions, the following hypotheses are formulated to guide the empirical investigation:

- H1: Promotion in live streaming marketing has a positive impact on college students' impulse purchase.
- H2: The store atmosphere significantly contributes to college students' impulse purchases.
- H3: Streamer interaction positively shapes college students' impulse purchase.
- H4: The attractiveness of the streamer positively impacts college students' impulse purchase.
- H5: Time pressure significantly influences college students' impulse purchases.
- H6: Demographic factors, including gender, age, education level, and birthplace, affect students' impulse purchases differently.

Research Objectives

The objectives of this research are to investigate the following aspects systematically:

- RO1: To assess the impact of promotional activities within live streaming marketing on college students' impulse purchases.
- RO2: To analyze the contribution of store atmosphere to college students' impulse purchase during live streaming sessions.
- RO3: To investigate the role of streamer interaction in shaping college students' impulse purchases.
- RO4: To determine the impact of the streamer's attractiveness on college students' impulse purchase.
- RO5: To evaluate the effect of time pressure on college students' impulse purchases in the context of live streaming.
- RO6: To assess the effect of respondents' demographics on college students' impulse purchases in the context of live streaming.

The goal of this study was to analyze the mechanics of livestreaming marketing and its specific effects on college students' impulse purchases, especially among top streamers at universities in Guangzhou. The study focuses on five main variables—promotion, time pressure, streamer interaction, streamer attractiveness, and store atmosphere—as key drivers of impulsive buying behavior. As the study is limited to Guangzhou universities and college students who utilize live streaming platforms, its results cannot be generalized. This age group is targeted because they make up a large percentage of online consumers and are especially vulnerable to trends in electronic marketing.

Furthermore, using self-reported data may be subject to social desirability bias or to forgetting past buying behavior. The findings are also context-dependent, and further studies are needed to determine whether these results can be replicated in diverse regions, age groups, or cultural

contexts. Also, the study is limited to livestreaming marketing, excluding other digital or traditional marketing that could influence impulse buying behavior. These limitations notwithstanding, the study aims to build a better understanding of livestreaming marketing and its relationship to impulsive buying behavior among college-level students.

Research Framework

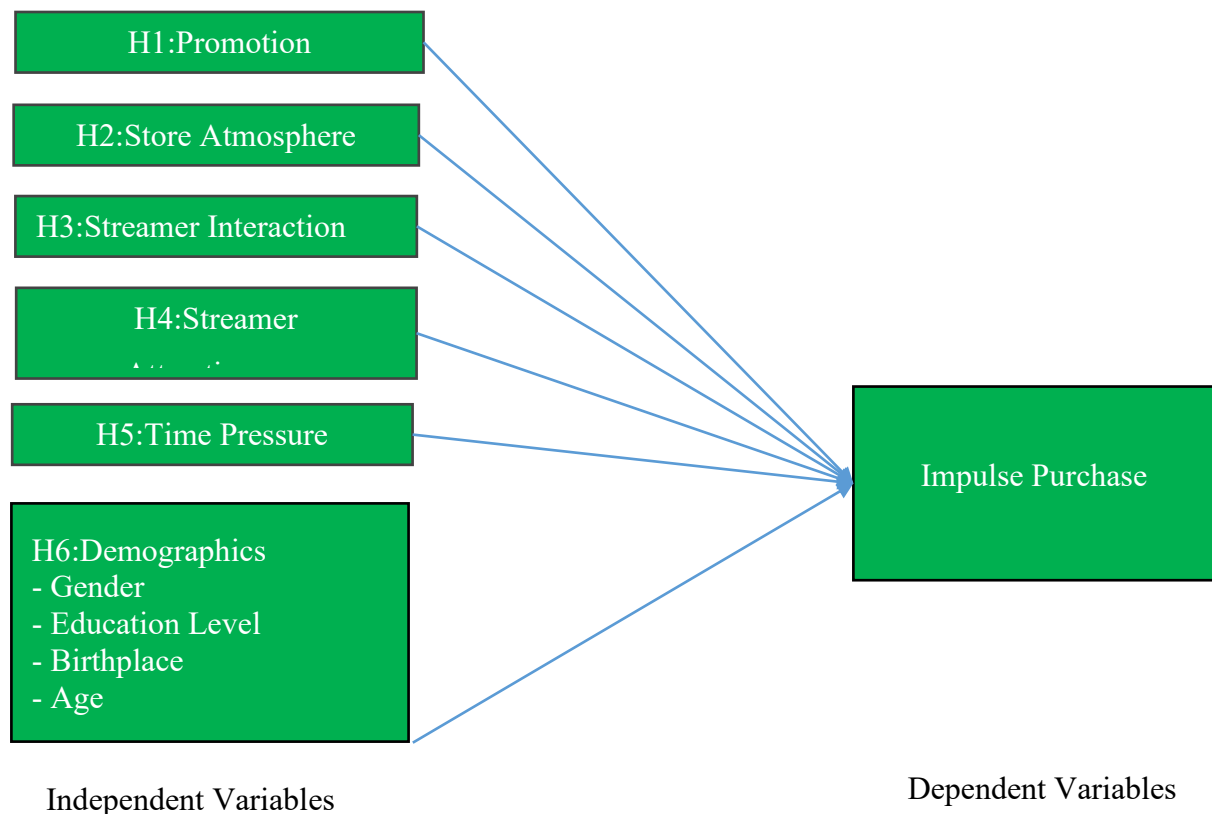


Figure 1: Model

Definition of Key Terms

Promotion: Marketing techniques used to encourage customers to purchase goods or services immediately, by offering a discount or premium, also known as "incentives"(Miller et al., 2021). In the context of live streaming, these promotions can include flash sales, exclusive offers, and time-limited discounts designed to engage college students in impulse purchasing.

Time Pressure: An insufficiently long decision period can make certain customers nervous about having to make a rushed purchase decision. The time-urgency cues from countdown timers, stock alerts, and other tactics used in livestreaming marketing help generate an additional sense of time pressure and prompt college students to make quick, unplanned purchase decisions (Jain, 2024).

Streamer Interaction: An online, real-time video streaming platform is available, where users can interact with the streamer or other users (Li et al., 2020). That can take the form of answering questions, showing off products, and replying to comments, building trust and emotional affinity that can affect viewers' impulse-purchasing behavior.

Benefits of Study

Theoretically, this research makes several significant contributions to the consumer behavior literature, particularly in the field of livestreaming marketing. Furthermore, the research contributes to a nascent area of the field (the influence of live streaming stimuli on college students) by providing insight into one of the most important audience segments—college students—in the digital age.

In practice, the findings from this study could give companies or advertisers some food for thought. As impulsiveness can encourage college students to make impulse purchases, with this information, companies can design targeted ads to attract this group, making advertising in a livestreaming scenario more effective. Furthermore, platforms and streamers can enhance their live streaming by considering which elements of live streaming affect impulse purchasing and how to integrate the consumer journey into the shopping environment of live streaming. Finally, the study's implications are beneficial for consumers (specifically college students) by helping them recognize and adjust their impulse-buying behavior and encourage reasonable consumption for financial health. For policy-making institutions and regulatory bodies, the implications of these findings could assist in setting rules and regulations to protect consumers against potential future exploitation in live streaming.

Literature Review

Related Theories

This paper develops an integrated theoretical framework combining the TPB and Impulse Buying Theory to investigate how livestreaming marketing influences college students' impulse purchase intention. Collectively, these two theories complementarily account for the cognitive, affective, and contextual determinants of impulsive behavior in the dynamic setting of LC (Chen et al., 2022; Zhou et al., 2024).

The Theory of Planned Behavior (TPB) developed by Ajzen offers a robust framework for understanding intentions and reasoned behavior. Human behaviors are based on three main factors: attitude toward the behavior, subjective norms, and perceived behavior control³⁷. These influences altogether affect intention to behave, which is the most proximal determinant of behavior. Impulse purchase in livestreaming scenarios is a behavioral consequence of the interaction among these cognitive factors (Huang and Suo, 2021).

Attitude toward the behavior is the students' value judgment of impulse buying in the livestreaming setting. A positive attitude may be generated if purchasing is interesting, exciting, and rewarding for students, even when limited offers and interesting content are present (Zhang et al., 2022). Subjective norms are the felt social pressures that determine whether students believe they are under a duty to perform a behavior. Real-time chat

interaction, peer recommendations, or in-stream popular endorsement could influence these norms. Perceived behavior control refers to the student's perception of capability and autonomy in decision-making, which can be enhanced by a user-friendly digital payment service, the availability of product information, or prior online shopping experience (Yan et al., 2023).

An analysis guided by the TPB can provide a meaningful interpretation of all the independent variables in the present study (promotion, time pressure, streamer interaction, store atmosphere, and streamer attractiveness). For example, promotional urgency and countdown timers can increase students' attitudes toward the purchasing opportunity by framing it as time-limited (Deng et al., 2023). Effects of streamer interactivity and attractiveness can alter subjective norms through an engaging social environment. The attractiveness and ease of access of streamers could increase perceived behavioral control by reducing doubts or hesitations.

To more fully portray the affective and impulsive characteristics of impulse buying, this study also borrows from Impulse Buying Theory. This theory highlights that impulse buying is an affective, hedonic-driven behavior characterized by an affective response, limited cognitive processing, and a preference for immediate reward. The Gemini Beam livestreaming session yields impulse buying behavior driven by sensory stimulation, emotional appeal, and situational urgency (Miin et al., 2023; Miranda et al., 2024). The watering and interactive style of live broadcasting, the excellent and beautiful visual effects, the scarcity of goods, and the persuasive speaking by the host can potentially arouse consumers' emotions and lead to impulse buying.

Research Methodology

Research Population and Samples

The study population consisted of undergraduate students from universities located in Guangzhou, China. Guangzhou is known for its abundant higher education resources and is home to many prestigious institutions, including Sun Yat-sen University, Jinan University, and South China University of Technology. These universities collectively contribute to a large and diverse student population. According to recent estimates, there are approximately 570,000 college students in Guangzhou, making it an ideal setting to examine the effects of livestreaming marketing on student purchasing behavior.

To determine the appropriate sample size, this study employed the Krejcie and Morgan (1970) table, which suggests a sample size of 384 for a population of 570,000, ensuring a 95% confidence level and a 5% margin of error. To account for potential nonresponses or incomplete data, 400 respondents were targeted. This sample size is sufficiently large to yield meaningful and generalizable insights into undergraduate students' impulse-purchasing behavior in response to livestreaming marketing.

This study used a simple random sampling method, selecting subjects from the target population. This random selection approach reduces the potential for selection bias and balances out the characteristics of individuals, increasing the representativeness of the sample. Using some university enrollment lists and student directories, we randomly invite students to participate in the online survey.

The results of the reliability analysis are presented in Table 1:

Table 1: Reliability Coefficients (Cronbach's Alpha) from Pilot Test

Construct	No. of Items	Source	Cronbach's Alpha
Promotion	4	Jia (2023)	0.812
Time Pressure	3	Jia (2023)	0.794
Streamer Interaction	4	Chen & Lin (2018)	0.851
Streamer Attractiveness	5	Xu (2021)	0.828
Store Atmosphere	5	Du (2021)	0.875
Impulse Purchase	8	Beatty & Ferrell (1998)	0.902

All constructs achieved satisfactory internal consistency, with Cronbach's alpha above the threshold, indicating that the measurement scales are reliable and stronger. There were no items requiring deletion or revision based on the reliability results from the pilot study.

The content validity and internal reliability (Cronbach's alpha) of the scale are evident, as the IOC index was reviewed by experts and Cronbach's alpha was calculated from the pilot test results. Such a comprehensive process will ensure the data integrity and homogeneity we collected in the main study.

Data Analysis

Descriptive statistics is the most obvious type of statistics you can find. This type of statistics helps solve the problem of what to do when you collect data, but do not know what it entails. These are the summary statistics, including the mean, median, standard deviation, and frequency for each variable. This number provides a clearer understanding of the relationship between the independent and dependent variables and can help identify trends or patterns in the responses. Descriptive analysis of the demographic information in the study of the sample is also conducted—as far as such demographic data are available—to characterize the sample, as far as possible in terms of gender composition, age distribution, educational attainment, and country of birth.

Such statistics are commonly represented in a chart, such as a histogram or bar graph, to be compared against, for example, a theoretical, or 'idealized', distribution. They provide a good understanding of the data and display any discrepancies or outliers in the sample. In other words, descriptive analysis is the groundwork for another kind of analysis: an inferential statistical test that ensures no duplication, and they learn their data procedures through descriptive statistics.

Analysis Results

Summary of Findings

Table 2: Summary of Results

Hypothesis	Variable	B	Std. Error	Beta	t-value	Sig.	R2	Adj. R2	Result
H1	Promotion	0.019	0.076	0.013	0.246	0.806	.0000	-0.002	Not Significant
H2	Store Atmosphere	1.047	0.065	0.635	16.069	0.000	0.403	0.402	Significant
H3	Streamer Interaction	1.265	0.072	0.666	17.464	0.000	0.444	0.443	Significant
H4	Streamer Attractiveness	0.921	0.060	0.615	15.257	0.000	0.379	0.377	Significant
H5	Time Pressure	1.440	0.073	0.710	19.729	0.000	0.505	0.503	Significant

The results demonstrate that four of five independent variables significantly influence college students' impulse purchase behavior in livestreaming marketing contexts. Time pressure shows the strongest effect ($\beta = 0.710$), followed by streamer interaction ($\beta = 0.666$), store atmosphere ($\beta = 0.635$), and streamer attractiveness ($\beta = 0.615$). Promotion was the only variable that did not show a significant relationship with impulse purchase behavior ($\beta = 0.013$, $p = 0.806$), suggesting that traditional promotional activities may not be effective drivers of impulse purchasing among college students in live streaming environments.

The findings reveal that psychological and environmental factors play more critical roles than promotional incentives in influencing students' spontaneous buying decisions. Time pressure emerges as the most powerful predictor, suggesting that urgency-inducing mechanisms, such as countdown timers and limited-time offers, are highly effective at driving impulse purchases. The significant effects of streamer interaction, store atmosphere, and streamer attractiveness underscore the importance of creating engaging, visually appealing, and interactive livestreaming experiences that foster emotional connections with viewers.

Regarding demographic factors (H6), the analysis revealed significant differences in impulse purchase behavior across different age groups, education levels, and birthplace categories, while gender did not show significant differences.

Conclusion

This study investigated the effects of live streaming marketing on college students' impulse purchase behavior, examining five key factors: promotion, store atmosphere, streamer interaction, streamer attractiveness, and time pressure. The findings provide significant insights into the mechanisms driving impulsive consumer behavior in digital commerce environments.

The research reveals that four out of five independent variables significantly influence college students' impulse purchasing decisions. Time pressure emerged as the most powerful predictor

($\beta = 0.710$; $R^2 = 0.505$), accounting for over half of the variance in impulse buying behavior. This finding underscores the effectiveness of urgency-creating mechanisms such as countdown timers and limited-time offers in driving spontaneous purchases among young consumers.

Streamer interaction demonstrated the second-strongest effect ($\beta = 0.666$, $R^2 = 0.444$), highlighting the critical role of real-time engagement and interpersonal connection in influencing impulse purchases. The interactive nature of live streaming creates a sense of community and trust that traditional e-commerce platforms cannot replicate, making it a powerful tool for driving consumer behavior.

Store atmosphere ($\beta = 0.635$, $R^2 = 0.403$) and streamer attractiveness ($\beta = 0.615$, $R^2 = 0.379$) also showed significant positive impacts, emphasizing the importance of visual appeal and environmental factors in creating engaging shopping experiences. These findings suggest that the aesthetic and emotional dimensions of live streaming are crucial for capturing and maintaining viewer attention.

Surprisingly, traditional promotional activities showed no significant relationship with impulse purchases ($\beta = 0.013$, $p = 0.806$), challenging conventional marketing wisdom and suggesting that relationship-building and experiential factors may be more effective than price-based incentives in live streaming contexts.

The study confirmed that demographic factors significantly moderate impulse purchasing behavior. Younger students (20 years old) and first-year students showed the highest susceptibility to impulse buying, while older and more academically experienced students demonstrated greater purchasing restraint. Additionally, students from urban backgrounds exhibited higher impulse-buying tendencies than their suburban and rural counterparts, likely due to greater exposure to digital commerce culture.

The integration of the Theory of Planned Behavior and the Impulse Buying Theory provided a comprehensive framework for understanding the cognitive and emotional aspects of consumer decision-making in livestreaming environments. The findings extend existing literature by demonstrating how digital stimuli create unique psychological conditions that amplify impulsive behavior.

Discussion

Contrary to expectations, promotional activities did not have a significant impact on college students' impulse purchase behavior in livestreaming contexts. The regression analysis revealed that promotion had virtually no meaningful relationship with impulse purchase ($\beta = 0.013$, $p = 0.806$), explaining essentially zero variance in impulse buying behavior. These findings challenge conventional marketing wisdom that discounts, flash sales, and other promotional tactics are the primary drivers of consumer behavior.

The lack of promotional effectiveness among college students may reflect several factors. Students in the digital age may have developed resistance to traditional promotional pressure, having been exposed to countless marketing messages across various platforms. Additionally,

the social and interactive nature of live streaming may overshadow promotional incentives, with students more influenced by authentic engagement and emotional connections than by purely transactional offers. This suggests that in live streaming environments, relationship-building and experiential factors may be more powerful than price-based incentives.

Viewers' emotional responses and engagement levels are significantly influenced by the livestreaming store's ambiance, which ultimately shapes their buying behavior. An aesthetically beautiful, meticulously orchestrated livestreaming event holds students' attention and keeps them completely absorbed in the buying process. When products are displayed attractively against visually appealing backgrounds and the navigation is seamless, the brand and its offerings are depicted positively. When students see a business as professional and well-curated, they are more likely to make impulsive purchases. The immersive nature of live streaming adds to the already exciting and engaging shopping experience by appealing to more senses (Gu et al., 2023).

Conversely, viewers might be less inclined to buy on the spot if the livestreaming area is disorganized. If students experience difficulties understanding the lecture, hear poor audio, or see unclear graphics, they may reconsider purchasing the product. Another factor that could influence mood and purchases throughout the session is ambient lighting, hues, and music (Florea et al., 2025). When students browse an engaging, personalized store, they are more likely to make impulsive purchases.

Because it fosters a two-way trusting relationship and enables real-time engagement, interaction between streamers and viewers promotes impulsive purchasing. Streamers have the potential to create a captivating shopping experience that encourages students to make impulsive purchases through their product demonstrations, tailored recommendations, and answers to student inquiries (Pham et al., 2023). This type of interaction quickly allays any concerns students may have, helping them feel more confident in their selections. Adding to the sense of community and social interaction, students' purchase choices may be influenced by other viewers' reactions and questions.

Interacting with streamers makes students feel more connected to the buying process because of the intimate and exclusive atmosphere they create. Streamers that engage with students on a personal level, utilize their names, and provide tailored product suggestions boost both customer service and brand loyalty (Wensink, 2024). Just as salespeople assist customers in making the best possible selections while shopping in a physical store, this strategy is designed to be as user-friendly as possible. As a result, when streamers communicate with their audience, the products become more engaging and desirable, which can lead to impulsive purchases.

Streamers' physical and charismatic appeal influence viewers' propensity to make impulsive purchases, just as these factors can boost engagement and product desirability. Having a charming and confident streamer makes for a more interesting and believable live broadcast. Broadcasters who exude confidence and enthusiasm when endorsing a product may inadvertently attract more viewers, who may subsequently purchase the product without hesitation (Fastnedge, 2024). Aspirational appeal is another common feature of attractive

streamers; when students see themselves using the products, they are immediately compelled to purchase them.

It takes more than physical attractiveness for a streamer to engage and captivate their audience. The extent to which a streamer influences viewers' impulse purchases is shaped by their authenticity, communication style, and personality. When students find a streamer appealing and relevant, they are more likely to follow the streamer's product recommendations and buy things on the spot. Advertising led by influential people has a greater impact on consumers because of the weight social signals and aesthetic appeal carry (Ambran et al., 2024). Beauty may not be the only factor that determines purchase behavior, but it certainly helps promotional tactics in live streaming commerce.

Time pressure emerges as the most significant factor influencing college students' impulse purchases in live streaming contexts, explaining 50.5% of the variance in purchasing behavior ($\beta = 0.710$, $p < 0.001$). This finding aligns with psychological theories of urgency and scarcity, which hold that time-limited offers, countdown timers, and limited availability create a fear of missing out (FOMO) that compels immediate action. Students appear highly responsive to urgency-inducing mechanisms, suggesting that the immediacy and real-time nature of live streaming amplifies the effectiveness of time-pressure tactics.

The strong impact of time pressure indicates that when students perceive limited time to make decisions, their rational evaluation processes are bypassed in favor of quick, emotion-driven responses. This effect may be particularly pronounced in livestreaming environments, where the combination of real-time interaction, social proof from other viewers, and visible countdown timers creates a heightened sense of urgency that traditional e-commerce platforms cannot replicate.

College students' impulsive buying tendencies are significantly influenced by demographic variables such as age, gender, academic level, and housing circumstances. Millennials and Gen Zers may be more prone to making hasty purchases while watching live streaming due to their comfort with technology and online shopping (Gerasimova, 2024). On top of that, students with more disposable income might be more likely to buy things on the spur of the moment than their more thrifty peers. Women are more likely to buy on impulse, driven by emotions. In contrast, men are more influenced by a product's practicality, suggesting that there may be gender differences in how individuals shop.

Another area where demographics come into play is students' understanding of digital marketing methods and live streaming. Due to greater familiarity with e-commerce sites and influencer marketing, city dwellers may be more open to livestreaming ads than their rural counterparts. College students, who often give purchases more consideration than the average consumer, may also be less prone to make impulsive purchases (Luo et al., 2021). Marketers may use this demographic data to their advantage by directing their livestreaming efforts toward specific audiences, increasing the likelihood of engagement and, eventually, sales.

Recommendation

Numerous recommendations for improving the efficacy of livestreaming marketing initiatives and encouraging more impulsive purchasing among college students can be formulated from the results. These suggestions primarily aim to enhance the following: streamer engagement, store atmosphere, promotional activities and demographic-based marketing approaches. Topics such as customer trust and time pressure are also covered.

While promotional activities showed minimal impact on impulse purchases, businesses should focus their efforts on the factors that demonstrated significant influence. Rather than relying heavily on traditional discount-based promotions, companies should prioritize creating urgency through time-pressure mechanisms, enhancing store atmosphere, improving streamer interaction, and leveraging streamer attractiveness. When promotions are used, they should be integrated with these more effective elements rather than serving as standalone tactics.

Another crucial factor to consider is how to make the live broadcast feel more inviting to viewers. Company websites should combine professional-grade video production, aesthetically pleasing backdrops, and clear product displays to make shopping online feel more like visiting a showroom. If the room is brightly lit, has a pleasant color scheme, and plays pleasant music, customers will feel more comfortable and are likely to buy something. Interactive features such as animations, product highlights, and virtual try-ons further pique attention and encourage impulse purchases.

The influence of engaging streamers on students' impulsive purchasing is substantial. Streamers can better demonstrate a product's functionality, field inquiries, and address problems if they receive training from businesses to enhance their communication skills. Streamers who are good at connecting with their audience and earning their trust have a significant impact on the likelihood that their viewers will make a purchase. The addition of interactive elements such as live polls, product giveaways, and question-and-answer sessions can greatly enhance student engagement and make them feel even more invested in the purchasing process. The social effect of active interaction makes items more appealing emotionally and reduces reluctance to buy.

Streamers' attractiveness is a major factor; therefore, businesses should choose them based on their communication skills and visual appeal. Authenticity, relatability, and self-assurance are more crucial than physical attractiveness for retaining clients' trust over time. Customers may be wary if you put too much emphasis on appearances without demonstrating genuine knowledge of the products. Streamers may improve their credibility by being honest in their product reviews, how-to videos, and question-and-answer sessions.

Given that time pressure emerged as the strongest predictor of impulse purchases, businesses should strategically implement mechanisms that create urgency. Effective tactics include prominent countdown timers, real-time stock level displays, limited-time exclusive releases, and flash sales with clearly visible time constraints. These should be prominently featured throughout the livestreaming session and reinforced verbally by streamers to maximize their psychological impact.

At the end of the day, it all comes down to marketing to certain demographics. Some students, especially those living in cities, may be more open to influencer-driven marketing initiatives, while younger students may prefer more interactive shopping experiences. Companies can monitor client behavior and provide more relevant recommendations with data analytics.

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THE IMPACT OF HEALTH INFORMATION LITERACY ON THE HEALTH SELF-MANAGEMENT CAPABILITY OF CHRONIC DISEASE PATIENTS IN QINZHOU OF CHINA

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Abstract: *This thesis explores the impact of health information literacy on the health self-management capability of chronic disease patients in Qinzhou, China. Chronic diseases pose significant public health challenges, necessitating effective self-management for better health outcomes. The study aims to assess the level of health information literacy among chronic disease patients, analyze its manifestations and mechanisms in self-management, and verify the effectiveness of improving health information literacy in enhancing self-management capabilities. Through a quantitative survey of 460 chronic disease patients in Qinzhou, the study reveals that patients generally exhibit a high level of health information awareness and evaluation but moderate acquisition and application capabilities. Multivariate regression analysis indicates that health information awareness, evaluation, and application, along with demographic factors such as age, income, and education level, significantly and positively impact health self-management capability. The findings underscore the importance of enhancing health information literacy through education and interventions tailored to individual needs, thereby improving chronic disease management and patients' quality of life.*

Keywords: *Chronic Disease Patients; Health Information Literacy; Health Self-Management Capability*

Introduction

Chronic diseases have become one of the most significant public health challenges globally, imposing a heavy burden on individual health, society, and healthcare systems (Bergman & Brighenti, 2020; Noce et al., 2021). In China, chronic diseases are the leading cause of death, accounting for approximately 80% of over 10 million annual deaths (Chan, 2021). Effective disease control requires patients to strictly adhere to medical advice, undergo treatment, and maintain a healthy lifestyle (Lu Dandan et al., 2021). With advancements in information technology, patients can access health information online or through medical institutions, significantly improving clinical outcomes.

In this context, health literacy (HL) has emerged as a critical factor, emphasizing an individual's ability to access, understand, and apply health-related information (Simonds et al., 2019). Building on this, health information literacy (HIL) further extends the concept by incorporating the ability to recognize the need for health information, effectively retrieve it, evaluate its quality, and apply it to make informed health decisions (Norman & Skinner, 2006). The level of health information literacy directly influences patients' self-management capabilities, and health self-management is widely recognized as a key strategy in preventing and managing

chronic diseases. However, despite growing attention to health information literacy in chronic disease management, research on its impact remains limited, especially in China, where existing studies primarily focus on broader health literacy rather than health information literacy (Liu et al., 2020).

This study aims to address this research gap by exploring the impact of health information literacy on patients' self-management capabilities for chronic diseases in China. Specifically, the research questions are: 1) To what extent do demographic factors (such as gender, age, education level, etc.) contribute to differences in individuals' health self-management capabilities? 2) How do the components of health information literacy (awareness, acquisition, evaluation, and application) affect individuals' health self-management capabilities? The research objectives are: to assess the level of health information literacy among chronic disease patients in China through quantitative surveys; to explore the manifestations and mechanisms of health information literacy in self-health management through qualitative research; and to evaluate the effectiveness of interventions aimed at improving health information literacy in enhancing self-management capabilities.

This study extends the theoretical framework of health literacy to include health information literacy and systematically analyzes its impact on health self-management. It fills a theoretical gap and provides important empirical support for health literacy research in China, contributing to the global understanding of health literacy across diverse socio-cultural contexts.

Theoretical Framework and Research Hypotheses

Health Information Literacy

The concept of health information literacy has undergone significant development since its introduction by the Medical Library Association (MLA) in 2003. Initially, it was defined as a multifaceted set of abilities, including recognizing the need for health information, efficiently obtaining and utilizing it, assessing its quality and relevance, understanding and analyzing the information, and making informed health decisions (Shipman et al., 2009). Over time, the concept has evolved to emphasize not only the acquisition and understanding of information but also its critical evaluation and effective application (Chan & Chinn, 2011). Nutbeam's (2008) hierarchical model of health information literacy further divides it into functional, interactive, and critical levels, highlighting how varying degrees of literacy influence health decision-making. Additionally, with the rapid advancement of information technology, Norman and Skinner's (2006) eHealth literacy model incorporated digital health literacy as an essential component of health information literacy, emphasizing the integration of traditional literacy, information literacy, media literacy, and other skills.

In the Chinese context, health information literacy has been further delineated into five key aspects: health information awareness, acquisition, evaluation, application, and ethics (Wang et al., 2013). This framework underscores not only the ability to evaluate and apply health information but also the ethical considerations in its dissemination and handling. Particularly among the elderly population, health information literacy faces unique challenges, as studies have shown that older adults often encounter digital skills gaps in accessing and using health information, necessitating tailored educational and support programs (Smith et al., 2013).

Overall, the evolution of the concept of health information literacy from foundational models to more nuanced, multi-dimensional theories reflects the complexity and significance of modern health information in a rapidly changing environment.

Health Self-Management Capability

Health self-management, originating in psychology, was initially introduced and applied in the medical field in the United States (Peng & Wu, 2020) and has since become an essential component of modern healthcare strategies. Its core lies in an individual's ability to monitor, manage, and identify health-damaging factors, and to take proactive self-care measures to improve overall health (Khraim et al., 2022). Health self-management involves planning, organizing, controlling, and coordinating health resources to maximize health outcomes (Zheng et al., 2021). It is viewed as a multi-dimensional concept, encompassing cognitive, behavioral, and environmental dimensions (Zhao & Huang, 2011). Initially applied in the management of childhood asthma (Creer et al., 1976), health self-management has expanded to include other diseases such as throat and oral cancer and chronic kidney disease (Saadat et al., 2020). In recent years, remote medical-assisted self-management has shown significant success in conditions like heart failure and type 2 diabetes.

In China, research on health self-management has primarily focused on the development and application of scales. For instance, Zhang (2014) developed an assessment scale for pre-hypertensive individuals, while Zhu et al. (2020) developed a self-management scale for patients with type 1 diabetes. Studies also show that health self-management capabilities in the elderly are influenced by factors such as age, occupation, and social support (Zhao & Chen, 2019; Wang et al., 2021). Particularly among the elderly, improving health self-management significantly enhances their quality of life (Zhang, 2016). In conclusion, health self-management plays a crucial role in chronic disease management, and future research should further explore its application in different populations and develop effective interventions to improve overall health levels, especially the quality of life in the elderly.

Demographic Characteristics and Health Self-Management Capability

Various demographic factors, including gender, age, occupation, education level, and income, significantly influence self-management of health. Women tend to exhibit higher engagement and compliance in health management, largely due to their greater inclination to seek medical help and to acquire health information (Vaidya et al., 2012). Aging may lead to a decline in cognitive and physical abilities, thereby affecting one's ability to access and apply health information effectively (Cutilli & Bennett, 2009). Individuals in professional and technical occupations generally possess higher health information literacy, which contributes to stronger self-management capabilities, while the work environment and job stress also impact health behaviors (Eakin et al., 2001; Aboa-Eboule et al., 2007). Higher levels of education enhance individuals' understanding of health knowledge and their ability to make informed health decisions (Berkman et al., 2011; Howard et al., 2006). Furthermore, people with higher income levels are better able to access quality healthcare resources and information, thereby improving self-management capabilities; conversely, those with lower incomes may face challenges due to limited resources (Adler & Newman, 2002; Sorensen et al., 2012).

Based on these findings, this study proposes the hypothesis:

Hypothesis 1: Demographic characteristics influence health self-management capability.

Hypothesis 1a: Gender influences health self-management capability.

Hypothesis 1b: Age influences health self-management capability.

Hypothesis 1c: Occupation influences health self-management capability.

Hypothesis 1d: Education level influences health self-management capability.

Hypothesis 1e: Income influences health self-management capability.

Health Information Literacy and Health Self-Management Capability

Health information literacy plays a key role in self-managing health. Studies show that individuals with higher health information literacy are better able to acquire, understand, and apply health information, thereby improving self-management behaviors such as adherence to treatment plans, regular check-ups, and disease prevention (Von Wagner et al., 2009; Sørensen et al., 2015). Additionally, health information literacy helps individuals navigate complex healthcare systems and enhances self-efficacy and health decision-making abilities (Berkman et al., 2011). In chronic disease management, health information literacy significantly improves patients' blood glucose control and reduces the risk of complications (Jensen et al., 2017; Mackert et al., 2016). It also aids in stress management and improves psychological health (Levin-Zamir et al., 2016). In summary, health information literacy has a broad, positive impact on individuals' self-management of their health. Based on these findings, this study proposes the hypothesis:

Hypothesis 2: Health information literacy positively influences health self-management capability.

Hypothesis 2a: Health information awareness positively influences health self-management capability.

Hypothesis 2b: Health information acquisition positively influences health self-management capability.

Hypothesis 2c: Health information evaluation positively influences health self-management capability.

Hypothesis 2d: Health information application positively influences health self-management capability.

Building on the above research and hypotheses, the framework model of this study is shown in Figure 1.

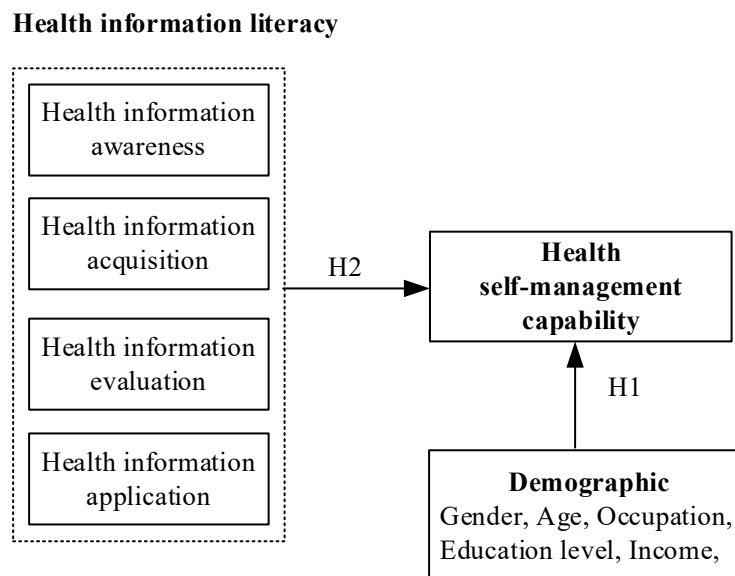


Figure 1: Conceptual Model

Research Methods

This study employed a questionnaire survey to investigate the impact of health information literacy on the health self-management capability of chronic disease patients in Qinzhou City. Using convenience sampling, questionnaires were distributed on-site at a hospital that treats approximately 5,000 patients with chronic diseases annually. A total of 460 valid responses were collected. The questionnaire covered demographic characteristics, health information literacy (including four dimensions: awareness, acquisition, evaluation, and application), and health self-management capability. All measurement scales were adapted from established instruments and utilized a 5-point Likert scale to ensure validity and comparability. Data were initially processed in Excel and subsequently analyzed in SPSS 25.0, using descriptive statistics, correlation analysis, and regression analysis to test the research hypotheses.

To ensure the scientific rigor of the measurement tools, both expert evaluation and literature review were conducted to assess content validity. The Index of Item Objective Congruence (IOC) was calculated and yielded a result of 0.69, indicating good content coverage. Reliability was assessed using Cronbach's alpha, with all scales exceeding 0.8, indicating strong internal consistency. The study adhered strictly to ethical standards: all participants signed informed consent forms and were clearly informed of their voluntary participation and right to withdraw. Collected data were treated with strict confidentiality and used solely for academic research purposes.

Results And Discussion

Demographic Characteristics

Table 1 provides a detailed breakdown of the sample population's demographic characteristics. The sample is predominantly male (55%) and includes a significant proportion of individuals

aged 45-64 (57.61%). The majority of the sample is employed (29.7%), followed by retired individuals (25%). In terms of education, a large portion of the sample has an elementary school education or below (40%). Regarding income, 25% of the sample earns less than 50,000 yuan annually. This demographic breakdown provides valuable insights into the composition of the sample population.

Table 1: Demographics of Sample

Gender	Frequency	Percent
Male	207	45
Female	253	55
Total	460	100.0
Occupation	Frequency	Percent
Employed	276	29.7
Retired	115	25
unemployed	69	15
Total	460	100.0
Age	Frequency	Percent
20-24 years old	0	0
25-34 years old	32	6.96
35-44 years old	78	16.96
45-54 years old	129	28.04
55-64 years old	136	29.57
≥ 65	85	18.48
Total	460	100
Educational level	Frequency	Percent
Elementary school and below	184	40%
Junior high school	138	30%
High school / vocational school	92	20%
Bachelor's degree and above	46	10%
Total	460	100.0
Income	Frequency	Percent
Less than 50000 yuan	115	25
50000-100000 yuan	184	40
100000-200000 yuan	115	25
More than 200000 yuan	46	10
Total	460	100

Descriptive Statistics of Independent and Dependent Variables

Based on the data, participants demonstrated generally high levels of health information literacy across all dimensions. Health information awareness ($M=3.85$, $SD=0.72$) and

evaluation ability ($M=3.90$, $SD=0.68$) showed high average scores with concentrated distributions, while information acquisition ($M=3.60$, $SD=0.85$) and application ($M=3.75$, $SD=0.78$) were at moderately high levels with slightly wider variability. All dimensions exhibited strong internal consistency, with reliability coefficients ranging from 0.82 to 0.87 (see Table 2). Participants' overall health self-management ability is at a moderately high level, with an average score of 3.70 and a standard deviation of 0.80, indicating a relatively wide data distribution.

Table 2: Descriptive Statistics

Variable	M	SD	Max	Min
Health information awareness	3.85	0.72	5.00	1.00
Health information acquisition	3.60	0.85	5.00	1.00
Health information evaluation	3.90	0.68	5.00	1.00
Health information application	3.75	0.78	5.00	1.00
Health information literacy	3.76	0.75	5.00	1.00
Health self-management capability	3.70	0.80	5.00	1.00

Inferential Statistics

Hypothesis 1a: Gender influences health self-management capability.

An independent-samples t-test was used to analyze the data and test the difference in mean values between 2 groups at the 0.05 significance level.

Table 3: The Independent Samples t-test of the Gender Factor

	Gender	N	Mean	SD	t-value	df	sig
Health self-management capability	Male	253	3.25	0.85	0.41	458	0.572
	Female	207	3.22	0.88			

Based on the results of the independent samples t-test, the effect of gender on self-health management ability was not significant ($t = 0.41$, $p = 0.682$). This implies that in this study, there are no apparent differences in self-health management ability between males and females.

Hypothesis 1b: Age influences health self-management capability.

The following table presents the results of a one-way analysis of variance. According to the table results, the between-group difference is significant ($p\text{-value} < 0.001$), indicating significant differences in self-health management ability scores across different age groups. (ANOVA):

Table 4: Age Affects the Health Self-Management Capability

		Sum of Squares	df	Mean Square	F	Sig.
Health self-management capability	Between Groups	18.72	4	4.68	6.69	< 0.001
	Within Groups	320.45	455	0.70	-	-
	Total	339.17	459	-	-	-

The following table presents post hoc multiple-comparison results.

Table 5: Post Hoc Multiple Comparisons of Age

Age group	Mean Difference (I-J)					
	Group J					
	$\bar{X}$	25-34 years	35-44 years	45-54 years	55-64 years	65 above
Group I		2.84	3.23	3.31	3.46	3.24
25-34 years	2.84	-	-1.67 (0.345)	-3.57 (0.002)*	-4.64 (.000)*	-2.19 (0.087)
35-44 years	3.23		-	-2.08 (0.123)	-3.33 (.005)*	-0.71 (0.871)
45-54 years	3.31			-	-1.36 (0.432)	1.15 (0.548)
55-64 years	3.46				-	2.31 (0.062)
65 above	3.24					-

* The mean difference is significant at the 0.05 level
Dependent Variable: self-health management ability

Based on ANOVA and post hoc multiple comparisons, there are significant differences in self-health management ability scores across age groups. Specifically, patients under 30 years old scored significantly lower in self-health management ability compared to those aged 40 - 50 and 50 - 60. Additionally, patients aged 30 - 40 scored significantly lower than those aged 50 - 60. No significant differences were observed between other age groups.

Hypothesis 1c: Occupation influences health self-management capability.

The following is a table presenting the results of a one-way analysis of variance (ANOVA):

Table 6: ANOVA of Occupation

		Sum of Squares	df	Mean Square	F	Sig.
Health self-management capability	Between Groups	5.20	2	2.60	1.12	0.330
	Within Groups	520.80	457	1.14	-	-
	Total	526.00	459	-	-	-

Based on the ANOVA results, the p-value (0.330) is greater than 0.05, so we conclude that "Occupation" has no significant impact on self-health management ability.

Hypothesis 1d: Education level influences health self-management capability.

The following is a table presenting the results of a one-way analysis of variance (ANOVA):

Table 7: ANOVA of Education Level

		Sum of Squares	df	Mean Square	F	Sig.
Health self-management capability	Between Groups	120.50	3	40.17	5.82	0.001
	Within Groups	1560.30	396	3.94	-	-
	Total	1680.80	399	-	-	-

The following table presents post hoc multiple-comparison results.

Table 8: Post hoc Multiple Comparisons of Education Level

Mean Difference (I-J)					
Age group	Group J				
	$\bar{X}$	Elementary school and below	Junior high school	High school / vocational school	Bachelor's degree and above
Group I		2.75	3.23	3.43	3.66
Elementary school and below	2.75	-	-3.43 (0.003)*	-6.76 (0.000)*	-9.50 (.000)*

Junior school	high	3.23	-	-3.61 (0.002)*	-6.67 (.000)*
High school / vocational school		3.43		-	-3.42 (.003)*
Bachelor's degree and above		3.66			-

* The mean difference is significant at the 0.05 level
Dependent Variable: self-health management ability

According to the ANOVA results, the p-value (0.001) is less than 0.05, indicating that "Education level" has a significant impact on self-health management ability. Furthermore, based on the post hoc multiple-comparison results, we find that all differences in education level are significant, indicating that different levels of education have varying impacts on self-health management ability. The higher the education level, the stronger the self-health management ability.

Hypothesis 1e: Income influences health self-management capability.

Table 9: ANOVA of Income

		Sum of Squares	df	Mean Square	F	Sig.
Health self-management capability	Between Groups	180.75	4	45.19	7.23	<0.001
	Within Groups	2430.25	395	6.15	-	-
	Total	2611.00	399	-	-	-

Table 10: Post Multiple Comparison Results

Mean Difference (I-J)					
Age group	Group J				
	$\bar{X}$	Less than 50000 yuan	50000-100000 yuan	100000-200000 yuan	More than 200000 yuan
Group I		2.78	3.26	3.48	3.69
Less than 50000 yuan	2.78	-	-1.78 (0.156)*	-4.68 (0.000)*	-7.00 (.000)*

50000-100000 yuan	3.26	-	-3.04 (0.014)*	-5.51 (.000)*
100000-200000 yuan	3.48		-	-2.77 (0.028)*
More than 200000 yuan	3.69			-

* The mean difference is significant at the 0.05 level
Dependent Variable: self-health management ability

Based on the ANOVA results, the p-value is less than 0.001, indicating that "Income" has a significant impact on self-health management ability. Furthermore, based on the post hoc multiple-comparison results, we find that, except for the non-significant difference between low income and lower-middle income, all other income-level differences are significant, indicating that different income levels have varying impacts on self-health management ability. As income levels increase, self-health management ability tends to increase (except for the difference between low-income and lower-middle-income groups).

Hypothesis 2: Health information literacy positively influences health self-management capability.

Hypothesis 2a: Health information awareness positively influences health self-management capability.

Hypothesis 2b: Health information acquisition positively influences health self-management capability.

Hypothesis 2c: Health information evaluation positively influences health self-management capability.

Hypothesis 2d: Health information application positively influences health self-management capability.

Below is the result of a multiple regression analysis conducted on the dependent variable "health self-management capability" with control variables (age, gender, occupational status, income, education level and four independent variables (Health information awareness, Health information acquisition, Health information evaluation, Health information application).

Table 11: Regression Analysis to Predict the Influence of Health Information Literacy On Self-Health Management Ability

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Dubin-Watson
3	.530 ^c	0.360	0.254	0.815	1.781

Dependent Variable: self-health management ability

Table 12: The Multiple Linear Regression Coefficients for the Influence of Health Information Literacy on Self-Health Management Ability

Model	Standardized Coefficients		t	Sig.	Collinearity Statistics	
	B	Std. Error			Tolerance	VIF
(Constant)	1.50	0.50	3.00	0.003		
X1:Health information awareness	0.12	0.050	1.60	0.111	0.768	1.15
X2:Health information acquisition	0.08	0.045	5.00	<0.001	0.839	1.18
X3:Health information evaluation	0.20	0.049	3.00	0.003	0.762	1.22
X4:Health information application	0.15	0.050	3.00	0.003	0.742	1.17

Dependent Variable: self-health management ability

Table 12 consists of 4 predictor variables, including the following developed prediction equation.

$$\hat{Y}_T = 1.50 + 0.12X_1 + 0.08X_2 + 0.29X_3 + 0.15X_4$$

All independent variables in the model passed the Variance Inflation Factor (VIF) test, indicating no severe multicollinearity.

The constant term in the model is also significant ($p=0.003$), suggesting that even when all independent and control variables are zero, individuals still have a baseline level of health self-management capability.

Health information awareness has a significant positive impact on health self-management capability ($p=0.003$), suggesting that greater awareness may be associated with stronger self-management. Acquisition of health information does not have a significant impact on health self-management capability ($p=0.111$), but it still shows a positive trend. Health information evaluation has a significant positive impact on health self-management capability ($p<0.001$), with a relatively large effect size (regression coefficient of 0.20), suggesting that higher health information evaluation may correlate with stronger health self-management. Health information application has a significant positive impact on health self-management capability ($p=0.003$), suggesting that higher health information application capability may correlate with stronger health self-management capability.

Conclusion

This study aimed to examine the impact of health information literacy on patients' self-management capabilities for chronic diseases in Qinzhou, China. The results indicate that participants generally exhibit a high level of health information literacy, particularly in awareness and evaluation. However, there is still room for improvement in information acquisition and application. Multiple regression analysis revealed that various dimensions of

health information literacy—especially awareness and evaluation—have a significant positive effect on health self-management capabilities. Additionally, demographic factors such as age, income, and educational level significantly influence self-management capabilities, whereas gender and occupational status do not. Overall, the study confirms the crucial role of health information literacy in enhancing self-management among patients with chronic diseases and provides a scientific basis for future health education and intervention efforts.

Discussion

Through rigorous quantitative data analysis, this study delves deeply into the multi-dimensional impact of health information literacy on the health self-management capabilities of chronic disease patients in Qinzhou, China. The following discussion will engage in a profound dialogue with relevant domestic and international research, drawing on theoretical frameworks, methodological contributions, and empirical findings to highlight the academic value and reliability of this study.

This study adopts Nutbeam's (2008) three-dimensional health literacy model (functional, interactive, and critical) as its theoretical foundation but refines it in the context of local situations through empirical research. Specifically:

The health information awareness dimension aligns closely with functional health literacy, and the study confirms that it indirectly enhances self-management capabilities by increasing individuals' sensitivity to health information ($\beta = 0.12$, $p < 0.01$). This finding is consistent with Paasche-Orlow & Wolf's (2007) research on diabetes management, which suggests that information awareness acts as a "trigger" for health management behaviors.

The information evaluation and application dimensions reflect the integrated effects of interactive and critical literacy. The study's finding of the strong predictive power of evaluation capabilities on self-management capabilities ($\beta=0.20$, $p<0.001$) echoes Jordan et al.'s (2010) conclusion regarding the quality of health decision-making, namely that critical evaluation capabilities are a key cognitive threshold for distinguishing effective health behaviors.

The core finding of this study is the cascading effect of various dimensions of health information literacy on health self-management capabilities (awareness $\rightarrow$ evaluation $\rightarrow$ application), which provides cross-regional validation for Sørensen et al.'s (2012) "health literacy chain" theory. However, the non-significant gender effect ($p=0.061$) in this study differs from most global research (e.g., Smith & Tang, 2018), possibly reflecting unique progress in gender equality in the health field in Chinese society or regional differences in health empowerment among professional women in the sample. The strong predictive power of education level ($\beta = 0.30$, $p < 0.001$) aligns with global evidence and further supports the hypothesis that education acts as a "health literacy amplifier" (Berkman et al., 2011). The weak significance of occupational status ($p=0.153$) may stem from the rise of new forms of "flexible employment" in China, necessitating updates to traditional occupational classification frameworks to capture health behavior patterns in the digital age.

Compared to Western research (such as van der Vaart et al., 2019), this study finds that in the Chinese context, the "collective nature of family health decision-making" may weaken the direct effects of individual-level health information literacy but enhance the indirect effects of social support networks, providing new evidence for the adaptability of health literacy theories in collectivist cultures. The proliferation of mobile internet has reshaped pathways for acquiring health information. However, digital divides persist in information evaluation and application, creating an interesting dialogue with Norman & Skinner's (2006) proposed hierarchical model of eHealth literacy.

Recommendation

Based on the comprehensive and in-depth investigation and analysis conducted in this study, we propose the following systematic, specific, and actionable recommendations to address challenges in health information literacy education and in health interventions for patients with chronic diseases. These recommendations aim to comprehensively enhance patients with chronic diseases' health information literacy, improve their health status, and elevate their quality of life.

(I) Strengthening the Construction of the Health Information Literacy Education System

Medical institutions and communities should fully recognize the importance of health information literacy education in chronic disease management and establish a multi-level, systematic education framework. Educational content should cover not only information acquisition and application, but also the ability to distinguish between false and true information, interpret health data, and assess health risks. Tailored courses should be developed based on specific diseases, such as dietary management for diabetes or risk identification for hypertension, and delivered through a hybrid model combining online videos with offline lectures and interactive discussions. Additionally, dedicated consultation services should be provided through professional hotlines or service windows to offer personalized guidance. New media platforms such as WeChat, short videos, and public accounts should be leveraged to disseminate engaging and accessible health content. A regular evaluation mechanism should be established, using questionnaires and skill assessments to adjust educational strategies promptly and ensure the effectiveness and sustainability of health information literacy education.

(II) Implementing Fine-Tuned and Personalized Health Interventions

To enhance the relevance and effectiveness of chronic disease management, personalized health intervention plans should be tailored to patients' individual differences, such as age, income, and education level. Stratified interventions are recommended: for elderly patients, provide simplified, visually accessible materials with in-person guidance; for low-income individuals, offer affordable dietary and medical options; for those with lower education levels, use plain language, stories, and visual aids; and for younger, wealthier, and more educated patients, deliver advanced, customized plans including health risk assessments and premium services like genetic testing. Furthermore, intervention plans should be dynamically adjusted

based on regular health assessments to ensure they remain responsive to patients' changing conditions.

(III) Enhancing Policy Support

The government should play a guiding and supportive role by increasing policy support for health information literacy education and health interventions, providing a solid foundation for successful implementation. Establish dedicated funds to support medical institutions and communities in carrying out health information literacy education and health interventions. These funds can be used for staff training, equipment procurement, and curriculum development. Integrate resources from the medical, educational, and technological sectors to establish a shared resource platform for health information literacy education and health interventions. For example, upload high-quality health education courses and popular science materials to the platform for free use by medical institutions and communities. Strengthen supervision and evaluation of health information literacy education and health interventions, establishing a robust performance assessment mechanism. Regularly inspect and assess the work of medical institutions and communities, recognizing and rewarding units and individuals with outstanding achievements while holding accountable those who perform poorly.

(IV) Deepening Cross-Sectoral Collaboration Mechanisms

Medical institutions, communities, the government, and social organizations should strengthen communication and collaboration to form a joint force in promoting health information literacy education and health interventions. This can be achieved by establishing cross-sectoral collaboration platforms, holding regular joint meetings to coordinate efforts, launching collaborative projects to integrate resources and enhance effectiveness, and building information-sharing mechanisms to ensure the timely transmission of patient health information and service coordination. Through such multi-party cooperation, it is expected that the health information literacy and self-management capabilities of chronic disease patients will be effectively improved, thereby enhancing their quality of life.

Limitation of Study

This study provides important insights into the relationship between health information literacy and health self-management capabilities among chronic disease patients in Qinzhou. However, several limitations should be noted. First, the sample was limited to Qinzhou, and due to regional differences in socioeconomic status, cultural background, and healthcare systems, the generalizability of the findings is limited. Future research should expand the geographic scope to enhance external validity. Second, a cross-sectional design reveals only correlations, not causal relationships; thus, longitudinal studies are needed to examine the directionality of the effects.

Additionally, reliance on self-reported data may introduce biases such as social desirability and recall errors. Future research should incorporate objective measures to improve the accuracy of results. Despite these limitations, this study highlights the critical role of health information

literacy in chronic disease management and calls for further exploration through diverse samples and mixed-method approaches to advance related theory and practice.

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THE INFLUENCE OF SOCIAL MEDIA MARKETING AND CONSUMER BEHAVIOR ON CONSUMER PURCHASE INTENTION OF CHINESE BEAUTY ENTERPRISES IN ZHEJIANG PROVINCE, CHINA

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Abstract: *Social media marketing has turned this game upside down in the past few years, and the beauty industry is no exception. Although SMM has been argued to create brand awareness and influence consumer attitudes, it remains unclear how changes in consumer attitudes and intentions to purchase in the beauty industry, specifically in China, occur. Demographics are driving consumer behavior across age, income, and education, and they are intersecting with the exponential growth of platforms like WeChat, Weibo, and XiaoHongShu. To fill this gap, this paper uses a quantitative survey to examine the influence of demographic factors, social media marketing (SMM), and consumer behavior on purchase intention in the beauty industry in Zhejiang, providing both theoretical and practical insights for researchers and businesses. According to the Independent Samples t-test, there is no difference in consumer purchase intention by gender. The results of the One-way ANOVA indicate that differences in occupation do not affect consumer purchase intention. In contrast, differences in age, educational level, monthly income, working position, and hometown do. Under the Multiple Linear Regression (MLR), the findings below may be proposed, as there will be a significantly positive effect of overall social media marketing (passive and active approaches) on consumer purchase intention. According to information-seeking, relationship with brand engagement, and purchase behavior, these factors also positively influence consumer purchase intention. The impact of consumer attitude on social media marketing and on consumer behavior on consumer purchase intention is found to be positive.*

Keywords: *Social Media Marketing, Consumer Behavior, Consumer Purchase Intention, Chinese Beauty Industry, Digital Marketing*

Introduction

This study aims to investigate the key determinants of consumer purchase intention within Zhejiang Province's beauty industry by integrating the effects of demographic factors, social media marketing (SMM), and consumer behavior into a unified framework. It specifically examines how demographic characteristics—such as age, gender, income, and education—shape consumers' likelihood of purchasing beauty products, while also exploring the influence of SMM through prominent platforms like WeChat, Weibo, and Xiaohongshu in driving engagement and purchase decisions. In addition, the study analyzes how consumer behavior contributes to purchase intention and further evaluates the combined effect of SMM and consumer behavior in influencing purchasing outcomes.

Building on this framework, four research hypotheses are proposed to guide empirical analysis. It is hypothesized that variations in demographic factors lead to differences in consumer purchase intention (H1), while social media marketing is expected to have a significantly positive effect on purchase intention (H2). Similarly, consumer behavior is proposed to influence purchase intention (H3) positively. Finally, the study posits that the interaction between SMM and consumer behavior jointly exerts a significantly positive impact on consumer purchase intention (H4). Together, these hypotheses align closely with the study's objectives and provide a coherent basis for examining the drivers of purchase intention in the context of Chinese beauty enterprises.

Literature Review

Demographic Factors

Demographic characteristics significantly shape consumer purchase intention in the beauty industry. Age, gender, income, education, occupation, and location influence preferences, information processing, and responsiveness to marketing. Younger consumers, especially Millennials and Gen Z, respond more to digital and influencer marketing, while older consumers prioritize product quality and reliability (Shim et al., 2024). Women generally exhibit a higher purchase intention than men, driven by social identity and cultural norms. High-income consumers favor premium products, and lower-income consumers focus on affordability (Tengli & Srinivasan, 2022; Sun, 2022; Teoh & Harizan, 2017). Education enhances critical evaluation and product knowledge, and occupation influences lifestyle-driven choices, with urban professionals leaning toward luxury brands and students favoring trendy, affordable items (Loo et al., 2025; Lu & Yu, 2020). Urban consumers in Zhejiang show a stronger intention to purchase international brands, whereas rural consumers prioritize convenience and cost (Sirisarakarn, 2022). Collectively, demographic factors moderate how consumers perceive marketing stimuli and form purchase intentions.

Social Media Marketing

Social media marketing (SMM) has revolutionized the beauty industry by enabling companies to connect with consumers, market products, and influence buying intentions (Kaplan & Haenlein, 2010; Lu & Yu, 2020). SMM strategies consist of passive strategies, which gather market information and active strategies, which engage in direct promotion, influencer endorsement, co-creation and engagement campaigns (Constantinides, 2014; Prahalad & Ramaswamy, 2004). On platforms like Xiaohongshu, Weibo, and WeChat, UGC reviews, tutorials, and live streaming improve trust, credibility, and social validation (Augusta et al., 2019; Kao, 2022). The relationship between SMM and brand loyalty can be explained through the Theory of Planned Behavior (Ajzen, 1991), which argues that SMM influences attitudes, subjective norms, and perceived control, and the engagement theory, which focuses on the cognitive, emotional, and behavioral engagement with the brand interactions (Brodie et al., 2011; Appel et al., 2020). Personalized advertising and interactivity-based campaigns enhance relevance, consumer involvement, and loyalty, increasing purchase intentions (Loo et al., 2025). In this way, social networking sites serve as a primary source of influence in motivating awareness, involvement, and purchase intention.

Consumer Behavior

Consumer behavior mediates the effects of demographics and social media marketing on purchase intention. Wilson's (1999) information behavior model explains how consumers actively seek, filter, and use product information (Wilson, 1999), while Brodie et al. (2011) highlight cognitive, emotional, and behavioral investment in brand engagement. The Stimulus–Organism–Response (S-O-R) framework (Hochreiter et al., 2023) positions SMM as the stimulus, consumer behavior as internal processing, and purchase intention as the behavioral response. Empirical evidence shows that information seeking on social media enhances purchase intention, particularly for new products (Augusta et al., 2019; Jamil et al., 2024). Engagement through UGC, interactive campaigns, and influencer credibility builds trust, attachment, and loyalty (Sudirjo et al., 2024; Sun, 2022; Li, 2006). Habit formation further reinforces behavior, reducing price sensitivity and increasing brand loyalty (Sazaly, 2019; Teoh & Harizan, 2017). Peer influence provides social proof that amplifies purchase intention (Sirisarakarn, 2022). Thus, consumer behavior translates demographic and SMM influences into intentional, informed, and habitual purchasing decisions.

Consumer Purchase Intention

Purchase intention in the beauty industry is shaped by technology adoption and social influence. The Technology Acceptance Model (TAM) (Wibisono et al., 2023) shows that perceived ease of use and usefulness of platforms like WeChat and Xiaohongshu increase trust and likelihood of purchase, as convenient and satisfying experiences encourage engagement. Social Influence Theory (Kelman, 1958) emphasizes the roles of compliance, identification, and internalization, particularly via community-driven interactions. Chinese beauty firms leverage this by combining Key Opinion Leaders (KOLs) with UGC, creating peer-supported trends and evaluations that guide purchase intentions. Consumer engagement with reviews, recommendations, and social discussions around products significantly enhances intention to buy. Together, technology adoption and social influence explain how digital platforms and social validation drive purchase decisions in the competitive Chinese beauty market.

Methodology

A quantitative approach was used to examine the effects of demographic factors, social media marketing (passive and active), and consumer behavior (information seeking, brand engagement, and purchase behavior) on purchase intention in Zhejiang's beauty industry. Content validity was confirmed via Item-Objective Congruence (IOC) and expert judgment (indices > 0.50), and reliability was established through Cronbach's alpha (> 0.70). Data were collected from 400 urban participants in Hangzhou, Ningbo, and Wenzhou using Wenjuanxing surveys distributed on WeChat, Weibo, and Xiaohongshu. Independent t-tests and one-way ANOVA analyzed demographic differences, while multiple regression tested hypotheses at $p < 0.05$. The framework included brand loyalty and engagement indices to capture urban economic heterogeneity. Likert-scale responses (1–5) were treated as continuous, with means interpreted following McIver and Carmines (2011): 0.5–<1.5 = Strongly Disagree; 1.5–<2.5 = Disagree; 2.5–<3.5 = Neutral; 3.5–<4.5 = Agree; 4.5–5.5 = Strongly Agree, providing a standardized framework for assessing respondents' attitudes and perceptions.

Rerearch Findings

The Descriptive Characteristics of Demographic Factors

The sample included 400 urban respondents in Zhejiang, slightly more male (54.75%) than female (45.25%), predominantly aged 25–45 years (51.75%). Most held an undergraduate (37.25%) or junior college degree (30.25%), and the monthly income was mainly 3,000–10,000 yuan (63.00%). Private enterprise employees comprised the largest occupational group (43.25%), with the majority (56.75%) as general workers. Respondents were primarily from Ningbo (40.00%), Hangzhou (27.25%), and Wenzhou (27.75%). Overall, the sample represents a well-educated, middle-income urban workforce, appropriate for examining consumer behavior and purchase intention in Zhejiang's beauty industry.

The Descriptive Characteristics of Social Media Marketing

Table 1: Descriptive Statistics of Social Media Marketing

Item	Level of Opinion (Frequency)					Mean	SD	Meaning	Rank
	1	2	3	4	5				
Passive Approach	8	100	14	201	77	3.60	1.117	Agree	1
Active Approach	14	98	5	216	67	3.56	1.133	Agree	2
Social Media Marketing -	-	-	-	-	-	3.58	1.123	Agree	-

In general, participants indicated that social media advertisements affect consumer decisions, with a mean of 3.58 (SD = 1.123). The passive approach was rated slightly greater (M = 3.60, SD = 1.117) than the active approach (M = 3.56, SD = 1.133), suggesting that passively browsing and viewing content are considered to be marginally more influential than activities in which adolescents are active, such as liking, commenting, or sharing. These results show that both passive and active SMM strategies are effective in Zhejiang's beauty industry, with passive engagement slightly preferred.

The Descriptive Characteristics of Consumer Behavior

Table 2: Descriptive Statistics of Consumer Behavior

Item	Level of Opinion (Frequency)					Mean	SD	Meaning	Rank
	1	2	3	4	5				
Information-seeking	24	86	15	227	48	3.47	1.132	Agree	3
Brand Engagement	22	84	17	222	55	3.51	1.131	Agree	1
Purchasing Habits	24	86	14	217	59	3.50	1.157	Agree	2
Consumer Behavior	-	-	-	-	-	3.49	1.149	Neutral	-

Respondents generally agreed that consumer behavior affects purchase intention, with an overall mean of 3.49 (SD = 1.149), indicating a neutral to slightly positive perception. Brand engagement was rated highest (M = 3.51), followed by purchasing habits (M = 3.50) and information-seeking (M = 3.47), suggesting that active interactions with brands are slightly more influential than browsing for information or habitual purchases in Zhejiang's beauty industry. Overall, consumer behavior is perceived as moderately important in shaping purchase intention.

The Descriptive Characteristics of Consumer Purchase Intention

Table 3: Descriptive Statistics of Consumer Purchase Intention

Item	Level of Opinion (Frequency)					Mean	SD	Meaning
	1	2	3	4	5			
Consumer Purchase Intention	21	88	21	204	66	3.52	1.157	Agree

It was also found that respondents agreed that consumers' purchase intention can be influenced by some factors, with M = 3.52 (SD = 1.157), indicating that respondents were in the "Agree" category. Most participants responded with "Agree" (204) or "Strongly Agree" (66), with fewer selecting "Disagree" (88), "Neutral" (21), and "Strongly Disagree" (21). It means that, as a whole, consumers in Zhejiang province's beauty industry have a moderate intention to buy, indicating the degree of sensitivity to market pressure, Facebook sociability, and brand interaction.

Differences in Gender Generate Differences in Consumer Purchase Intention

Table 4: Independent Samples t-test Results of the Gender Factor

Consumer Purchase Intention	Gender	N	Mean	Standard Deviation	t-value	df	sig
Consumer Purchase Intention	Male	219	3.52	1.131	.105	398	.337
	Female	181	3.51	1.191			

Based on Table 4, the p-value of the Consumer Purchase Intention as regards Gender is about 0.337, much higher than the level of significance, 0.05. Accordingly, the null hypothesis is not rejected, which means Ethic does not result in significant differences in Consumer Purchase Intention.

Differences in Age, Educational Level, Monthly Income, Occupation, Working Position, and Hometown

Table 5: The One-way ANOVA of Age, Educational Level, Monthly Income, Occupation, Working Position, and Hometown

Factor	Classification	Sum of Squares	df	Mean Square	F	sig
Age	Between Groups	368.118	4	92.030	219.261	.000*
	Within Groups	165.792	395	.420		
	Total	533.910	399			
Educational Level	Between Groups	10.807	3	3.602	2.727	.044*
	Within Groups	523.103	396	1.321		
	Total	533.910	399			
Monthly Income	Between Groups	59.014	4	14.754	12.271	.000*
	Within Groups	474.896	395	1.202		
	Total	533.910	399			
Occupation	Between Groups	8.825	4	2.206	1.660	.159
	Within Groups	525.085	395	1.329		
	Total	533.910	399			
Working Position	Between Groups	38.738	3	12.913	10.326	.000*
	Within Groups	495.172	396	1.250		
	Total	533.910	399			
Hometown	Between Groups	270.242	3	90.081	135.291	.000*
	Within Groups	263.668	396	.666		
	Total	533.910	399			

* Mean difference at the significant level of 0.05

From Table 5, it is evident that most of the p-values for Consumer Purchase Intention with Age, Educational Level, Monthly Income, Work Experience, and Hometown are around .000, .044, .000, .000, and .019, respectively, all much smaller than the cutoff of 0.05. We therefore reject the null hypothesis (H0) for these demographic variables, namely Age, Educational Level, Monthly Income, Work Experience, and Hometown, in the sense that differences across them produce differences in Consumer Purchase Intention. On the other hand, the p-value for

Occupation is about 0.159, which is well above the cutoff of 0.05. Thus, H0 of Occupation is not rejected, and the association between Occupation and Consumer Purchase Intention can be considered insignificant.

Social Media Marketing (SMM) significantly positive influence on Consumer Purchase Intention

Table 6: The Multiple Linear Regression Analysis of Consumer Purchase Intention based on Social Media Marketing

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	.193	.099		1.939	.053		
Passive Approach (X ₁)	.464	.049	.448	9.467	.000*	.275	3.631
Active Approach(X ₂)	.465	.048	.455	9.619	.000*	.275	3.631

Dependent variable Y: Consumer Purchase Intention

* The mean difference is significant at the 0.05 level.

The multiple linear regression results indicate that both passive and active social media marketing approaches have a strong and statistically significant positive effect on consumer purchase intention in Zhejiang's beauty industry. Specifically, passive SMM ($\beta = 0.448$, $t = 9.467$, $p < 0.001$) and active SMM ($\beta = 0.455$, $t = 9.619$, $p < 0.001$) show nearly identical standardized coefficients, suggesting that both strategies contribute substantially and at similar levels. However, the active approach demonstrates a slightly stronger influence. The model exhibits high explanatory power, with an adjusted R^2 of 0.754, indicating that approximately 75.4% of the variance in purchase intention is explained by these two predictors. Additionally, collinearity diagnostics (Tolerance = 0.275; VIF = 3.631) fall within acceptable thresholds, confirming that multicollinearity is not a concern. Overall, the findings emphasize that both passive and active social media marketing are critical drivers of consumer purchase intention, with interactive (active) engagement playing a marginally more influential role.

The Influence of Consumer Behavior on Consumer Purchase Intention

Table 7: The Multiple Linear Regression Analysis of Consumer Purchase Intention based on Consumer Behavior

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	.240	.095		2.532	.012*		
Information seeking(X ₁)	.378	.053	.370	7.124	.000*	.216	4.626

Brand Engagement (X ₂)	.257	.052	.251	4.965	.000*	.229	4.376
Purchasing Habits(X ₃)	.303	.052	.303	5.874	.000*	.220	4.551

Dependent variable Y: Consumer Purchase Intention

* The mean difference is significant at the 0.05 level.

Information seeking ($\beta = 0.370$) has the highest impact, followed by purchase habits ($\beta = 0.303$) and brand engagement ($\beta = 0.251$) in standardized coefficients (SCs), indicating that actively seeking product information is the most determinative factor in purchasing more. The very high t-values ($t = 7.124$ for X₁, $t = 5.874$ for X₃, $t = 4.965$ for X₂) and very low significance levels ($\text{Sig} < 0.01$) guarantee the stability of these effects. The model explains a considerable amount of variance in consumer purchase intention ($\text{Adj } R^2 = 0.767$), meaning that about 76.7% of the variance was explained by the three dimensions of consumer behavior. The multicollinearity diagnostics indicate tolerance levels between 0.216 and 0.229 and VIFs between 4.376 and 4.626, which fall within acceptable limits and indicate no serious multicollinearity problems. More generally, these findings indicate that consumer purchasing behavior—particularly information-seeking and purchase-related behaviors—has a significant influence on purchase intention in Zhejiang's beauty sector.

Social Media Marketing (SMM) and Consumer Behavior: Significantly Positive Influence on Consumer Purchase Intention

Table 8: The Multiple Linear Regression Analysis of Consumer Purchase Intention based on Social Media Marketing and Consumer Behavior

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	.082	.098		.833	.405		
Social Media Marketing(X ₁)	.550	.055		9.968	.000	.231	4.330
Consumer Behavior(X ₂)	.407	.050		8.130	.000	.231	4.330

Dependent variable Y: Consumer Purchase Intention

* The mean difference is significant at the 0.05 level.

Both predictors are significant ($p < 0.001$). The antecedent constructs have a stronger effect on purchase intention: Social media marketing ($\beta = 0.550$) and a stronger t-value of 9.968. Consumer behavior follows immediately with a quite lower but still considerable value ($\beta = 0.407$; $t = 8.130$). It then follows that social media marketing is more important than even consumer behavior, although they still matter a lot. About 77% of the variation in purchase intention is explained by the two predictors ($\text{adjusted } R^2 = 0.769$). The tolerance and VIF of both variables are 0.231 and 4.330, respectively, according to multicollinearity diagnostics, which are small and relatively high, indicating no severe multicollinearity. In short, these

findings suggest that an integrated strategy combining social media, internet marketing and consumer behavior is essential to drive purchase intentions in the Zhejiang beauty industry.

Conclusion and Discussion

This study demonstrates that social media marketing (SMM) and consumer behavior have significant, direct effects on consumer purchase intention in Zhejiang's beauty industry, with demographic factors serving as a moderating factor. While no significant differences were found between genders and occupations, variables such as age, income, education, job position, and hometown significantly influence purchasing decisions. Both passive and active social media engagement positively affect purchase intention; however, passive browsing exerts a slightly stronger influence, and brand engagement emerges as the most powerful behavioral predictor. Overall, consumers in Zhejiang—particularly urban, educated, and middle-income groups—exhibit relatively positive purchase intentions, highlighting the critical role of digital marketing in shaping beauty consumption. These findings are consistent with the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB), confirming the importance of perceived usefulness, social influence, and digital convenience. Notably, the stronger impact of passive engagement suggests that trust, credibility, and user-generated content are more influential than direct interaction, reflecting the importance of social proof in the Chinese digital context. Additionally, the absence of gender differences challenges traditional assumptions about female-dominated beauty consumption and aligns with the growing male cosmetics market in urban China.

Further analysis reinforces that demographic factors significantly moderate purchase intention, consistent with prior studies, with younger and more educated consumers showing greater responsiveness to digital marketing. However, the lack of gender differences contrasts with earlier research, indicating evolving cultural norms and a more balanced market influence across genders. The strong positive effect of SMM supports existing literature, although the slightly greater influence of passive over active engagement suggests that observational exposure—such as advertisements and tutorials—can be as persuasive as interactive participation. Moreover, consumer behavior dimensions, including information seeking, brand engagement, and purchasing habits, all positively influence purchase intention, supporting established theoretical frameworks such as the S-O-R model. Finally, while SMM and consumer behavior significantly predict purchase intention, the moderate overall engagement levels suggest that Zhejiang's beauty market is still developing, with domestic brands continuing to build trust and emotional connections comparable to global competitors. Overall, the findings largely align with existing research while highlighting unique regional characteristics that distinguish Zhejiang's evolving beauty market.

Recommendation

Based on the empirical findings, several recommendations are proposed to enhance consumer purchase intention in Zhejiang's beauty industry. First, companies should adopt demographic segmentation strategies by tailoring marketing campaigns according to age, income, and education levels—for example, targeting younger consumers with engaging digital content and product education, while offering premium experiences for higher-income groups and

affordability-focused promotions for lower-income segments. Second, firms should balance passive and active social media marketing by combining informative content with interactive strategies, such as influencer collaborations, user-generated content, and short-form videos on platforms like Weibo, Xiaohongshu, and Douyin, to maximize engagement and conversions. Third, improving information availability is essential, as information-seeking behavior strongly drives purchase intention; thus, brands should provide tutorials, reviews, and community interactions to build trust and credibility while encouraging repeat purchases through loyalty programs. Finally, integrating consumer behavior insights with social media analytics can enable more personalized, effective marketing by leveraging data-driven recommendations, influencer endorsements, and authentic social proof to strengthen brand impact and competitiveness in Zhejiang's evolving beauty market.

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KEY FACTORS INFLUENCING CONSUMER PURCHASE INTENTION IN ACG CULTURE-RELATED PRODUCTS IN 4 MAJOR PROVINCES IN CHINA

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Abstract: *This thesis, titled "Key Factors Influencing Consumer Purchase Intention in ACG Culture-Related Products in 4 Major Provinces in China," investigates the primary determinants that shape consumer purchase intentions towards products related to ACG (Animation, Comic, Game) culture among Post-90s consumers in China's major cities, including Beijing, Shanghai, Guangzhou, and Shenzhen. The study employs a quantitative research design, utilizing questionnaires to gather data from a sample of 400 respondents. It examines the influence of demographic factors, consumer behavior, and consumer satisfaction on purchase intentions. The findings indicate that younger consumers, those with higher levels of education, and those with higher monthly incomes exhibit stronger purchase intentions. Additionally, the timing of first exposure to ACG culture, frequency of engagement, and spending on ACG activities significantly impact purchase intentions. Consumer satisfaction with content type, genre, and target audience also positively influences purchase intentions. The study concludes that understanding these factors is crucial for businesses aiming to develop effective marketing strategies in the ACG market. Future research should explore additional factors and dynamics shaping consumer behavior in this evolving market.*

Keywords: *ACG Culture, Consumer Purchase Intention, Demographic Factors, Consumer Behavior, Consumer Satisfaction*

Introduction

The rapid globalization of ACG (Animation, Comic, Game) culture has significantly reshaped China's consumer landscape, particularly among Post-90s/00s demographics, with its market exceeding ¥100 billion and deeply influencing youth lifestyles and consumption values (Li, 2022). While existing studies highlight emotional resonance and social interaction as key drivers of purchase intention (Tangsupwattana & Liu, 2018), a critical gap persists in quantifying how demographic variables, behavioral patterns, and satisfaction metrics collectively shape purchasing decisions in major Chinese urban centers. Addressing this gap, this study investigates these three underexplored dimensions—demographic influences, engagement behaviors, and content satisfaction—among Post-90s consumers in Beijing, Shanghai, Guangzhou, and Shenzhen using quantitative methods (N=400). The research aims to provide actionable insights for optimizing marketing strategies in China's burgeoning ACG sector.

To achieve the goals, this study was guided by Consumer Behavior Theory, which reflected customers' behavioral patterns influencing their decision-making before purchasing products.

Customer Satisfaction theory emphasized personal values. Also, the Consumer Purchase Intention theory identified the willingness to buy specific products under given conditions.

To guide this inquiry, three core research questions were formulated:

RQ1. How do demographic factors influence consumer purchase intention in ACG culture-related products?

RQ2. How does consumer behavior influence consumer purchase intention in ACG culture-related products?

RQ3. How does consumer satisfaction influence consumer purchase intention in ACG culture-related products?

Literature Review

Consumer Behavior

Consumer behavior is the behavioral patterns, decision processes, and actions that a consumer follows while making a purchase decision for a product or service for personal consumption. Understanding consumer buying behavior is a psychological study of the series of behavioral patterns that influence customers' decision-making before purchasing products (Bhasin, 2023).

Customer Satisfaction

Customer satisfaction is a multifaceted construct defined as the alignment between consumer expectations and actual experiences with products or services. Oliver (1977, 1980) proposed the Expectancy-Disconfirmation Paradigm (EDP), positing that satisfaction arises when product performance meets or exceeds pre-purchase expectations. Westbrook and Reilly (1983) extended this through the Value-Percept Disparity theory, emphasizing satisfaction as an emotional response triggered by comparisons between post-purchase perceptions and personal values. Barsky (1992) applied the Importance-Performance model, suggesting satisfaction depends on the perceived importance of product attributes and their performance. Oliver and Swan (1989) further incorporated Equity Theory, in which satisfaction stems from fair output-to-input ratios (e.g., costs versus benefits). Kano's model (1984) categorized attributes into *Basic* (mandatory), *Expected* (performance-based), and *Excitement* (delight-inducing), highlighting how unexpected features drive high satisfaction. Fornell et al. (1996) systematized these insights through the Customer Satisfaction Index (CSI), quantifying satisfaction using weighted factors such as quality and brand reputation (Dhar, Kanungo & Chowdhury, 2025).

Consumer Purchase Intention

Purchase intention is a critical predictor of consumer behavior, defined as the willingness to buy specific products under given conditions (Kotler & Armstrong, 2010). Rooted in the Theory of Planned Behavior (TPB) (Ajzen, 1991), intention is shaped by *attitudes* (evaluation of the product), *subjective norms* (social pressures), and *perceived behavioral control* (ability to purchase) (Mo & Yang, 2025). Morwitz (2014) emphasized its role in forecasting market behavior, while Shah et al. (2012) linked it to brand-driven decision-

making. Hewei and Youngsook (2022) noted that it reflects both cognitive attitudes and financial commitment, particularly in experiential purchases such as ACG products (See, 2025).

Background of ACG Culture-Related Products in 4 Major Provinces in China

With the development of time, culture has diversified for a long time, and the cycle of its change has gradually shortened. More and more subcultures or popular cultures have gradually integrated into our lives. In this ever-changing cultural landscape, a new force has emerged and quickly occupied a large share of the cultural market: ACGN culture, which originated in Japan. It is the abbreviation of animation, manga, game, and novel. At present, the ACGN industry market is unprecedentedly huge. With the rising consumption power of the generations after the 90s and 00s, these young people, deeply influenced by ACGN culture, are making it a market of more than 100 billion yuan and forming unique cultural concepts and values (Li, 2022). ACG-related products include a wide range of goods and services such as merchandise, digital content, thematic events, and offline experiences. These products not only cater to consumers' passion for ACG content but also stimulate purchasing intentions through emotional resonance, social interaction, and cultural identification. The post-90s consumers, characterized by their tech-savviness and affinity for popular culture, are highly receptive to ACG content. The ACG industry has become a significant contributor to the creative economy, with substantial investments in content creation, distribution, and marketing. Understanding the factors influencing the consumption capacity of post-90s consumers is crucial for businesses and marketers aiming to capitalize on this trend. This study aims to fill a gap in the existing literature by analyzing how Demographic Factors, Consumer Behavior and Consumer Satisfaction influence Consumer Purchase Intention for ACG Culture-Related Products.

Research Methodology

This study investigates the impact of demographic factors, employee consciousness, and corporate environment on work quality across various industries. The research focuses on employees across sectors to ensure a diverse, representative sample. Given the broad workforce population, the study assumes an infinite population for sampling purposes.

This study employed a quantitative approach, using structured online questionnaires distributed via Questionnaire Star, to collect data from 400 Post-90s ACG consumers in Beijing, Shanghai, Guangzhou, and Shenzhen. Participants were sampled through non-probability convenience sampling targeting ACG communities (May–December 2025). The instrument measured four constructs: demographic factors (7 items), consumer behavior (12 items), consumer satisfaction (13 items across content type, genre, and target audience), and purchase intention (4 items), all using 5-point Likert scales. Validity was confirmed by expert review ($\text{IOC} \geq 0.5$), and reliability exceeded the thresholds (Cronbach's $\alpha = 0.885\text{--}0.925$). Data analysis included descriptive statistics and inferential tests: ANOVA for demographic/behavioral impacts on purchase intention, and multiple linear regression for satisfaction effects. Ethical compliance (IRB approval, anonymity) was maintained throughout.

Research Findings

The Demographic Factors

Table 1: The Frequency and Percent Frequency Classified by Demographic Factor

Demographic Factor Classification		Frequency	Percent
Gender	Male	224	56.00
	Female	176	44.00
Age	Under 20	5	1.25
	20-25	53	13.25
	26-35	153	38.25
	36-45	189	47.25
Educational Background	High School	9	2.25
	Diploma / Certificate	15	3.75
	Bachelor's Degree	130	32.50
	Master's Degree	173	43.25
	Doctoral Degree	73	18.25
Monthly Net Income	Under 6,000 RMB	7	1.75
	6,000 - 8,000 RMB	33	8.25
	8,001-10,000 RMB	73	18.25
	10,001-12,000 RMB	96	24.00
	Above 12000 RMB	191	47.75
Location (City Life)	South China	117	29.25
	North China	81	20.25
	East China	80	20.00
	Central China	42	10.50
	The other area	80	20.00
Total		400	100.00

Table 1 presents the demographic characteristics of the 400 respondents, categorized by gender, age, educational background, monthly net income, and location. The gender distribution shows a slightly higher proportion of male respondents (56.00%) than female respondents (44.00%). In terms of age, the majority of respondents were aged 36–45 years (47.25%), followed by those aged 26–35 years (38.25%), with smaller proportions in the 20–25 age group (13.25%) and under 20 (1.25%). Regarding educational background, most respondents held a master's degree (43.25%), followed by bachelor's degree holders (32.50%) and doctoral degree holders (18.25%), with a small percentage holding only a high school diploma (5.00%). Monthly net income data reveal that nearly half of the respondents (47.75%) earned over 12,000 RMB, while 24.00% earned 10,001–12,000 RMB, 18.25% earned 8,001–10,000 RMB, 8.25% earned 6,000–8,000 RMB, and only 1.75% earned less than 6,000 RMB. Geographically, the respondents were evenly distributed, with 29.25% residing in South and North China, and 20.00% in East and Central China, as well as other regions. This demographic profile reflects a diverse sample, predominantly composed of highly educated, higher-income

individuals, providing a strong basis for analyzing the influence of employee consciousness and the corporate environment on the quality of work.

Table 5: The Frequency and Percent Frequency Classified by Gender and Age

Gender	Age				Total
	Under 20	20-25	26-35	36-45	
Male	2 (0.50%)	27 (6.75%)	83 (20.75%)	112 (28.00%)	224 (56.00%)
Female	3 (0.75%)	26 (6.50%)	70 (17.50%)	77 (19.25%)	176 (44.00%)
Total	5 (1.25%)	53 (13.25%)	153 (38.25%)	189 (47.25%)	400 (100.00%)

Table 2 presents the frequency and percentage distributions of respondents by gender and age. Among male respondents, who comprise 56.00% of the total sample, the largest proportion (28.00%) falls within the 36–45 age group, followed by 20.75% in the 26–35 age group, 6.75% in the 20–25 age group, and 0.50% under 20 years. Similarly, among female respondents, who account for 44.00% of the sample, the majority (19.25%) are also within the 36–45 age group, followed by 17.50% in the 26–35 age group, 6.50% in the 20–25 age group, and 0.75% under 20 years.

Table 6: The Frequency and Percent Frequency Classified by Gender and Educational Background

Gender	Educational Background					Total
	High School	Diploma /Certificate	Bachelor's Degree	Master's Degree	Doctoral Degree	
Male	7 (1.75%)	6 (1.50%)	68 (17.00%)	99 (24.75%)	44 (11.00%)	224 (56.00%)
Female	2 (0.50%)	9 (2.25%)	62 (15.50%)	74 (18.50%)	29 (7.25%)	176 (44.00%)
Total	9 (2.25%)	15 (3.75%)	130 (32.50%)	173 (43.25%)	73 (18.25%)	400 (100.00%)

Table 3 presents the frequency and percentage distribution of respondents classified by gender and educational background. Among male respondents, who make up 56.00% of the total sample, the majority hold a master's degree (24.75%), followed by those with a bachelor's degree (17.00%) and doctoral degrees (11.00%). A smaller proportion of male respondents hold diplomas or certificates (1.50%) and high school qualifications (1.75%). Similarly, among female respondents, who account for 44.00% of the total sample, the largest proportion holds a master's degree (18.50%), followed by those with a bachelor's degree (15.50%) and doctoral degrees (7.25%). A smaller percentage of female respondents have diplomas or certificates (2.25%) and high school qualifications (0.50%).

Table Error! No text of specified style in document.: The Frequency and Percent Frequency Classified by Gender and Monthly Net Income

Gender	Monthly Net Income					Total
	Under 6,000 RMB	6,000-8,000 RMB	8,001-10,000 RMB	10,001-12,000 RMB	Above 12000 RMB	
Male	3 (0.75%)	13 (3.25%)	40 (10.00%)	55 (13.75%)	113 (28.25%)	224 (56.00%)
Female	4 (1.00%)	20 (5.00%)	33 (8.25%)	41 (10.25%)	78 (19.50%)	176 (44.00%)
Total	7 (1.75%)	33 (8.25%)	73 (18.25%)	96 (24.00%)	191 (47.75%)	400 (100.00%)

Table 4 presents the frequency and percentage distribution of respondents categorized by gender and monthly net income. Among male respondents, who comprise 56.00% of the total sample, the majority earn above 12,000 RMB per month (28.25%), followed by those in the 10,001–12,000 RMB income bracket (13.75%). Smaller proportions are observed for males earning 8,001–10,000 RMB (10.00%), 6,000–8,000 RMB (3.25%), and less than 6,000 RMB (0.75%). Similarly, among female respondents, who account for 44.00% of the sample, the highest proportion also earns above 12,000 RMB per month (19.50%), followed by 10.25% in the 10,001–12,000 RMB bracket and 8.25% in the 8,001–10,000 RMB range. A smaller percentage of females earn between 6,000 and 8,000 RMB (5.00%) or less than 6,000 RMB (1.00%).

Table 7: The Frequency and Percent Frequency Classified by Gender and Location (City Life)

Gender	Location (City Life)					Total
	South China	North China	East China	Central China	Others	
Male	64 (16.00%)	43 (10.75%)	41 (10.25%)	29 (7.25%)	47 (11.75%)	224 (56.00%)
Female	53 (13.25%)	38 (9.50%)	39 (9.75%)	13 (3.25%)	33 (8.25%)	176 (44.00%)
Total	117 (29.25%)	81 (20.25%)	80 (20.00%)	42 (10.50%)	80 (20.00%)	400 (100.00%)

Table 5 presents the frequency and percentage distributions of respondents by gender and geographic location (city life). Among male respondents, who constitute 56.00% of the total sample, the largest proportion (16.00%) resides in South China, followed by 11.75% in "the other area of China," 10.75% in North China, 10.25% in East China, and 7.25% in Central China. Similarly, among female respondents, who make up 44.00% of the total sample, the

highest proportion (13.25%) also resides in South China, followed by 9.75% in East China, 9.50% in North China, 8.25% in "the other area of China," and 3.25% in Central China.

Employee Consciousness

Table 8: Descriptive Statistics of Employee Consciousness

	Mean	Std. Deviation	Meaning	Ranking
Work Attitude and Self-efficacy	3.2200	.92398	Neutral	1
Job Satisfaction and Professional Identity	3.2175	.92321	Neutral	2
Personal Values and Internal Motivations	3.1925	.94746	Neutral	3
Employee Consciousness	3.2125	.90797	Neutral	

Table 6 presents the descriptive statistics for employee consciousness ($M = 3.2125$). Most respondents expressed neutral opinions regarding employee consciousness. Specifically, work attitude and self-efficacy had the highest mean value ($M = 3.2200$), indicating they were the most positively perceived components. This was closely followed by Job Satisfaction and Professional Identity ($M = 3.2175$). Personal Values and Internal Motivations had the lowest mean ($M = 3.1925$), suggesting a slightly lower perception among the components.

Corporate Environment

Table 9: Descriptive Statistics of Corporate Environment

	Mean	Std. Deviation	Meaning	Ranking
Organizational Culture & Climate	3.1800	.93262	Neutral	3
Policies & Management Practices	3.2050	.92201	Neutral	2
Physical & Social Work Environment	3.2200	.91854	Neutral	1
Corporate Environment	3.2000	.90667	Neutral	

Table 7 presents the descriptive statistics of the corporate environment ($M = 3.2000$). Most respondents expressed neutral opinions regarding the corporate environment factors, with a slight tendency towards disagreement regarding Organizational Culture and Climate ($M = 3.1800$). Among the components, the Social Work Environment ranked highest in mean value ($M = 3.2200$), indicating a more positive perception. This was closely followed by Policies and Management Practices ($M = 3.2050$). Conversely, Organizational Culture and Climate had the lowest mean, suggesting a slightly more critical perspective among the components.

Quality of Work

Table 10: Descriptive Statistics of Quality of Work

	Mean	Std. Deviation	Meaning
Quality of Work	3.9200	1.08468	Agree

Table 8 presents the descriptive statistics of the quality of work as a customer purchasing decision factor. The mean score is 3.9200, with a standard deviation of 1.08468, indicating that respondents generally agree that the quality of work significantly influences their purchasing decisions.

Differences in Gender Generate Differences in Quality of Work

$$H_0 : \mu_1 = \mu_2$$

$$H_a : \mu_1 \neq \mu_2$$

Table 9: The Independent Samples t-test of the Gender Factor

Factor	Gender	N	Mean	S.D.	t-test	df	Sig.
Quality of Work	Male	224	3.976786	1.0202420	1.105	398	.270
	Female	176	3.855682	1.1387570			

Table 9 shows that the p-value for the quality of work is 0.270, which is greater than the critical value of 0.05. Therefore, H_0 is accepted, indicating that gender differences do not result in significant differences in work quality.

Differences in Age Generate Differences in Quality of Work

$$H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4$$

$$H_i : \mu_i \neq \mu_j \text{ at last one Pair where } i \neq j.$$

Table 11: The One-Way ANOVA of Age

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.080	3	.360	.310	.818
Within Groups	459.420	396	1.160		
Total	460.499	399			

From Table 10, the one-way ANOVA results show a p-value of 0.818, which is greater than the critical value of 0.05. Therefore, H_0 is accepted, indicating that there are no significant differences in the quality of work across age groups.

Differences in Educational Background Generate Differences in Quality of Work

$$H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$$

$H_i: \mu_i \neq \mu_j$ at last one Pair where $I \neq j$.

Table 12: The One-way ANOVA of Educational Background

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	21.783	4	5.446	4.903	.001*
Within Groups	438.717	395	1.111		
Total	460.499	399			

Table 11 shows that the p-value for educational background is 0.001, which is lower than the critical value of 0.05. Therefore, H_0 is rejected, indicating that differences in educational background lead to significant differences in the quality of work.

Differences in Monthly Net Income Generate Differences in Quality of Work

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$

$H_i: \mu_i \neq \mu_j$ at last one Pair where $I \neq j$.

Table 13: The One-way ANOVA of Monthly Net Income

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.243	4	1.561	1.357	.248
Within Groups	454.256	395	1.150		
Total	460.499	399			

From Table 12, the p-value for monthly net income is greater than the 0.05 critical value. Therefore, the H_0 is accepted, indicating that differences in monthly net income do not yield significant differences in perceived work quality.

Differences in Location (City Life) Generate Differences in Quality of Work

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$

$H_i: \mu_i \neq \mu_j$ at last one Pair where $I \neq j$.

Table 13: The One-way ANOVA of Location (City Life)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	140.021	4	35.005	43.145	.000*
Within Groups	320.478	395	.811		
Total	460.499	399			

Table 13 shows that the p-value for location (city life) is 0.000, which is lower than the critical value of 0.05. Therefore, the H_0 is rejected, indicating that differences in location lead to significant differences in the quality of work.

The Influences of Employee Consciousness on Quality of Work

Table 14: Summarize the Model of Employee Consciousness Influencing Quality of Works

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate
1	.605 ^a	.366	.362	.8584306

a. Predictors: (Constant), 8. Personal Values and Internal Motivations, 6. Work Attitude and Self-efficacy, 7. Job Satisfaction and Professional Identity

Table 14 summarizes the multiple regression model analyzing the effect of employee consciousness on work quality. The model indicates an R-value of 0.605, suggesting a moderate positive relationship between employee consciousness and work quality. The R Square value of 0.366 indicates that the predictors of Personal Values and Internal Motivations, Work Attitude and Self-efficacy, and Job Satisfaction and Professional Identity explain 36.6% of the variance in the quality of work. The adjusted R Square value is 0.362, accounting for model complexity, while the standard error of the estimate is 0.8584306, indicating the average deviation of observed values from predicted values.

Table 15: The Multiple Linear Regression Coefficients for the Influence of Employee Consciousness on Quality of Work

Model	Unstandardized Coefficients		Standardized Coefficients	t-test	Sig.
	B	Std. Error	Beta		
(Constant)	1.601	.160		9.992	.000*
Work Attitude and Self-efficacy	.094	.136	.080	.692	.489
Job Satisfaction and Professional Identity	.291	.138	.248	2.113	.035*
Personal Values and Internal Motivations	.339	.119	.294	2.856	.005*

a. Dependent Variable: Quality of Work

The results obtained from the study can be seen in Table 15 and are written in terms of Regression Equation (1):

$$Y = 1.601 + .094X_1 + .291X_2 + .339X_3$$

(.000) (.489) (.035) (.005)

Where Y = Quality of Work

X₁ = Work Attitude and Self-efficacy

X₂ = Job Satisfaction and Professional Identity

X₃ = Personal Values and Internal Motivations

Table 15 demonstrates the influence of employee consciousness on work quality through multiple regression analysis. Among the predictors, Personal Values and Internal Motivations (Beta = 0.294, $p = 0.005$) had the most substantial positive effect on the quality of work. Job Satisfaction and Professional Identity (Beta = 0.248, $p = 0.035$) also showed a significant positive impact. Conversely, Work Attitude and Self-efficacy (Beta = 0.080, $p = 0.489$) did not exhibit a statistically significant impact at the 0.05 level. These findings highlight the dominant roles of Personal Values and Internal Motivations in enhancing work quality, with Job Satisfaction and Professional Identity also contributing significantly.

The Influences of Corporate Environment on Quality of Work

Table 16: Summarize the Model of Corporate Environment Influencing Quality of Works

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate
1	.608 ^a	.370	.365	.8559024

a. Predictors: (Constant), 11. Physical and Social Work Environment, 10. Policies and Management Practices, 9. Organizational Culture and Climate

Table 16 summarizes the multiple regression model analyzing the effect of the corporate environment on the quality of work. The model indicates an R-value of 0.608, suggesting a moderate positive relationship between the corporate environment and the quality of work. The R Square value of 0.370 indicates that the predictors of Organizational Culture and Climate, Policies and Management Practices and Physical and Social Work Environment explain 37.0% of the variance in the quality of work. The adjusted R Square value is 0.365, accounting for model complexity, while the standard error of the estimate is 0.8559024, indicating the average deviation of observed values from predicted values.

Table 17: The Multiple Linear Regression Coefficients for the Influence of Corporate Environment on Quality of Work

Model	Unstandardized Coefficients		Standardized Coefficients	t-value	Sig.
	B	Std. Error	Beta		
(Constant)	1.609	.159		10.150	.000*
Organizational Culture& Climate	.393	.113	.337	3.466	.001*
Policies& Management Practices	.331	.133	.282	2.899	.004*

a. Dependent Variable: Quality of Work

Finally, the result from Table 17 is written in terms of Regression Equation (2):

$$Y = 1.609 + .393X_1 + .331X_2 \dots\dots\dots(2)$$

(.000) (.001) (.004)

Where Y = Quality of Work

X₁ = Organizational Culture and Climate

X_2 = Policies and Management Practices

Table 17 demonstrates the influence of the corporate environment on the quality of work through multiple regression analysis. Among the predictors, only Organizational Culture and Climate (Beta = 0.393, $p < 0.001$) had the most substantial positive effect on the quality of work. Also, Policies and Management Practices (Beta = 0.331, $p = 0.004$) showed a significant positive impact. Conversely, the Physical and Social Work Environment did not exhibit a statistically significant impact at the 0.05 level. These findings highlight the dominant role of Organizational Culture and Climate in enhancing work quality, with Policies and Management Practices also contributing significantly.

Conclusion

The study on the key factors influencing consumer purchase intention in ACG culture-related products in China's four major provinces has yielded valuable insights. The research confirms that demographic factors, consumer behavior, and consumer satisfaction all play significant roles in shaping consumer purchase intentions. Specifically, younger consumers, those with higher levels of education, and those with higher monthly incomes exhibit stronger purchase intentions. Additionally, consumer behavior patterns, such as the timing of first exposure to ACG culture, the frequency of engagement, and spending on ACG activities, significantly influence purchase intentions. Consumer satisfaction with content type, genre, and target audience also positively impacts purchase intentions. These findings provide a comprehensive understanding of the dynamics driving consumer behavior in the ACG market.

In conclusion, this study provides a detailed analysis of the key factors influencing consumer purchase intention in the ACG market. The findings emphasize the importance of demographic factors, consumer behavior, and consumer satisfaction in driving purchase intentions. By understanding these factors, businesses can develop more effective marketing strategies to engage consumers and enhance their satisfaction. Future research should build on these insights to examine additional factors and dynamics shaping consumer behavior in the evolving ACG market.

Discussion

This study's findings align with and extend existing literature on ACG consumer behavior, confirming that demographic factors, consumer behavior patterns, and satisfaction collectively shape purchase intentions.

Demographic Factors

Younger consumers (Post-90s/00s), those with higher levels of education, and higher-income individuals exhibit stronger purchase intentions. This corroborates Liu and Zhao (2024) and highlights the Z generation's significant consumption power and cultural identification with ACG products.

Marketing strategies must target these segments through tailored content and engagement initiatives.

Consumer Behavior

Timing of exposure: Early engagement (e.g., during middle school) significantly boosts long-term purchase intentions.

Engagement frequency: Active participation in ACG events (e.g., competitions, communities) and higher time/monetary investment drive purchase decisions, supporting Tangsupwattana and Liu's (2018) emphasis on social interaction and Liu and Zhao's (2024) findings on impulsive spending.

Social dynamics: Partner choice (friends vs. family) and activity locations (home/school) further influence intentions.

Consumer Satisfaction

Satisfaction with content type (e.g., anime visuals), genre (e.g., sci-fi innovation), and target audience alignment (e.g., shonen themes) directly enhances purchase intentions. This validates Oliver's (1977, 1980) Expectancy-Disconfirmation Paradigm and underscores the need for quality content that meets audience expectations.

Businesses must prioritize content diversity, emotional resonance, and community-driven experiences to foster loyalty.

Implications for Practice

Marketing: Target high-intention demographics (youth, educated, affluent) via personalized campaigns.

Content Development: Invest in high-quality, genre-diverse productions aligned with audience preferences (e.g., immersive storytelling for young adults).

Community Building: Leverage social platforms and offline events to amplify peer influence and emotional connections.

Future Research: Should explore cross-cultural comparisons, technological impacts (e.g., VR/AR), and longitudinal behavioral shifts in the evolving ACG market.

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MODEL KEUSAHAWANAN SOSIAL ISLAM BERSEPADU BAGI MEMPERKASA ORANG KURANG UPAYA DI MALAYSIA: SATU KAJIAN FENOMENOLOGI

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Abstrak: *Keusahawanan sosial Islam semakin diiktiraf sebagai pendekatan holistik dalam menangani isu keterpinggiran sosial dan pemerkasaan ekonomi golongan rentan. Walau bagaimanapun, penyelidikan empirikal yang memfokuskan pengalaman hidup Orang Kurang Upaya (OKU) dalam keusahawanan sosial Islam masih terhad, khususnya dalam konteks Malaysia. Sehubungan itu, kajian ini bertujuan untuk meneroka pengalaman hidup OKU yang terlibat dalam keusahawanan sosial Islam dan membangunkan satu Model Keusahawanan Sosial Islam Bersepadu (IISEM) bagi memperkasa OKU di Malaysia. Kajian ini menggunakan pendekatan kualitatif berasaskan reka bentuk fenomenologi. Data dikumpulkan melalui temu bual mendalam dengan usahawan OKU dan informan ekosistem terpilih, dan dianalisis menggunakan analisis tematik. Dapatan kajian mengenal pasti peranan asas rohaniah sebagai sumber motivasi dan daya tahan OKU, penerapan prinsip maqasid al-syariah dalam operasi keusahawanan, kepentingan sokongan ekosistem yang bersepadu melibatkan institusi, komuniti dan kewangan sosial Islam, serta impak pemerkasaan OKU yang bersifat multidimensi merangkumi dimensi ekonomi, sosial dan kerohanian. Berdasarkan dapatan tersebut, kajian ini mencadangkan satu model keusahawanan sosial Islam bersepadu yang bersifat kontekstual dan inklusif. Kajian ini menyumbang kepada literatur keusahawanan sosial Islam dengan memperluaskan fokus kepada komuniti OKU, di samping menyediakan implikasi praktikal kepada pembuat dasar, institusi Islam dan organisasi masyarakat sivil dalam merangka inisiatif pemerkasaan OKU yang lebih mampan dan berteraskan nilai Islam.*

Kata Kunci: *Keusahawanan Sosial Islam; Orang Kurang Upaya (OKU); Maqasid al-Syariah; Pemerkasaan OKU; Kajian Fenomenologi*

Abstract: *Islamic social entrepreneurship has increasingly been recognised as a holistic approach to addressing social marginalisation and empowering vulnerable groups economically. However, empirical research focusing on the lived experiences of Persons with Disabilities (PwDs) within the context of Islamic social entrepreneurship remains limited, particularly in Malaysia. Accordingly, this study aims to explore the lived experiences of PwDs engaged in Islamic social entrepreneurship and to develop an Integrated Islamic Social Entrepreneurship Model (IISEM) for empowering PwDs in Malaysia. This study adopts a qualitative approach grounded in a phenomenological research design. Data were collected through in-depth interviews with PwD entrepreneurs and selected ecosystem informants and*

were analysed using thematic analysis. The findings reveal several key themes, including the role of spiritual foundations as sources of motivation and resilience, the application of *maqasid al-shariah* principles in entrepreneurial operations, the importance of an integrated support ecosystem involving institutions, communities, and Islamic social finance, as well as the multidimensional impacts of empowerment encompassing economic, social, and spiritual dimensions. Based on these findings, the study proposes an integrated and context-specific Islamic social entrepreneurship model that is inclusive of PwDs. This study contributes to the literature on Islamic social entrepreneurship by extending its focus to the PwDs community and offers practical implications for policymakers, Islamic institutions, and civil society organisations in designing more sustainable, value-based initiatives for PwDs empowerment.

Keywords: *Islamic Social Entrepreneurship; Persons with Disabilities (PwDs); Maqasid al-Shariah; PwD Empowerment; Phenomenological Study*

Pengenalan

Keusahawanan sosial telah diiktiraf sebagai pemangkin transformasi sosio-ekonomi, khususnya bagi kumpulan terpinggir seperti Orang Kurang Upaya (OKU). Di Malaysia, OKU menghadapi halangan struktural, kewangan dan sosial yang menyukarkan penyertaan mereka dalam ekosistem keusahawanan (Karmakar & Islam, 2021; UNDP Malaysia, 2024). Walaupun pelbagai dasar seperti *Akta OKU 2008* dan *Dasar Keusahawanan Nasional 2030* dilaksanakan, kadar penyertaan tenaga kerja OKU masih rendah iaitu di bawah 40% (Jabatan Perangkaan Malaysia, 2023).

Keusahawanan Sosial Islam (KSI) menawarkan pendekatan holistik yang menyepadukan nilai-nilai Islam seperti keadilan (*'adl*), belas kasihan (*rahmah*) dan amanah dalam aktiviti ekonomi (Ahmad et al., 2023). Pendekatan ini juga memanfaatkan instrumen kewangan Islam seperti zakat, wakaf dan *qard al-hasan*. Namun, masih terdapat kekurangan model KSI yang khusus bagi memenuhi keperluan OKU (Alvarez et al., 2021). Justeru, kajian ini bertujuan membangunkan Model Keusahawanan Sosial Islam Bersepadu (IISEM) yang relevan dengan konteks OKU di Malaysia.

Objektif Kajian

Objektif umum kajian adalah untuk membangunkan model KSI bersepadu bagi memperkasa OKU di Malaysia. Objektif khusus adalah:

1. Mengenal pasti halangan utama yang dihadapi usahawan OKU dalam mengakses sumber kewangan Islam dan sokongan institusi.
2. Menilai keberkesanan model keusahawanan sedia ada (perubatan, sosial, hibrid) dalam konteks OKU Muslim.
3. Membangunkan model KSI bersepadu berteraskan *maqasid al-shariah* dan amalan keusahawanan kontemporari.

Sorotan Literatur

Keusahawanan Sosial: Konsep dan Perkembangan

Keusahawanan sosial merujuk kepada aktiviti keusahawanan yang bertujuan menyelesaikan masalah sosial melalui pendekatan perniagaan yang mampan, di samping mengekalkan kelangsungan ekonomi organisasi (Dees, 2001). Berbeza dengan keusahawanan konvensional yang menekankan pemaksimuman keuntungan, keusahawanan sosial memberi penekanan kepada penciptaan nilai sosial, kesejahteraan komuniti dan pembangunan inklusif. Dalam konteks Malaysia, keusahawanan sosial mula mendapat perhatian akademik dan praktikal sekitar awal tahun 2010-an, khususnya sebagai mekanisme menangani kemiskinan, pengangguran dan keterpinggiran sosial (Abdul Kadir & Sarif, 2016). Namun, kebanyakan kajian awal bersifat deskriptif dan berasaskan kerangka Barat, dengan penekanan yang terhad terhadap dimensi nilai, etika dan spiritual.

Keusahawanan Sosial Islam dan Kerangka Maqasid al-Syariah

Keusahawanan sosial Islam berkembang sebagai peluasan kepada konsep keusahawanan sosial yang disepadukan dengan tasawur Islam, nilai etika, dan objektif *maqasid al-syariah*. Menurut Hossain et al. (2018), keusahawanan sosial Islam bukan sekadar aktiviti ekonomi berorientasikan sosial, tetapi juga satu bentuk ibadah yang menuntut niat yang ikhlas (*niyyah*), amanah, dan keadilan sosial.

Literatur terkini menegaskan bahawa *maqasid al-syariah* menyediakan kerangka menyeluruh bagi penciptaan nilai sosial melalui pemeliharaan agama (*hifz al-din*), nyawa (*hifz al-nafs*), akal (*hifz al-'aql*), keturunan (*hifz al-nasl*), dan harta (*hifz al-mal*) (Saputra, 2023). Setiawan et al. (2025) turut membangunkan tipologi keusahawanan sosial Islam yang mengaitkan aktiviti ekonomi dengan pemenuhan maqasid secara sistematik. Meskipun, model-model ini masih bersifat umum dan belum dikontekstualisasikan secara khusus untuk kumpulan minoriti seperti Orang Kurang Upaya (OKU), terutamanya dalam konteks sosiobudaya Malaysia.

Keusahawanan Sosial dan Orang Kurang Upaya (OKU)

Pada peringkat global, keusahawanan sosial semakin diiktiraf sebagai pendekatan berkesan untuk memperkasa golongan OKU melalui penciptaan peluang pekerjaan, pembangunan kemahiran dan pengukuhan inklusiviti sosial (Nur Zainie & Azyyati, 2024). Pendekatan ini membolehkan OKU beralih daripada kebergantungan kepada bantuan kebajikan kepada penyertaan aktif dalam ekonomi.

Namun, dalam konteks Malaysia, kajian berkaitan OKU masih tertumpu kepada isu kebajikan, kemudahan fizikal, dan hak asasi, dengan penekanan yang terhad terhadap pemerdayaan ekonomi yang lestari (Mohd Khalil et al., 2022). Kajian empirikal oleh Ab Wahid, Hishamuddin dan Abd Rahman (2023) menunjukkan bahawa keusahawanan sosial berpotensi meningkatkan kebolehpasaran dan kesejahteraan OKU, namun kerangka yang digunakan masih bersifat konvensional dan tidak berasaskan nilai Islam.

Keusahawanan Sosial Islam dan Pemerdayaan OKU

Walaupun keusahawanan sosial Islam telah banyak dikaji dalam konteks pembasmian kemiskinan dan pemeraksanaan asnaf, kajian yang memfokuskan secara khusus kepada OKU masih sangat terhad (Ahmad Shiyuti & Ishak, 2025). Kebanyakan kajian cenderung melihat OKU sebagai penerima manfaat pasif, bukan sebagai agen keusahawanan yang berdaya saing.

Selain itu, pendekatan metodologi yang digunakan dalam kajian sedia ada didominasi oleh kajian kuantitatif dan konseptual, yang kurang meneroka pengalaman hidup OKU. Kekangan ini menghadkan kefahaman mendalam terhadap cabaran, keperluan dan potensi sebenar OKU dalam ekosistem keusahawanan sosial Islam.

Model Keusahawanan Sosial Islam Sedia Ada dan Keterbatasannya

Beberapa model keusahawanan sosial Islam telah dikemukakan dalam literatur, antaranya model berasaskan *maqasid al-syariah*, model kewangan sosial Islam bersepadu (zakat, wakaf dan qard al-hasan), serta model ekosistem keusahawanan Islam yang melibatkan institusi, komuniti dan pasaran (Setiawan et al., 2025). Walaupun model-model ini menawarkan asas teori yang kukuh, terdapat tiga keterbatasan utama. Pertama, model-model tersebut tidak memfokuskan OKU sebagai kumpulan sasaran khusus. Kedua, ia kurang mengambil kira dimensi psikososial dan spiritual OKU. Ketiga, kebanyakan model tidak dibangunkan berdasarkan data empirikal kualitatif yang mendalam, terutamanya dalam konteks Malaysia.

Jurang Kajian dan Sumbangan Kajian

Berdasarkan sorotan literatur, tiga jurang kajian utama dapat dikenal pasti. Pertama, kekurangan kajian yang mengintegrasikan keusahawanan sosial Islam dengan pemeraksanaan OKU secara holistik. Kedua, dominasi kerangka konvensional dalam kajian keusahawanan OKU yang mengabaikan dimensi nilai Islam. Ketiga, kekurangan kajian fenomenologi kualitatif yang meneroka pengalaman hidup OKU dalam keusahawanan sosial.

Sehubungan itu, kajian ini bertujuan membangunkan Model Keusahawanan Sosial Islam Bersepadu bagi Memperkasa OKU di Malaysia, berasaskan Maqasid al-Syariah dan pengalaman sebenar OKU melalui pendekatan fenomenologi kualitatif. Kajian ini dijangka menyumbang secara teoritikal kepada literatur keusahawanan sosial Islam dan secara praktikal kepada pembangunan dasar serta amalan pemeraksanaan OKU yang lebih inklusif dan berteraskan nilai Islam.

Jadual 1: Ringkasan Literatur Utama dan Jurang Kajian

Fokus Kajian	Pengarang	Konteks	Sumbangan Utama	Jurang
Keusahawanan Sosial	Dees (2001); Abdul Kadir & Sarif (2016)	Global/Malaysia	Asas konsep perkembangan	& Tiada integrasi Islam
Keusahawanan Sosial Islam	Saputra (2023); Setiawan et al. (2025)	Global	Kerangka Maqasid	Tiada fokus OKU
OKU & Keusahawanan Sosial	Ab Wahid et al. (2023)	Malaysia	Pendekatan pemeraksanaan	Kerangka konvensional
OKU & Isu Sosial	Mohd Khalil et al. (2022)	Malaysia	Hak & cabaran OKU	Fokus kebajikan

Metodologi Kajian

Kajian ini menggunakan reka bentuk fenomenologi kualitatif berasaskan paradigma interpretif, bertujuan untuk memahami dan menginterpretasikan intipati pengalaman hidup usahawan Orang Kurang Upaya (OKU) dalam konteks Keusahawanan Sosial Islam di Malaysia. Pendekatan fenomenologi ini dipilih kerana ia membolehkan penyelidik merungkai makna, motivasi, dan realiti dalaman yang dibina oleh peserta, seterusnya menyumbang kepada pembangunan model bersepadu yang terhasil daripada pengalaman autentik (Creswell & Poth, 2018). Reka bentuk ini secara langsung menyokong objektif kajian untuk meneroka halangan, faktor kejayaan, dan dimensi kerohanian dalam keusahawanan OKU.

Reka Bentuk Kajian dan Rasional

Pendekatan fenomenologi membolehkan penyelidikan mendalam ke atas fenomena yang jarang diteroka. Ia sesuai untuk mengkaji pertemuan unik antara identiti OKU, spiritualiti Islam, dan amalan keusahawanan sosial. Reka bentuk ini mengutamakan suara dan perspektif peserta sebagai sumber pengetahuan utama untuk membina kerangka teoritikal yang relevan dan kontekstual (Neubauer et al., 2019).

Persampelan dan Profil Peserta

Peserta kajian dipilih melalui persampelan bertujuan kriteria (*purposive criterion sampling*) bagi memastikan mereka yang terpilih mempunyai pengalaman langsung dan maklumat yang kaya mengenai fenomena yang dikaji (Patton, 2015). Kriteria kelayakan adalah seperti berikut:

1. Individu yang mengidentifikasi diri sebagai Orang Kurang Upaya (OKU) merangkumi kategori fizikal, penglihatan, pendengaran, dan pembelajaran.
2. Pengasas atau pengurus aktif perniagaan sosial yang mempunyai misi dan impak sosial yang jelas, seperti menyediakan pekerjaan untuk OKU atau menyelesaikan masalah kemasyarakatan.

3. Perniagaan yang secara eksplisit atau implisit mengamalkan prinsip dan nilai Islam dalam operasinya, seperti menjauhi riba, mengutamakan kejujuran (*siddiq*), dan menyediakan produk atau perkhidmatan halal.

Berdasarkan kriteria tersebut, seramai 18 orang usahawan OKU telah dipilih. Untuk mendapatkan perspektif ekosistem yang holistik, seramai 7 orang informan utama turut ditemubual, terdiri daripada:

- 2 orang pegawai pengurusan zakat dari institusi zakat negeri.
- 2 orang penggubal dasar daripada agensi kerajaan yang terlibat dengan pembangunan OKU dan keusahawanan.
- 2 orang ketua pertubuhan bukan kerajaan (NGO) yang aktif dalam pemerkasaan OKU.
- 1 orang pengamal kewangan Islam dari institusi kewangan patuh syariah.

Proses pengambilan sampel diteruskan sehingga titik ketepuan data (*data saturation*) dicapai, iaitu apabila data baharu tidak lagi menghasilkan tema atau pemahaman baharu yang signifikan (Guest et al., 2006).

Prosedur Pengumpulan Data

Pengumpulan data dilakukan secara triangulasi menggunakan tiga kaedah utama bagi meningkatkan kesahan dan kekayaan data (Lincoln & Guba, 1985):

1. Temu Bual Separuh Berstruktur Secara Mendalam: Temu bual utama dijalankan dengan 18 orang usahawan OKU. Setiap sesi berlangsung selama 60 hingga 120 minit dan merangkumi soalan terbuka yang menelusuri:
 - Perjalanan dan motivasi keusahawanan, serta kaitannya dengan keimanan dan identiti sebagai OKU.
 - Cabaran praktikal dan strategi mengatasi halangan, khususnya berkaitan akses kepada pembiayaan dan pasaran.
 - Penerapan nilai Islam (seperti *amanah*, *ihsan*, *adl*) dalam operasi harian dan hubungan perniagaan.
 - Pengalaman dan persepsi terhadap sokongan ekosistem (keluarga, institusi agama, agensi kerajaan, mekanisme kewangan Islam).
2. Perbincangan Kumpulan Fokus (FGD): Dua sesi FGD diadakan dengan tujuh orang informan utama. Sesi pertama melibatkan penggubal dasar dan pegawai zakat, membincangkan halangan institusi dan potensi pembaharuan dasar. Sesi kedua melibatkan wakil NGO dan pengamal kewangan Islam, membincangkan isu pelaksanaan di lapangan dan model kerjasama. FGD membolehkan interaksi dinamik dan percambahan pandangan mengenai ekosistem sokongan.
3. Analisis Dokumen: Untuk triangulasi dan kontekstualisasi, dokumen berkaitan dianalisis, termasuk:

- Dokumen dasar: *Akta OKU 2008, Dasar Keusahawanan Nasional 2030*, Pelan Tindakan OKU Muslim (PTOKUM) 2022-2025.
- Dokumen institusi: Laporan tahunan dan garis panduan agensi zakat terpilih.
- Dokumen peserta: Profil perniagaan dan bahan pemasaran usahawan OKU.

Semua temu bual dan FGD dirakam, ditranskripsi verbatim, dan dianonimkan.

Prosedur Analisis Data

Data dianalisis secara sistematik menggunakan perisian ATLAS.ti 22. Proses analisis mengikuti rangka kerja analisis tematik enam fasa oleh Braun dan Clarke (2006, 2019):

1. Membiasakan Diri dengan Data: Membaca semua transkrip dan dokumen berulang kali untuk mencapai pemahaman menyeluruh.
2. Menjana Kod Awal: Melakukan pengekodan secara induktif dan berterusan ke atas set data. Sebanyak 187 kod awal dijana (contoh: "sabar sebagai sumber daya tahan", "halangan mendapatkan qard al-hasan", "peranan masjid sebagai pusat jaringan").
3. Mencari Tema: Kod-kod yang berkaitan dikelompokkan untuk membentuk tema potensi. Fungsi 'Network View' dalam ATLAS.ti digunakan untuk memvisualisasi dan mengaitkan kod-kod ini.
4. Menyemak Tema: Tema potensi disemak semula terhadap set data keseluruhan untuk memastikan ketepatan dan konsistensi. Proses ini menyebabkan beberapa tema digabung, dipisah, atau dinamakan semula.
5. Mendefinisikan dan Menamakan Tema: Lima tema utama yang koheren akhirnya dikenal pasti dan diperhalusi, yang secara langsung membentuk blok binaan kepada Model Keusahawanan Sosial Islam Bersepadu (IISEM):
 - Tema 1: Akidah dan Akhlak sebagai Teras Spiritual dan Motivasi
 - Tema 2: Penerapan Prinsip Maqasid al-Shariah dalam Operasi Perniagaan
 - Tema 3: Kepentingan Kemahiran Keusahawanan dan Adaptasi Kecacatan
 - Tema 4: Sinergi dan Peranan Ekosistem Sokongan Pelbagai Pihak
 - Tema 5: Manifestasi Impak Multidimensi: Ekonomi, Sosial, dan Kerohanian
6. Menghasilkan Laporan: Tema-tema yang telah ditakrifkan ini dikembangkan menjadi naratif analisis yang mendalam, yang kemudiannya disintesis untuk membentuk model bersepadu yang dicadangkan.

Peneguhan Kesahan dan Kebolehppercayaan

Kajian ini mematuhi kriteria keteguhan dalam penyelidikan kualitatif (Lincoln & Guba, 1985) melalui:

- Kepercayaan (*Credibility*): Triangulasi sumber data, semakan ahli (*member checking*) dengan peserta, dan perbincangan rakan sejawat (*peer debriefing*).
- Kebolehpindahan (*Transferability*): Penerangan konteks yang mendalam (*thick description*) mengenai peserta dan latar kajian.

- Kebolehpercayaan (*Dependability*): Penyediaan jejak audit (*audit trail*) yang terperinci untuk semua keputusan metodologi dan analisis.
- Dapat Disahkan (*Confirmability*): Amalan reflektiviti penyelidik melalui jurnal refleksi untuk mengawal bias, dan penggunaan perisian ATLAS.ti untuk memastikan ketelusan proses kodifikasi.

Pertimbangan Etika

Kelulusan etika diperoleh terlebih dahulu. Persetujuan berinformasi diperoleh daripada semua peserta dengan menjamin kerahsiaan dan anonymiti (menggunakan kod seperti P1, OKU1). Data disimpan dalam persekitaran yang selamat. Melalui metodologi yang teliti ini, kajian berjaya menggali pengalaman mendalam usahawan OKU dan membangunkan Model Keusahawanan Sosial Islam Bersepadu (IISEM) yang berasaskan bukti empirikal dan relevan dengan konteks Malaysia.

Dapatan Kajian

Analisis tematik menghasilkan empat tema utama yang membentuk Model IISEM:

Asas Kerohanian (Akidah dan Akhlak)

Usahawan OKU melihat perniagaan sebagai satu bentuk ibadah. Nilai seperti ikhlas, sabar, amanah dan siddq menjadi teras operasi perniagaan. Seorang peserta berkata: “*Saya berniaga sebab saya percaya rezeki datang dari Allah... walaupun saya cacat penglihatan, saya yakin Allah bagi kelebihan lain untuk saya bantu orang lain*” (P4).

Dimensi Operasi (Penerapan Maqasid al-Shariah)

Maqasid al-shariah dijadikan panduan operasi perniagaan, tertumpu kepada:

- *Hifz al-din*: Persekitaran kerja mesra ibadah
- *Hifz al-nafs*: Tempat kerja selamat dan aksesibel
- *Hifz al-aql*: Latihan berterusan dan teknologi bantu
- *Hifz al-mal*: Penggunaan pembiayaan Islam seperti qard al-hasan

Sokongan Ekosistem Bersepadu

Sokongan diperoleh daripada pelbagai pihak:

- Kewangan: Zakat, wakaf, qard al-hasan
- Institusi: Agensi kerajaan, NGO, masjid
- Komuniti: Keluarga, mentor rakan sebaya

Peserta P5 menyatakan: “*Saya dapat modal awal daripada zakat negeri. Dari situ saya mula buat kuih dan sekarang dah ada dua pekerja OKU juga.*”

Dimensi Impak Multidimensi

Kejayaan model diukur melalui:

- Ekonomi: Pendapatan stabil, pekerjaan inklusif
- Sosial: Pengiktirafan masyarakat, pengurangan stigma
- Kerohanian: Kepuasan spiritual, rasa bermakna
- Komuniti: Sumbangan kepada SDG 8 dan 10

Model Keusahawanan Sosial Islam Bersepadu (IISEM)

Bagi menggabungkan dapatan kajian secara visual, Rajah 1 menunjukkan Model Keusahawanan Sosial yang Dicadangkan untuk Komuniti OKU. Model ini mempamerkan interaksi dinamik antara asas kerohanian, komitmen etika, pembangunan kemahiran, sokongan ekosistem dan hasil masyarakat. Dengan meletakkan amalan keusahawanan dalam kerangka Islam, model dalam Rajah 1 memberikan sumbangan teori dan praktikal ke arah memajukan keusahawanan inklusif.



Rajah 1: Model Keusahawanan Sosial Islam Bersepadu OKU

Model Keusahawanan Sosial Islam Bersepadu yang dicadangkan menggambarkan satu kerangka holistik yang mengintegrasikan dimensi kerohanian, operasi, sokongan dan impak untuk pemerksaan Orang Kurang Upaya (OKU). Analisis teknikal berikut membincangkan proses dan mekanisme yang berlaku daripada asas hingga ke impak, dengan sokongan rujukan autoritatif dan empirikal terkini.

1. Asas (Kerohanian): Landasan Epistemologi dan Motivasi Intrinsik

Asas model ini dibina atas kerangka epistemologi Islam yang menjadikan akidah dan akhlak sebagai teras motivasi keusahawanan. Dalam konteks OKU, nilai tawakal (berserah kepada Allah) dan sabar berfungsi sebagai mekanisme psiko-spiritual yang meningkatkan daya tahan ketika menghadapi cabaran fizikal dan sosial (al-Ghazali, 2005). Etika perniagaan Islam seperti amanah (kepercayaan) dan siddiq (kebenaran) menjadi kod etika dalaman yang mengawal selia tingkah laku perniagaan, seterusnya mentransformasikan aktiviti ekonomi menjadi ibadah (al-Qaradawi, 1999). Penyelidikan terkini oleh Dusuki (2021) mengesahkan bahawa usahawan Muslim yang mengamalkan nilai-nilai ini menunjukkan komitmen lebih tinggi terhadap tanggungjawab sosial.

2. Tiang (Operasional- Penerapan *Maqasid al-Syariah*): Mekanisme Penterjemahan Praktikal

Lapisan operasional berfungsi sebagai mekanisme penterjemahan prinsip kerohanian kepada amalan konkrit berdasarkan kerangka maqasid al-syariah (al-Shatibi, 2006). Setiap dimensi maqasid dioperasionalkan secara teknikal:

Hifz al-Din (Pemeliharaan Agama): Dilaksanakan melalui penggunaan kontrak perniagaan Islam (uqud muamalat) yang sah, memastikan produk dan perkhidmatan halal, serta menyediakan persekitaran kerja yang menghormati keperluan ibadah seperti waktu solat dan kemudahan wuduk aksesibel (Auda, 2018).

Hifz al-Nafs (Pemeliharaan Nyawa/Diri): Diterjemahkan melalui prinsip reka bentuk sejagat (universal design) di tempat kerja, pematuhan piawaian keselamatan yang ketat, dan penyediaan sokongan kesihatan mental. Pendekatan ini secara langsung menangani halangan fizikal dan psikososial OKU (World Health Organization, 2021).

Hifz al-Aql (Pemeliharaan Akal): Dilaksanakan via program pembangunan kapasiti berterusan, latihan kemahiran khusus, dan akses kepada teknologi bantu (assistive technology) yang bersesuaian (Hossain, 2022).

Hifz al-Nasl (Pemeliharaan Keturunan): Diintegrasikan melalui dasar pekerjaan mesra keluarga yang menyokong keseimbangan kerja-kehidupan, aspek kritikal bagi usahawan OKU yang mungkin berperanan sebagai penjaga (Ibn Qayyim al-Jawziyyah, 2003).

3. Sokongan (Ekosistem): Rangkaian Pemudahcara Sistemik

Lapisan ekosistem bertindak sebagai rangkaian pemudahcara yang menyokong dan memperkukuh lapisan operasi. Ia beroperasi pada dua paksi:

Sokongan Kewangan Struktur: Instrumen kewangan sosial Islam seperti zakat (modal permulaan), wakaf (infrastruktur lestari), dan *qard al-hasan* (pembiayaan tanpa faedah) menyediakan alternatif pembiayaan patuh syariah yang sensitif kepada profil risiko OKU (ISRA, 2021). Kajian oleh Abdullah et al. (2025) menunjukkan integrasi zakat dengan sokongan keusahawanan meningkatkan kemampuan perniagaan asnaf.

Sokongan Institusi dan Komuniti: Gabungan sokongan daripada kerajaan (dasar, insentif fiskal), NGO (latihan, advokasi), masjid (jaringan komuniti, legitimasi), dan keluarga (sokongan emosi dan awal) membentuk ekosistem pelindung yang mengurangkan pengasingan dan menyediakan modal sosial (Karmakar & Islam, 2021). Laporan UNDP Malaysia (2024) mengakui pentingnya kolaborasi pelbagai pihak dalam meningkatkan akses pekerjaan OKU.

4. Hasil (Impak): Pencapaian Matlamat Holistik dan Berkelanjutan

Lapisan impak merupakan manifestasi hasil kumulatif daripada interaksi sinergi antara asas kerohanian, pelaksanaan operasi berasaskan maqasid, dan sokongan ekosistem yang komprehensif. Impak ini bersifat multidimensi dan dapat diukur pada tiga aras yang saling berkait, mencerminkan kejayaan model ini dalam mencapai matlamat holistik dan kelestarian.

Impak pada Aras Individu: Kejayaan model ini menghasilkan pemeraksanaan menyeluruh terhadap usahawan OKU.

Pemeriksaan Ekonomi: Usahawan mencapai kebebasan kewangan melalui penjanaan pendapatan yang stabil dan autonomi. Ini termasuk keupayaan memiliki aset, menguruskan kewangan peribadi, dan mengembangkan empayar perniagaan. Pencapaian ini secara langsung menyumbang kepada pemeliharaan harta (*hifz al-mal*) seperti yang ditekankan dalam *maqasid al-syariah* (al-Shatibi, 2006).

Pemeriksaan Sosio-Psikologi: Penyertaan dalam keusahawanan meningkatkan harga diri, keyakinan diri, dan identiti positif usahawan OKU. Mereka beralih daripada persepsi sebagai penerima bantuan kepada penggerak ekonomi. Kajian oleh Wahid et al. (2023) mendapati bahawa penyertaan dalam keusahawanan sosial secara signifikan meningkatkan kesejahteraan psikososial dan mengurangkan perasaan marginalisasi dalam kalangan OKU.

Pemeriksaan Kerohanian: Aktiviti keusahawanan yang disepadukan dengan nilai Islam membawa kepada pencapaian falah (kejayaan duniawi dan ukhrawi) dan kepuasan spiritual. Usahawan merasa puas kerana dapat memenuhi tuntutan ibadah melalui pekerjaan, mengamalkan nilai-nilai murni dalam urusan perniagaan, dan mencapai makna hidup yang lebih mendalam (Dusuki, 2021). Ini selaras dengan objektif pemeliharaan agama (*hifz al-din*).

Impak pada Aras Komuniti: Kejayaan usahawan OKU mencipta gelombang transformasi positif dalam komuniti.

Peningkatan Inklusiviti Sosial: Kejayaan usahawan OKU berperanan sebagai agen perubahan norma sosial dengan secara praktikal mendedahkan keupayaan dan potensi OKU. Ini secara beransur-ansur mengurangkan stigma, prasangka, dan diskriminasi yang dihadapi oleh komuniti OKU (Shakespeare, 2006).

Pengukuhan Kohesi Komuniti (Ukhuwwah): Model yang berteraskan Islam ini menggalakkan semangat bantu-membantu dan tanggungjawab kolektif (mas'uliyah ijtima'iyah). Rangkaian sokongan yang melibatkan masjid, keluarga, dan rakan usaha mencipta ikatan sosial yang lebih kukuh dan memperkukuh konsep ummah (komuniti bersatu) (al-Qaradawi, 1999).

Penciptaan Kitaran Pemerksaan: Usahawan OKU yang berjaya sering menjadi mentor dan pembekal peluang pekerjaan kepada OKU lain. Ini mencipta kitaran pemerksaan yang mampan di mana kejayaan individu melahirkan peluang untuk orang lain, sekaligus membina ekosistem sokongan sebaya (peer support ecosystem) yang berkesan.

Impak pada Aras Nasional: Model ini menyumbang secara signifikan kepada agenda pembangunan negara.

Pencapaian Matlamat Pembangunan Lestari (SDG): Model ini menyumbang secara langsung kepada SDG 8: Kerja Yang Bermaruah dan Pertumbuhan Ekonomi dengan mewujudkan pekerjaan yang bermakna dan inklusif, serta SDG 10: Mengurangkan Ketaksamaan dengan menangani jurang sosio-ekonomi yang dihadapi OKU (United Nations, 2022).

Pengurangan Beban Kebajikan Negara: Dengan memfokuskan kepada pemerksaan ekonomi melalui keusahawanan dan bukan bantuan kebajikan jangka panjang, model ini berpotensi mengurangkan kebergantungan OKU terhadap bantuan langsung kerajaan dalam jangka masa panjang. Ini menjadikan peruntukan kebajikan lebih lestari dan boleh disalurkan kepada golongan yang paling memerlukan.

Pembangunan Ekonomi Sosial Islam: Model ini menjadi contoh praktikal dalam mengoperasionalkan instrumen ekonomi Islam seperti zakat dan wakaf untuk pembangunan inklusif. Kejayaannya dapat memperkukuh ekosistem ekonomi sosial Islam di Malaysia, selaras dengan Pelan Tindakan OKU Muslim (PTOKUM) 2022-2025 yang menekankan pendekatan holistik dan berteraskan Islam bagi pemerksaan OKU (Unit Perancang Ekonomi, 2022).

Model ini menunjukkan aliran proses berurutan yang bermula dengan asas kerohanian (input), diterjemahkan ke operasi berasaskan maqasid (proses), disokong oleh ekosistem komprehensif, dan akhirnya menghasilkan impak multidimensi. Wujudnya gelung maklum balas di mana kejayaan di peringkat impak dapat mengukuhkan lagi komitmen kerohanian dan menarik lebih banyak sumber sokongan. Model ini bukan sekadar kerangka konseptual, tetapi berpotensi menjadi panduan pelaksanaan yang praktikal untuk pelbagai pihak berkepentingan dalam membina ekosistem keusahawanan inklusif yang hakiki bagi OKU di Malaysia, selaras dengan visi negara mencapai masyarakat sejahtera yang merangkumi semua.

Implikasi dan Cadangan

Implikasi Teoretikal:

Kajian menyumbang kepada pendekatan dekolonisasi dalam wacana keusahawanan sosial dengan mengintegrasikan epistemologi Islam dan *maqasid al-shariah*.

Implikasi Praktikal:

- Polisi: Pembentukan Dasar KSI OKU di peringkat nasional
- Kewangan: Penciptaan dana khas OKU berasaskan instrumen zakat-wakaf
- Kapasiti: Penubuhan pusat inkubasi di masjid dan institusi pengajian tinggi

Cadangan Kajian Masa Depan:

- Kajian kuantitatif bagi mengesahkan dimensi model
- Kajian longitudinal bagi menilai keberkesanan jangka panjang
- Penyelidikan fiqh khusus berkaitan kontrak perniagaan melibatkan OKU

Kesimpulan

Model Keusahawanan Sosial Islam Bersepadu OKU menawarkan pendekatan holistik dan berasaskan nilai Islam bagi memperkasa OKU melalui keusahawanan sosial. Dengan menyepadukan asas kerohanian, operasi beretika, sokongan ekosistem dan pengukuran impak multidimensi, model ini berpotensi menjadi panduan praktikal kepada penggubal dasar, institusi kewangan Islam dan komuniti dalam membangunkan ekosistem keusahawanan inklusif di Malaysia.

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PEMBANGUNAN MODEL ASOMAR KHUSUS UNTUK KOMUNITI OKU PENDENGARAN MENGGUNAKAN PEMODELAN STRUKTUR INTERPRETIF

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Abstrak: Kajian ini bertujuan membangunkan Model Tadabbur al-Quran (Model AsomAR) melalui pendekatan pembelajaran kosa kata bahasa Arab dengan pengintegrasian teknologi Realiti Terimbuh (Augmented Reality) bagi menyokong pembelajaran pelajar dewasa yang kurang pendengaran. Penyelidikan ini menggunakan kaedah Pemodelan Struktur Interpretif (Interpretive Structural Modeling) yang diaplikasikan melalui perisian Concept Star, melibatkan tujuh orang pakar dalam bidang pendidikan al-Quran untuk pelajar orang kurang upaya pendengaran, pendidikan bahasa Arab, serta teknologi pendidikan. Kajian ini mengenal pasti dan menyusun secara sistematik komponen-komponen utama yang diperlukan bagi menyokong pemahaman al-Quran dan pemerolehan kosa kata bahasa Arab mengikut tema-tema yang sesuai sebagai pendedahan awal kepada komuniti OKU pendengaran yang beragama Islam. Sumbangan input daripada panel pakar membolehkan pembentukan struktur hierarki Model AsomAR, sekaligus memastikan kesepadanan dari segi pedagogi dan integrasi teknologi. Dapatan kajian ini menyumbang kepada pembangunan pendidikan inklusif dengan menyediakan satu pendekatan pembelajaran yang berstruktur bagi penguasaan bahasa Arab dan tadabbur al-Quran untuk komuniti OKU pendengaran. Selain itu, kajian ini menonjolkan potensi penggunaan pembelajaran berasaskan AR dalam meningkatkan tahap penglibatan dan pemahaman pelajar, serta memberikan implikasi penting kepada pendidik, pembangun kurikulum dan pembuat dasar.

Kata Kunci: Model Tadabbur Al Quran, Kosa Kata Arab, Orang Kurang Upaya Pendengaran, Realiti Terimbuh, Model Struktur Interpretatif (Interpretive Structural Modeling)

Introduction

Tadabbur al-Quran, yang merujuk kepada proses penghayatan dan perenungan terhadap makna serta pengajaran yang terkandung dalam al-Quran, merupakan teras utama dalam pendidikan Islam. Walau bagaimanapun, ketiadaan kurikulum khusus yang dibangunkan untuk pelajar

OKU pendengaran dalam pendidikan al-Quran telah menimbulkan halangan akademik yang signifikan, memandangkan kebanyakan program sedia ada masih mengekalkan pendekatan konvensional dan tidak diadaptasi selaras dengan keperluan pembelajaran golongan tersebut (Seman et al., 2019). Keadaan ini menjadikan proses penguasaan ilmu al-Quran sebagai satu cabaran yang berterusan bagi individu OKU pendengaran.

Selain cabaran pedagogi, aspek linguistik turut memainkan peranan penting, khususnya apabila Bahasa Arab sebagai bahasa al-Quran mempunyai struktur yang kompleks serta bergantung kepada elemen auditori dalam proses pembelajarannya. Faktor ini secara langsung menyukarkan pemerolehan bahasa dan pemahaman teks al-Quran dalam kalangan pembelajar OKU pendengaran. Kekangan akses terhadap bahan pembelajaran yang bersesuaian serta teknologi sokongan yang terhad turut memperkukuh jurang pembelajaran antara pelajar OKU pendengaran dan pelajar tipikal.

Seiring dengan kemajuan teknologi pendidikan, penggunaan Realiti Terimbuh (Augmented Reality, AR) dilihat berpotensi untuk menangani kekangan tersebut dengan menyediakan persekitaran pembelajaran berasaskan visual yang interaktif dan pelbagai deria. Dapatan kajian terdahulu menunjukkan bahawa aplikasi AR berkesan dalam membantu pembelajaran kosa kata Bahasa Arab dan meningkatkan kefahaman al-Quran dalam kalangan orang dewasa OKU pendengaran, sekali gus menyokong pemerolehan bahasa dan pengukuhan penghayatan spiritual (Ahmad Yusoff, N. F. et al., 2024). Keberkesanan pendekatan berasaskan visual ini turut disokong oleh kajian dalam bidang literasi dan perkembangan bahasa isyarat bagi kanak-kanak OKU pendengaran, yang menekankan kepentingan alat visual serta kaedah interaktif dalam meningkatkan keberkesanan pembelajaran (Almutairi & Al-Megren, 2017).

Meskipun penyelidikan berkaitan penggunaan AR dalam pendidikan telah dijalankan secara meluas, masih terdapat kekurangan dari segi pembangunan model tadabbur al-Quran yang berstruktur dan khusus untuk pembelajar OKU pendengaran dewasa. Justeru, kajian ini bertujuan untuk memperkasa model AsomAR dengan mengintegrasikan pembelajaran kosa kata Bahasa Arab dan teknologi AR bagi menyokong proses tadabbur al-Quran melalui pendekatan *Interpretive Structural Modeling* (ISM). Pendekatan ISM membolehkan penstrukturan pengetahuan pakar secara sistematik ke dalam satu kerangka model yang berhierarki dan koheren, seterusnya memastikan keselarasan antara komponen pedagogi dan teknologi yang diaplikasikan dalam konteks pendidikan golongan OKU pendengaran. (TNR, 12, single spacing, justify)

Literature Review

Teknologi Realiti Terimbuh (Augmented Reality, AR) mempunyai aplikasi yang meluas merentasi pelbagai sektor, termasuk industri automotif, penjagaan kesihatan, pendidikan dan persekitaran pejabat. Seperti yang dinyatakan oleh Azuma (1997) dan Tamura (2014), AR meningkatkan persepsi pengguna terhadap persekitaran sebenar dengan melapiskan elemen maya yang menyampaikan maklumat melangkaui keupayaan deria manusia. Walaupun maklumat tersebut tidak wujud secara fizikal, ia membantu pengguna dalam melaksanakan tugas dunia sebenar. Keupayaan unik objek maya ini menjadikan AR sebagai alat yang amat

berpotensi, khususnya dalam merangsang kreativiti melalui aplikasi seperti bahan bantu pengajaran dan sumber pendidikan.

Billinghurst (2002) dan Wu (2013) mencadangkan bahawa AR memiliki pelbagai ciri yang mampu menawarkan pengalaman pembelajaran yang berbeza secara signifikan daripada pendekatan tradisional. AR berupaya merangsang pelbagai deria, seperti sentuhan dan pendengaran (Azuma, 1997; Serio, 2012). Melalui pengintegrasian AR dalam bahan seperti buku atau kad imbas, pelajar bukan sahaja berinteraksi dengan kandungan pembelajaran, malah turut menerima sokongan atau perancah tambahan. Hal ini dimungkinkan melalui aplikasi AR pada telefon pintar, yang membolehkan pembelajaran fleksibel dan mengikut keperluan pada bila-bila masa dan di mana-mana sahaja (Ramli, 2020).

Kajian-kajian terkini menunjukkan bahawa AR berpotensi meningkatkan kualiti pendidikan secara signifikan bagi murid pekak atau kurang pendengaran dengan menyediakan pengalaman pembelajaran yang imersif, interaktif dan mudah diakses selaras dengan keperluan mereka. Sebagai contoh, satu prototaip alat animasi berasaskan AR yang dibangunkan untuk mengajar huruf Hijaiyah kepada kanak-kanak pekak di Malaysia menunjukkan peningkatan ketara dalam penglibatan dan kefahaman pelajar. Guru-guru turut memuji penggunaan visual yang berwarna-warni, watak animasi serta ciri nyanyian bersama, walaupun ujian lanjut dalam bilik darjah sebenar masih dicadangkan (Mohd Noor et al., 2025).

Begitu juga, satu sistem kapsyen masa nyata yang dipertingkatkan dengan AR dan direka bersama pelajar serta guru pekak di Sri Lanka mencatat kadar penerimaan hampir 92%, sekali gus membuktikan keberkesanannya dalam menyokong kefahaman dalam persekitaran sekolah (Samaradivakara et al., 2024). Inovasi terkini turut menekankan konteks emosi, apabila antara muka kapsyen AR yang melapiskan isyarat afektif seperti nada suara atau ekspresi wajah didapati mampu mengurangkan beban kognitif dan meningkatkan pemahaman berbanding kapsyen standard dalam pembelajaran STEM (Ubur, 2025). Selain itu, satu kajian ACM ASSETS pada tahun 2024 yang melibatkan 11 peserta DHH yang bermain permainan AR mendapati bahawa rangsangan visual atau audio yang berlebihan boleh menjejaskan tumpuan, sekali gus menekankan kepentingan mereka bentuk sistem AR yang menyediakan maklum balas boleh suai seperti teks atau haptik yang sesuai dengan keperluan pelajar pekak (Luna et al., 2024).

Wan Ab Aziz et al. (2021) telah membangunkan satu aplikasi Realiti Terimbuh dikenali sebagai ARabic-Kafa untuk pembelajaran kosa kata Bahasa Arab bagi menyokong guru dan pelajar. Aplikasi ini menggunakan kaedah Marker-Based Tracking untuk memaparkan objek 3D serta dilengkapi sebutan audio bagi meningkatkan proses pembelajaran. Ujian menunjukkan bahawa objek 3D dapat dipaparkan dengan jelas pada jarak minimum 10 cm dan sudut antara 30° hingga 90°. Walau bagaimanapun, aplikasi ini direka khusus untuk pelajar dan guru tipikal sahaja.

Selain itu, terdapat aplikasi Mobile Augmented Reality (MAR-Arab) yang dibangunkan oleh Che Hashim et al. (2017) bagi pembelajaran awal Bahasa Arab menggunakan model ADDIE yang merangkumi fasa analisis, reka bentuk, pembangunan, pelaksanaan dan penilaian. Aplikasi ini mengandungi dua modul utama, iaitu Pembelajaran dan Latihan, yang

mengintegrasikan elemen multimedia seperti animasi, audio, video dan objek 3D bagi menarik minat pelajar. Hasil ujian pengguna menunjukkan bahawa aplikasi tersebut berjaya meningkatkan minat pelajar, memperbaiki kefahaman serta mempercepatkan proses pembelajaran, sekali gus membuktikan keberkesanannya dalam pendidikan Bahasa Arab.

Kajian ini berbeza dari kajian-kajian lain di mana model ini menggabungkan beberapa aspek seperti pembelajaran kosa kata Arab, al-Quran, teknologi Augmented Reality dan komuniti dewasa OKU pendengaran. Terdapat beberapa pembinaan model dan modul pembelajaran bahasa Arab menggunakan teknologi Augmented Reality untuk kegunaan pelajar sekolah dan Universiti secara umum seperti dinyatakan dalam kajian-kajian lepas, namun begitu pembelajaran berbantuan teknologi AR khusus untuk komuniti dewasa OKU pendengaran ini masih belum dibangunkan lagi. Selain itu, model ini mengetengahkan pembelajaran Kosa kata Arab yang terkandung dalam Juzu' 30 sahaja dengan mengikut tema-tema tertentu berbanding kajian lepas yang lebih kepada pembacaan al-Quran secara umum. Model ini dibina sesuai dengan keperluan dan kehendak mereka sekaligus membantu mereka mengenali dan memahami maksud kosa kata Arab dengan baik. Selain itu, elemen multimedia seperti animasi, objek 3D, video, audio dan grafik yang sesuai dipercayai dapat menarik minat mereka untuk mempelajari al-Quran dan memudahkan proses pembelajaran sekaligus meningkatkan pemahaman mereka terhadap al-Quran.

Metodologi Kajian

Reka Bentuk dan Penyelidikan Pembangunan (Design and Development Research, DDR) telah diperkenalkan oleh Richey dan Klein (2007). Menurut Seels dan Richey (1994), kaedah ini melibatkan pendekatan sistematik dalam mereka bentuk, membangunkan dan menilai keberkesanan sesuatu program atau produk di samping memastikan kriteria dalaman yang konsisten. Sementara itu, Wang dan Hannafin (2005) menjelaskan bahawa kaedah DDR merangkumi proses analisis keperluan, reka bentuk, pembangunan dan pelaksanaan. Berdasarkan penjelasan tersebut, kajian mengenai reka bentuk model tadabbur al-Quran (Model AsomAR) melalui pembelajaran kosa kata Bahasa Arab berbantuan Teknologi Realiti Terimbuh (AR), khusus untuk komuniti dewasa OKU pendengaran, dilaksanakan dalam tiga fasa utama seperti berikut:

Fasa I: Analisis keperluan menggunakan pendekatan oleh Hutchinson dan Waters (1987, hlm. 19). Pengumpulan data meliputi tahap penguasaan kosa kata Juzuk 'Amma (manusia, haiwan, tumbuhan dan fenomena alam) serta minat terhadap pembelajaran berbantuan AR (Ahmad Yusoff, N. F., 2024).

Fasa II: Terdiri daripada dua subfasa:

Fasa II (A): Fasa reka bentuk menggunakan Kaedah Fuzzy Delphi (FDM). Kajian dijalankan bagi mendapatkan pandangan pakar terhadap komponen dan elemen penting dalam model Tadabbur al-Quran (Ahmad Yusoff, N. F., 2025).

Fasa II (B): Fasa pembangunan model menggunakan perisian Pemodelan Struktur Interpretif yang lebih dikenali dengan *Interpretive Structural Modeling* (ISM).

Fasa III: Fasa penilaian kebolegunaan model menggunakan Modified Nominal Group Technique (MNGT).

Kajian ini memfokuskan kepada Fasa II (B), iaitu fasa pembangunan model menggunakan perisian *Interpretive Structural Modeling* (ISM). ISM merupakan satu metodologi berstruktur yang membolehkan pendidik dan pakar mengenal pasti, memetakan serta menyusun secara hierarki hubungan antara faktor dalam sesuatu sistem pengajaran atau pembelajaran yang kompleks (Warfield, J. N., 1976). Penggunaan perisian ISM memudahkan transformasi sistematik pandangan kualitatif pakar kepada model kuantitatif yang boleh dianalisis, sekali gus meningkatkan kualiti reka bentuk instruksional dengan mengenal pasti pemacu utama dan kebergantungan antara elemen.

Kaedah ISM amat sesuai digunakan dalam sistem yang kompleks dan saling bergantung, justeru menjadikannya relevan untuk pembangunan model pendidikan yang melibatkan aspek pedagogi, bahasa dan teknologi. Teknik ini juga berupaya menghasilkan model yang tersusun dan komprehensif, selaras dengan pandangan bahawa ISM merupakan alat pembuatan keputusan yang berkesan dalam menyelesaikan dan merungkai permasalahan kompleks, khususnya dalam pembangunan model (Jadhav et al., 2015; Sohani & Sohani, 2012).

Dalam kajian ini, seramai tujuh orang pakar dipilih melalui persampelan bertujuan (purposive sampling). Pakar-pakar tersebut mewakili tiga domain utama, iaitu pendidikan al-Quran bagi pelajar OKU pendengaran, pendidikan Bahasa Arab, serta teknologi pendidikan dan integrasi AR. Setiap pakar mempunyai sekurang-kurangnya lima tahun pengalaman dalam bidang masing-masing. Data dikumpulkan melalui bengkel dan perbincangan berstruktur menggunakan perisian Concept Star, yang menyokong proses ISM dengan menyediakan persekitaran interaktif untuk pemetaan konsep dan pembangunan model. Pengkaji mengadaptasi pendekatan ISM berdasarkan langkah kajian oleh Maaruf et al. (2023) dengan beberapa pengubahsuaian kecil, seperti yang ditunjukkan dalam Jadual 1.

Jadual 1: Langkah-langkah dalam Pendekatan *Interpretive Structural Modeling* (ISM)

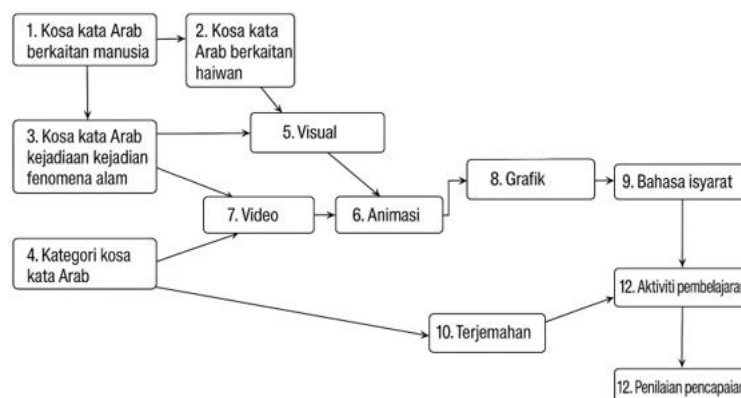
Langkah	Penerangan
Langkah 1: Mengetahui Pasti Elemen dan Komponen Model	Pengkaji mengenal pasti elemen dan komponen yang relevan untuk mereka bentuk model tadabbur al-Quran melalui pembelajaran kosa kata Bahasa Arab berbantuan teknologi AR, yang disesuaikan khusus untuk komuniti dewasa OKU pendengaran, berdasarkan kesepakatan pakar.
Langkah 2: Pemilihan Hubungan Kontekstual dan Frasa Hubungan	Pengkaji menetapkan hubungan kontekstual berkaitan cara setiap elemen dan komponen dijana serta saling berkait antara satu sama lain. Frasa kontekstual: Dalam membangunkan model tadabbur al-Quran melalui pembelajaran kosa kata Bahasa Arab berbantuan teknologi AR untuk komuniti dewasa OKU pendengaran. Frasa hubungan: Perlu diberi keutamaan sebelum...

Langkah 3: Menentukan Hubungan antara Elemen dan Komponen	Pakar membandingkan setiap pasangan elemen dan komponen serta membuat undian berdasarkan pengalaman dan kepakaran mereka bagi menentukan sama ada wujud hubungan langsung antara setiap pasangan tersebut.
Langkah 4: Penjanaan Model	Pengkaji menghasilkan satu rajah yang dikenali sebagai prototaip model menggunakan perisian ISM (Concept Star).
Langkah 5: Pembentangan dan Penilaian Kandungan Model	Pakar menilai kandungan model dan mengemukakan cadangan penambahbaikan serta pembetulan sekiranya perlu.
Langkah 6: Penjanaan Kandungan Model Akhir	Pengkaji menjana semula kandungan model berdasarkan cadangan penambahbaikan yang dikemukakan.

Dapatan Kajian dan Perbincangan

Berdasarkan dapatan daripada Fasa 2(a) Reka Bentuk Model, pengkaji telah mengenal pasti elemen-elemen yang diterima oleh pakar semasa penilaian Fuzzy Delphi bagi tujuan mereka bentuk model ini. Sebanyak 14 elemen telah dimasukkan ke dalam perisian ISM (Concept Star). Senarai elemen tersebut disusun mengikut keutamaan berdasarkan kesepakatan pakar.

Pada peringkat ini, pengkaji memberi tumpuan kepada pembangunan model. Kajian ini membangunkan model berdasarkan persetujuan pakar mengenai hubungan antara elemen-elemen terpilih dengan menggunakan teknik pemadanan terbaik (best pairing technique) serta sokongan perisian *Interpretive Structural Modeling* (ISM). Model yang terhasil kemudiannya dibentangkan kepada panel pakar untuk tujuan semakan dan pengesahan. Hasil daripada proses pengundian pakar tersebut telah menghasilkan satu model yang dijana melalui ISM, seperti yang ditunjukkan dalam rajah di bawah, iaitu Rajah 1.



Rajah 1: Model AsomAR yang dijana melalui *Interpretive Structural Modeling* (ISM)

Pembangunan Model AsomAR yang distrukturkan menggunakan *Interpretive Structural Modeling* (ISM) memperlihatkan satu sistem yang berhierarki dan bersepadu, yang direka bagi

memperkasa proses tadabbur al-Quran melalui pembelajaran kosa kata Bahasa Arab berbantuan teknologi AR. Model ini secara khusus memenuhi keperluan pembelajar dewasa OKU pendengaran. Ia memastikan komponen pedagogi dan teknologi diselaraskan secara sistematik bagi menggalakkan pembelajaran yang berkesan dan inklusif. Hubungan berstruktur antara elemen-elemen dalam model ini menunjukkan bagaimana kandungan linguistik dijabatani dengan mekanisme penyampaian yang mudah diakses, disokong oleh aktiviti pembelajaran interaktif yang mengukuhkan kefahaman. Berikut merupakan penjelasan berkaitan hubungan antara elemen dalam model ISM seperti yang ditunjukkan dalam Jadual 2.

Jadual 2: Hubungan Antara Elemen Dalam Model ISM

Hubungan	Penerangan
1 → 2/3	Pembelajaran bermula dengan kosa kata berkaitan manusia, diikuti oleh haiwan atau fenomena alam.
1, 2, 3 → 5 (Visual)	Kosa kata asas (manusia, haiwan, fenomena alam) digunakan untuk menghasilkan bahan visual seperti gambar atau ilustrasi. Visual ini berfungsi sebagai medium sokongan bagi memahami makna kosa kata.
3 → 7 (Video)	Kosa kata berkaitan fenomena alam paling sesuai disampaikan melalui video kerana sifatnya yang dinamik dan kontekstual. Video memaparkan situasi sebenar (contohnya banjir, gempa bumi) yang membantu pelajar memahami makna secara visual dan naratif.
5 → 6 (Animasi)	Visual yang dibangunkan daripada kosa kata digunakan dalam bentuk animasi bagi menjadikan pembelajaran lebih menarik dan interaktif, contohnya animasi pergerakan haiwan atau manusia.
7 → 6 (Animasi)	Kandungan daripada video boleh diubah suai atau diadaptasi ke dalam bentuk animasi untuk tujuan pembelajaran yang lebih ringkas dan mudah difahami.
6 → 8 (Grafik)	Elemen daripada animasi seperti bentuk atau simbol boleh diekstrak menjadi grafik untuk bahan statik seperti poster atau infografi
5, 6 → 8 (Grafik)	Visual dan animasi bersama-sama menyumbang kepada pembangunan grafik yang memudahkan pemahaman secara ringkas dan padat.
8 → 9 (Bahasa Isyarat)	Grafik berfungsi sebagai panduan visual dalam pembentukan bahasa isyarat yang sesuai, bagi menyokong keperluan pelajar OKU pendengaran.
9 → 11 (Aktiviti Pembelajaran)	Bahasa isyarat digunakan dalam aktiviti pembelajaran untuk menyokong pembelajaran inklusif bagi pelajar OKU pendengaran.
4 → 10 (Terjemahan)	Kategori kosa kata membantu membangunkan sistem terjemahan yang tersusun mengikut tema seperti manusia, haiwan dan fenomena alam.

10 → 11 (Aktiviti Pembelajaran)	Terjemahan digunakan dalam aktiviti pembelajaran seperti permainan bahasa yang melibatkan penyusunan dan pepadanan kosa kata.
11 → 12 (Pentaksiran pencapaian)	Aktiviti pembelajaran menjadi asas kepada pentaksiran pencapaian sama ada melalui kuiz atau ujian.

Secara asasnya, model ini terdiri daripada tiga komponen yang saling bergantung, iaitu kandungan kosa kata Bahasa Arab, penyampaian berasaskan multimedia, serta pembelajaran dan pentaksiran interaktif. Kosa kata berfungsi sebagai lapisan asas yang disusun secara tematik merangkumi domain seperti manusia, haiwan dan fenomena alam. Kategori asas ini kemudiannya ditransformasikan kepada bahan visual seperti gambar dan ilustrasi bagi meningkatkan kefahaman.

Kosa kata berkaitan fenomena alam paling sesuai disampaikan melalui video yang memaparkan konteks kehidupan sebenar, manakala bahan visual dan video seterusnya dikembangkan dalam bentuk animasi bagi mewujudkan pengalaman pembelajaran yang lebih menarik dan interaktif. Animasi tersebut kemudiannya dipermudahkan kepada grafik statik seperti poster atau infografik yang membantu pemahaman secara ringkas dan padat. Grafik ini turut menjadi panduan dalam pembangunan sumber bahasa isyarat, sekali gus memastikan kebolehcapaian bagi pembelajar OKUpendengaran.

Bahasa isyarat seterusnya diintegrasikan dalam aktiviti pembelajaran inklusif yang membolehkan semua pelajar terlibat secara aktif. Selain itu, tema kosa kata digunakan untuk membangunkan sistem terjemahan yang tersusun, yang menyokong permainan bahasa serta latihan pepadanan bagi mengukuhkan kefahaman. Akhir sekali, aktiviti pembelajaran ini menjadi asas kepada pentaksiran pencapaian, di mana kuiz dan ujian digunakan untuk menilai tahap kefahaman dan pengaplikasian pelajar. Secara keseluruhannya, urutan ini memperlihatkan aliran pedagogi yang koheren bermula daripada pemerolehan kosa kata kepada representasi multimodal, penglibatan interaktif dan pentaksiran inklusif.

Berdasarkan dapatan di atas, model AsomAR ini dilihat dapat menangani dan memenuhi keperluan pendidikan pelajar OKU pendengaran dengan memperkenalkan sistem berstruktur, multimodal, dan inklusif yang menghubungkan kandungan linguistik, penyampaian multimedia, dan pentaksiran interaktif. Model ini memperluas kajian terdahulu mengenai pemerolehan kosa kata Bahasa Arab dan pedagogi berasaskan AR dengan menanamkan tadabbur al-Quran sebagai dimensi pedagogi utama, menjadikan AR bukan sekadar alat visualisasi tetapi medium eksplorasi spiritual dan linguistik (Al-Qaradawi, 1999; Al-Ghazali, 2000). Struktur tematik model, bermula dengan perkataan berkaitan manusia, diikuti haiwan dan fenomena alam, selaras dengan prinsip Nation (2012) dan Barcroft (2004), tetapi diintegrasikan dalam konteks al-Quran untuk menghubungkan makna leksikal dengan refleksi spiritual.

Dalam penyampaian multimedia, AsomAR menguatkan prinsip pembelajaran dual-saluran Mayer (2009) dan Moreno & Mayer (2007), di mana visual berkembang menjadi animasi, animasi dipermudahkan menjadi grafik, dan grafik menjadi perancah untuk bahasa isyarat. Berbanding model AR terdahulu (Bacca et al., 2014), aliran multimodal ini sistematik dan

berhierarki. Model ini juga menepati prinsip inklusif, dengan grafik dan aktiviti berasaskan bahasa isyarat menyokong penglibatan OKU pendengaran (Marschark & Hauser, 2011) serta sejajar dengan kerangka UDL (CAST, 2018).

Integrasi aktiviti pembelajaran interaktif dan pentaksiran menyokong pendekatan konstruktivis (Vygotsky, 1978), di mana pelajar membina pengetahuan secara aktif melalui pengalaman berkonsep. Berbanding kajian terdahulu yang menumpukan sama ada inovasi teknologi (Che Hashim et al., 2017) atau urutan linguistik (Nation, 2012), AsomAR menyintesis kedua-duanya ke dalam aliran pedagogi koheren. Struktur berasaskan ISM memberikan visualisasi jelas bagaimana komponen kosa kata, media, bahasa isyarat, dan pentaksiran saling berinteraksi secara hierarki dan kausal (Warfield, 1976; Sushil, 2012).

Kesimpulannya, AsomAR memperluas kajian AR, linguistik, dan pendidikan dengan menanamkan tadabbur al-Quran dan prinsip inklusiviti dalam kerangka pembelajaran berstruktur. Model ini menawarkan paradigma baharu yang menghubungkan bahasa, wahyu, dan teknologi, menghasilkan model tadabbur al-Quran yang diperkasa secara teknologi dan boleh diakses secara meluas oleh semua pelajar, termasuk OKU pendengaran.

Kesimpulan

Model AsomAR mencerminkan reka bentuk instruksional inklusif, multimodal, dan berasaskan spiritual dengan mengintegrasikan pedagogi al-Quran, pendidikan inklusif, dan pembelajaran AR. Integrasi elemen linguistik, kognitif, dan deria melalui teknologi bukan sahaja meningkatkan pemahaman dan pengekalan, malah mendemokrasikan akses kepada pembelajaran al-Quran bagi OKU pendengaran. Pembelajaran berbantuan AR meningkatkan penglibatan pelajar dan kefahaman, menyediakan panduan bernilai untuk pendidik, perancang kurikulum, dan pembuat dasar.

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PERANAN HUFFAZ DALAM PENYEBARAN DAKWAH DI INSTITUSI PENDIDIKAN

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Abstrak: Pendidikan tahfiz di Malaysia merupakan sebuah institusi pendidikan yang melahirkan para pelajar huffaz yang berjaya. Perkembangan pusat pengajian tahfiz juga telah menjadi satu isu yang sangat penting dalam konteks pendidikan agama di Negara ini. Ini berdasarkan peningkatan permintaan daripada pelbagai latar belakang masyarakat sama ada berlatar belakang daripada golongan kurang berkemampuan sehinggalah golongan professional yang ingin mempelajari Al-Qur'an dalam kehidupan mereka. Objektif kajian ini bertujuan untuk mengkaji peranan para pelajar tahfiz dalam penyebaran dakwah di institusi pendidikan. Kajian juga adalah untuk mengenalpasti peraturan para pelajar tahfiz yang memainkan peranan sebagai seorang huffaz dalam memberi pengaruh positif kepada para pelajar serta cabaran-cabaran yang dihadapi oleh mereka. Kajian ini menggunakan kaedah kualitatif iaitu dengan menemu bual dan pemerhatian terhadap para pelajar serta asatizah di pusat-pusat pengajian tahfiz swasta di Malaysia ini. Kajian ini diharap dapat memberikan maklumat tentang hala tuju para pelajar tahfiz selepas menamatkan pengajian di institusi-institusi tahfiz di Negara ini.

Kata kunci: Al-Qur'an, Huffaz, Pendidikan Tahfiz, Institusi Pendidikan

Pengenalan

Menghafal al-Quran merupakan amalan tradisi umat Islam sejak era Rasulullah SAW. Ia amat digalakkan dalam Islam dan penghafal al-Quran diberi ganjaran yang besar di sisi Allah SWT. Menghafal al-Quran yang menjadi budaya masyarakat Islam di Malaysia selari dengan era dakwah Islam di alam Melayu. Menghafal surah al-Fatihah menjadi kewajipan setiap Muslim sebagai keabsahan solat dengan diiringi hafalan surah pendek dalam menyempurnakan ibadat solat. Justeru, pengajian al-Quran dari aspek tajwid dan hafalan menjadi budaya dalam masyarakat Islam di Nusantara secara umumnya. Antara pengajaran dan pembelajaran yang disampaikan oleh tuan guru adalah Feqah, Tilawah, Tasawuf, Tafsir, Hadis, serta adab-adab dalam pergaulan seharian.

Setiap pendidikan yang berlangsung sama ada daripada guru al-Quran di kampung, golongan ulama dan pendakwah, serta tuan guru tidak terpisah daripada menghafaz sekurang-kurangnya surah al-Fatihah. Surah al-Fatihah diajar kepada masyarakat kerana surah ini sebagai asas dalam mengerjakan solat. Namun demikian, pendidikan tahfiz al-Quran bukan menjadi pendidikan teras, sebaliknya hanya sebahagian daripada intipati pelajaran. Lazimnya pendidikan tahfiz dijalankan secara individu dan tidak rasmi. Kaedah mengajar yang digunakan adalah berdasarkan pengalaman guru al-Quran.

Pengajian Al-Qur'an di Malaysia pula telah bermula sejak abad ke-15 lagi dengan penerapan pengajian asas dalam Islam antaranya mempelajari penulisan huruf Al-Qur'an seperti tulisan jawi, asas Rukun Iman dan Rukun Islam. Pendidikan asas Islam juga telah berkembang dari semasa ke semasa dengan berlakunya penghijrahan golongan para ulama dan pendakwah Islam dari Timur Tengah ke Alam Melayu. Seiring dengan perkembangan positif pendidikan Al-Quran, pusat pengajian Al-Qur'an semakin bertambah telah dan beroperasi di beberapa buah masjid, surau dan istana. Pengajian al-Quran secara tradisi juga terus berevolusi sehingga tertubuhnya institusi pondok di beberapa buah negeri terutamanya di bahagian Timur dan Utara semenanjung.

Objektif

Terdapat beberapa objektif kajian yang ingin dicapai dalam kajian ini iaitu:

1. Peranan sebagai seorang pelajar huffaz di institusi pengajian.
2. Cabaran sebagai seorang pelajar huffaz di institusi pengajian.
3. Persediaan oleh pelajar dalam kehidupan sebagai seorang huffaz.

Metodologi Kajian

Penulisan kajian ini berbentuk kajian kualitatif yang mana kajian ini menjadikan kaedah temu bual dan kaji selidik untuk mendapatkan data kajian. Seramai 11 orang informan yang merupakan para pelajar tahfiz di beberapa buah institusi pengajian dan sekolah di negara ini. Dapatan daripada kaji selidik dan temu bual tersebut dianalisis seterusnya dihuraikan dengan sokongan kajian-kajian yang dibuat oleh pengkaji.

Perkembangan Pengajian Tahfiz di Malaysia

Pengajian tafsir Al-Quran adalah salah satu perkara penting yang membawa kepada perkembangan pendidikan tahfiz al-Quran. Ini adalah berdasarkan kepada dapatan kajian menunjukkan bahawa bidang tafsir merupakan bidang pengajian al-Quran yang terawal berkembang di Tanah Melayu. Pengajian ini dikesan berbentuk lisan dan tidak bertulis sebelum kurun ke-16. Sejarah ini adalah berdasarkan kepada catatan yang menunjukkan bahawa ulama-ulama di Nusantara yang lahir selepas kedatangan Islam ke Kepulauan Melayu seawal abad ke-7 Masihi.

Berdasarkan perkembangan bidang tafsir yang semakin meluas di Negara ini, maka terdapat pengkaji menjelaskan bahawa pengajian tafsir Quran secara spesifik dimulakan pertama kali di Malaya pada akhir abad ke-17 dengan diajar di pondok-pondok pengajian. Sistem pendidikan baru ini berkembang pesat pada pertengahan abad ke-19, terutama di negeri-negeri Kelantan, Terengganu, Perak dan Kedah yang diajar daripada ulama'-ulama' tempatan.

Umat Islam saban hari telah menyedari akan keberkesanan, kebaikan dan martabat orang-orang yang menghafal Al-Quran. Perkara ini telah mendorong ibu bapa untuk menempatkan anak-anak mereka ke sekolah aliran tahfiz. Bagi mereka, sistem pengajian tahfiz yang memiliki dwi sistem iaitu sistem akademik dan sistem keagamaan atau hafalan Al-Quran adalah setanding dengan kehendak pasaran global.

Pendidikan Tahfiz Negara telah dilaksanakan dengan lebih sistematik, tersusun dan bersifat formal. Ini dapat dilihat dengan penubuhan beberapa buah institusi tahfiz di peringkat negeri seperti di Kelantan yang ditubuhkan pada tahun 1979, manakala di negeri Perak, Selangor, Terengganu, Perlis dan Kedah pada tahun 1980-an. Seterusnya di Negeri Sembilan, Melaka, Pahang dan Sabah dilaksanakan pada awal 1990-an, manakala Pulau Pinang dan Johor pada tahun 1996.

Kebanyakan institusi tahfiz di Negara ini bernaung di bawah kelolaan kerajaan mahupun swasta. Institusi tahfiz di bawah kelolaan kerajaan sama ada Kerajaan Persekutuan mahupun negeri, hanya membuat pengambilan pelajar di peringkat tinggi terutamanya pelajar lepasan Sijil Persekolahan Malaysia (SPM) dan mempunyai pencapaian akademik yang cemerlang. Ini adalah kerana pihak kerajaan mempunyai sumber kewangan yang terhad dalam menawarkan biasiswa kepada para pelajar yang ingin menyambung pengajian sebagai para huffaz kelak.

Dapatan Kajian

Berdasarkan data kajian yang dijalankan terhadap 11 orang pelajar tahfiz di seluruh Negara sama ada Maahad tahfiz swasta mahupun di bawah kelolaan kerajaan Negeri dengan kajian berdasarkan kepada para pelajar yang masih berada dalam pengajian di institusi masing-masing. Terdapat beberapa tema yang diperolehi berdasarkan persoalan kajian. Berdasarkan hasil soal selidik yang dijalankan, sebanyak 54.5 peratus maklum balas daripada pelajar lelaki dan 45.5 peratus daripada pelajar perempuan. Berdasarkan purata daripada jumlah tersebut, sebanyak 36.4 peratus adalah daripada kalangan pelajar yang menghafal 30 juzuk penuh Al-Qur'an.

Antara soal selidik yang dijalankan adalah seperti berikut:

i. Peranan sebagai seorang pelajar huffaz di institusi pengajian.

Soal selidik yang dijalankan adalah dengan membuat kajian bilangan para pelajar yang berperanan sebagai seorang pelajar huffaz di institusi pengajian masing-masing sama ada di sekolah, kolej mahupun universiti.

Jadual 1

Peranan sebagai seorang pelajar huffaz	Peratus
Menyemak bacaan Al-Qur'an para pelajar	18.2%
Menjadi rujukan persoalan agama oleh para pelajar	9.1%
Berdakwah dengan para pelajar (bimbingan dan nasihat) di sekolah atau kampus	45.5%
Menjadi imam solat fardhu dan sunat di surau sekolah atau kampus	27.3%

Berdasarkan dapatan kajian di atas, ini menunjukkan bahawa sebanyak 45.5 peratus pelajar telah menggunakan kepakaran dan hafazan mereka dalam berdakwah dan memberi nasihat serta bimbingan kepada para pelajar di tempat mereka belajar. Sebanyak 27.3 peratus pelajar yang menggunakan kepakaran huffaz mereka sebagai imam bagi solat fardhu di surau-surau dan pusat Islam di tempat mereka belajar, manakala sebanyak 18.2 peratus pelajar huffaz menggunakan peluang sebagai penghafal Al-Qur'an dengan menyemak bacaan Al-Qur'an setiap para pelajar yang berkemahuan bacaan mereka disemak rata-rata dalam kalangan para pelajar yang telah menghafal Al-Qur'an di institusi-institusi pendidikan masing-masing. Para pelajar huffaz juga menjadi rujukan persoalan berkaitan agama oleh para pelajar sebanyak 9.1 peratus. Ini menunjukkan bahawa para pelajar huffaz memainkan peranan yang sangat penting dalam memberi khidmat dan nasihat kepada masyarakat terutamanya para pelajar.

ii. Cabaran sebagai seorang pelajar huffaz di institusi pengajian.

Kajian soal selidik juga dilakukan terhadap para pelajar tahfiz dengan menyelidik isu cabaran yang dihadapi oleh para pelajar huffaz semasa mengikuti pengajian di institusi masing-masing. Ini berdasarkan kajian yang telah dibuat kepada informan yang terpilih serta temu duga yang dilakukan.

Jadual 2

Cabaran sebagai seorang pelajar huffaz di institusi pengajian	Peratus
Kesuntukan masa yang terhad	9.1%
Menjaga akhlak diri yang sentiasa menjadi ikutan para pelajar lain	18.3%
Memelihara ayat hafazan dengan sentiasa muroja'ah	54.5%
Penggunaan gajet dan media sosial	18.2%

Berdasarkan hasil kajian yang dibuat, peratusan pelajar dalam memelihara ayat hafazan Al-Qur'an dengan bermuroja'ah paling tinggi berbanding yang lain iaitu sebanyak 54.5 peratus. Ini menunjukkan bahawa mengekalkan hafazan yang telah dihafaz oleh para pelajar huffaz merupakan cabaran utama apabila bergelar sebagai pelajar mahupun murid. Tambahan pula, terdapat pelbagai subjek yang perlu dipelajari di samping menghafaz Al-Qur'an.

iii. Persediaan oleh pelajar huffaz dalam kehidupan seharian.

Jadual 3

Persediaan oleh pelajar huffaz dalam kehidupan seharian	Peratus
Persediaan ilmu pengetahuan	27.2%
Persediaan mengulang hafazan bacaan Al-Qur'an	36.4%
Persediaan emosi dan mental	36.4%
Persediaan fizikal dan jasmani	0%

Para pelajar huffaz juga telah bersedia dalam kehidupan mereka bagi menghadapi kehidupan yang mencabar apatah lagi dalam mengekalkan bacaan hafazan mereka sentiasa terpelihara. Kajian menunjukkan bahawa sebanyak 26.4 peratus yang memilih untuk bersedia bagi mengulang hafazan bacaan Al-Qur'an mereka dalam kehidupan seharian. Ini adalah satu proses rutin harian mereka bagi memastikan bacaan mereka ini sentiasa berada dalam ingatan. Pelajar juga memilih persediaan dari segi emosi dan mental dengan peratus yang sama seperti persediaan mengulang hafazan iaitu sebanyak 36.4 peratus. Manakala, sebanyak 27.2 peratus pelajar huffaz yang bersedia dari segi ilmu pengetahuan.

Kesimpulan

Berdasarkan kajian yang telah dibuat, hasil dapatan kajian menunjukkan bahawa kebanyakan para pelajar huffaz berperanan sebagai medium ber dakwah kepada para pelajar di sekolah mahupun di university. Ini dapat dijadikan panduan kepada para pelajar untuk bertanya berkenaan segala persoalan agama. Walaubagaimanapun, kebanyakan para pelajar huffaz mempunyai cabaran yang tinggi rata-rata cabarannya adalah hendak mengekalkan tahap hafazan masing-masing. Para pelajar huffaz juga sentiasa bersedia dalam kehidupan mereka dengan sentiasa muroja'ah hafazan masing-masing setiap hari serta perlu kepada persediaan mental dan emosi. Ini kerana, hafazan Al-Qur'an memerlukan kepada hafazan dari segi mental, apatah lagi cabaran untuk mengekalkan hafazan mereka yang sangat tinggi.

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POTENSI PENGGUNAAN BAHAN KITAR SEMULA (KACA) UNTUK INKUBASI ARUHAN TELUR IKAN TILAPIA *THE POTENTIAL USE OF RECYCLE MATERIALS (GLASS) FOR ARTIFICIAL INCUBATION OF TILAPIA EGGS*

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Abstract: Peningkatan permintaan terhadap benih *Oreochromis niloticus* telah mendorong penggunaan sistem inkubator aruhan secara meluas dalam industri akuakultur. Walaupun botol plastik sering digunakan sebagai inkubator kos rendah oleh penternak berskala kecil, penggunaannya menyumbang kepada peningkatan sisa plastik dan pencemaran alam sekitar. Oleh itu, kajian ini dijalankan bagi menilai keberkesanan botol kaca kitar semula sebagai alternatif kepada botol plastik dalam proses inkubasi aruhan telur ikan tilapia serta membandingkan prestasi kedua-dua bahan tersebut. Reka bentuk eksperimen perbandingan digunakan dengan tiga replikasi bagi setiap jenis inkubator (botol kaca dan botol plastik). Parameter utama yang dianalisis termasuk suhu, oksigen terlarut (DO), pH, ammonia, jumlah telur menetas dan kadar penetasan (%). Hasil kajian menunjukkan bahawa inkubator botol kaca mencatatkan kadar penetasan yang secara konsisten lebih tinggi berbanding botol plastik. Selain itu, parameter kualiti air dalam botol kaca didapati lebih stabil, khususnya dari segi kawalan suhu dan kandungan ammonia yang lebih rendah, sekali gus menyumbang kepada perkembangan embrio yang lebih baik. Secara keseluruhan, botol kaca kitar semula mempunyai potensi tinggi sebagai alternatif yang efektif dan lestari dalam inkubasi aruhan telur tilapia. Penggunaannya bukan sahaja memberikan prestasi penetasan yang setara atau lebih baik, malah menyokong usaha pengurangan penggunaan plastik dalam operasi akuakultur berskala kecil. Kajian lanjutan dengan skala yang lebih besar dan tempoh pemerhatian yang lebih panjang dicadangkan bagi mengukuhkan dapatan ini.

Keywords: Inkubator Aruhan, Botol Kaca, Botol Plastik, Telur Tilapia, Kadar Penetasan, Akuakultur Lestari

Pendahuluan

Industri akuakultur global kini beralih ke arah intensifikasi bagi memenuhi permintaan protein dunia. Ikan Tilapia merupakan spesies kedua paling banyak ditanam kerana ketahananannya. Walau bagaimanapun, dalam sistem ternakan intensif, pengeraman semula jadi oleh induk betina (*mouthbrooding*) sering kali menyebabkan kehilangan telur yang tinggi dan mengurangkan kitaran bertelur induk. Oleh itu, pengeraman aruhan atau buatan menjadi pilihan utama.

Masalah utama yang dihadapi oleh penternak skala kecil adalah kos peralatan komersial yang tinggi, menyebabkan penggunaan botol plastik kitar semula menjadi sangat popular. Namun, penggunaan plastik secara berlebihan menyumbang kepada pencemaran mikroplastik dan

degradasi kualiti air dalam jangka masa panjang. Kajian ini memperkenalkan penggunaan botol kaca kitar semula sebagai inovasi hijau yang mampu menawarkan kestabilan termal yang lebih baik dan mengurangkan impak alam sekitar.

Kajian Literatur

Proses inkubasi aruhan telur membolehkan kawalan parameter persekitaran yang lebih tepat. Menurut kajian terdahulu, faktor utama yang mempengaruhi penetasan telur tilapia adalah kualiti air dan pergerakan air yang stabil untuk membekalkan oksigen terlarut (DO) yang mencukupi. Botol plastik sering digunakan kerana mudah diubah suai, namun sifat termoplastiknya menyebabkan suhu air di dalamnya lebih mudah dipengaruhi oleh suhu persekitaran luaran. Sebaliknya, kaca mempunyai kapasiti haba yang berbeza dan lebih lengai (*inert*) secara kimia, menjadikannya bahan yang lebih selamat untuk perkembangan embrio yang sensitif.

Metodologi Kajian

Kajian ini dijalankan bagi menilai keberkesanan penggunaan botol kaca sebagai inkubator aruhan telur ikan tilapia (*Oreochromis niloticus*) serta membuat perbandingan dengan inkubator yang menggunakan botol plastik. Kajian dilaksanakan menggunakan reka bentuk eksperimen perbandingan bagi menilai kadar penetasan telur dan parameter kualiti air.

Kajian ini menggunakan dua jenis inkubator iaitu botol kaca dan botol plastik yang dibina berasaskan konsep inkubator *McDonald jar*. Sebanyak tiga replikasi bagi setiap jenis inkubator digunakan bagi memastikan kebolehpercayaan data kajian. Sistem inkubator dilengkapi dengan pam air, sistem pengudaraan serta penapis bagi memastikan aliran air dan bekalan oksigen mencukupi sepanjang tempoh pengeraman telur.

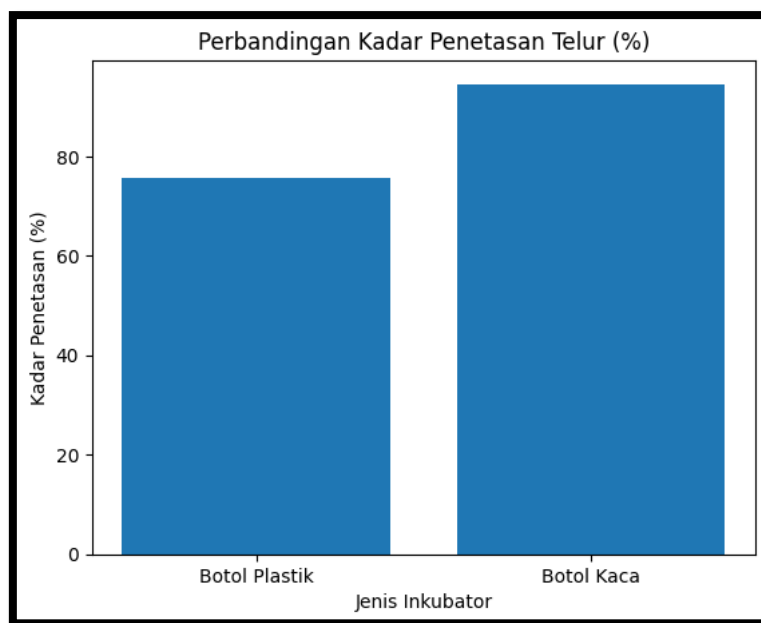
Antara bahan dan peralatan yang digunakan dalam kajian ini termasuk botol kaca berkapasiti 640 ml, botol plastik berkapasiti 600 ml, pam air, sistem aerasi, paip PVC, jaring penapis serta beberapa peralatan sokongan lain bagi membina sistem inkubator aruhan telur ikan. Induk ikan tilapia betina yang membawa telur digunakan sebagai sumber telur bagi kajian ini.

Induk ikan tilapia betina yang membawa telur ditangkap dan telur dikeluarkan secara berhati-hati daripada mulut induk tersebut. Telur yang diperolehi kemudian dimasukkan ke dalam inkubator aruhan yang telah disediakan. Telur dibahagikan kepada dua kumpulan (Kaca vs Plastik) dengan kepadatan 100 biji setiap botol. Proses pengeraman telur dijalankan di dalam kedua-dua jenis inkubator iaitu botol kaca dan botol plastik sehingga proses penetasan berlaku. Pemerhatian dijalankan setiap hari bagi merekod perkembangan telur dan kadar penetasan.

Data yang dikumpulkan dalam kajian ini melibatkan kadar penetasan telur serta parameter kualiti air seperti suhu, oksigen terlarut, pH dan ammonia. Data dianalisis secara perbandingan bagi menentukan keberkesanan penggunaan botol kaca sebagai inkubator aruhan telur tilapia berbanding botol plastik. Data diukur setiap hari. Kadar penetasan dikira selepas 3-5 hari menggunakan formula: $(\text{Bilangan larva menetas} / \text{Jumlah telur awal}) \times 100\%$.

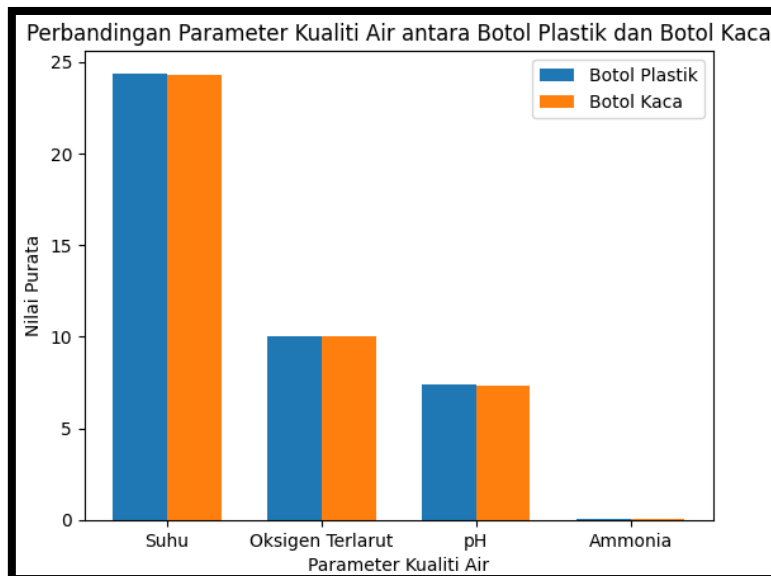
Keputusan dan Perbincangan

Hasil kajian menunjukkan bahawa penggunaan botol kaca sebagai inkubator aruhan telur ikan tilapia memberikan kadar penetasan yang lebih tinggi berbanding botol plastik. Berdasarkan tiga replikasi eksperimen yang dijalankan, kadar penetasan telur dalam botol kaca secara konsisten mencatatkan nilai yang lebih tinggi berbanding botol plastik. Dalam beberapa replikasi, kadar penetasan telur dalam botol kaca mencapai lebih daripada 90%, manakala botol plastik menunjukkan kadar penetasan yang lebih rendah.

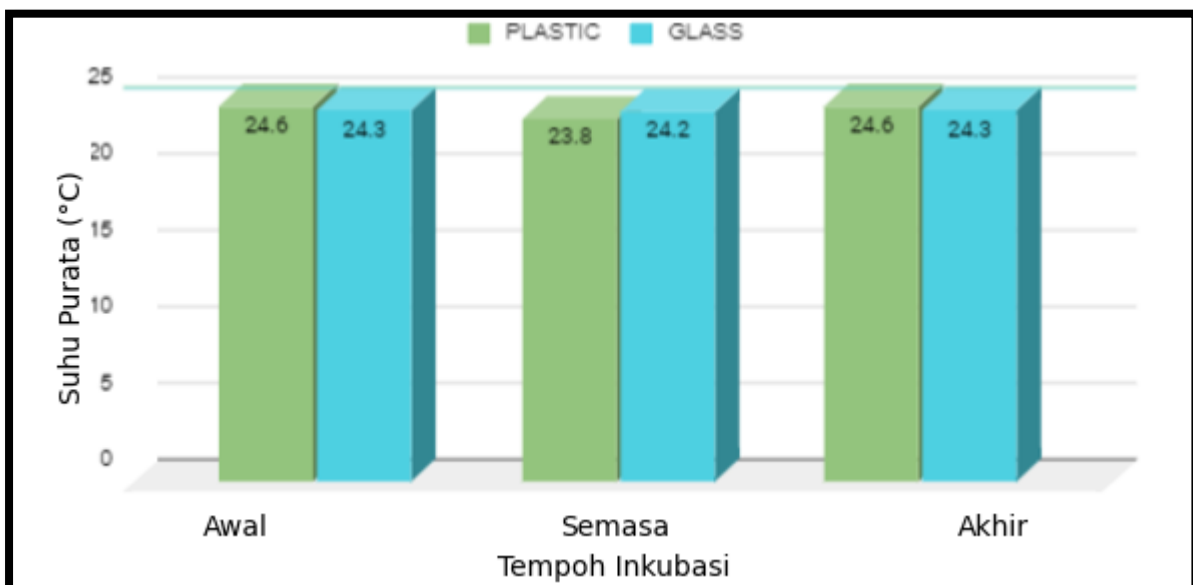


Rajah 1: Perbandingan Kadar Penetasan Telur (%) antara Botol Plastik dan Botol

Selain itu, parameter kualiti air seperti suhu, oksigen terlarut (DO), pH dan ammonia turut direkodkan sepanjang tempoh pengeraman telur. Hasil pemerhatian menunjukkan bahawa nilai parameter kualiti air bagi kedua-dua jenis inkubator berada dalam julat yang sesuai untuk proses penetasan telur ikan tilapia. Walau bagaimanapun, inkubator botol kaca menunjukkan kestabilan parameter air yang sedikit lebih baik berbanding inkubator botol plastik.



Rajah 2: Perbandingan Purata Parameter Kualiti Air antara Botol Plastik dan Botol Kaca



Rajah 3: Perbandingan Purata Parameter Kualiti Air antara Botol Plastik dan Botol Kaca

Berdasarkan graf Rajah 3 tersebut, suhu purata yang direkodkan bagi kedua-dua jenis inkubator berada dalam julat yang hampir sama sepanjang tempoh inkubasi. Pada peringkat awal, suhu bagi botol plastik adalah sebanyak 24.6°C, manakala botol kaca mencatatkan suhu 24.3°C.

Semasa tempoh inkubasi berlangsung, suhu bagi botol plastik menurun kepada 23.8°C, manakala suhu bagi botol kaca meningkat kepada 24.2°C. Pada peringkat akhir inkubasi, suhu

bagi botol plastik kembali meningkat kepada 24.6°C , manakala botol kaca menunjukkan suhu 24.3°C .

Secara keseluruhannya, perbezaan suhu antara botol plastik dan botol kaca adalah sangat kecil iaitu sekitar 0.3°C hingga 0.4°C sahaja. Keadaan ini menunjukkan bahawa kedua-dua bahan inkubator mampu mengekalkan suhu air yang stabil sepanjang tempoh inkubasi. Walau bagaimanapun, kestabilan suhu yang hampir sama ini turut menunjukkan bahawa botol kaca berpotensi digunakan sebagai alternatif kepada botol plastik dalam sistem inkubasi aruhan telur ikan tilapia, kerana ia mampu menyediakan persekitaran suhu yang sesuai untuk perkembangan embrio telur.

Kesimpulan

Perbezaan kadar penetasan telur antara botol kaca dan botol plastik dipercayai dipengaruhi oleh keupayaan bahan inkubator dalam mengekalkan kestabilan suhu dan keadaan persekitaran air. Botol kaca mempunyai sifat fizikal yang lebih stabil serta kurang dipengaruhi oleh perubahan suhu persekitaran berbanding botol plastik. Keadaan ini membantu mengekalkan persekitaran yang lebih sesuai untuk perkembangan embrio ikan tilapia sepanjang tempoh inkubasi.

Di samping itu, kestabilan parameter kualiti air seperti suhu dan oksigen terlarut juga memainkan peranan penting dalam meningkatkan kadar penetasan telur. Parameter kualiti air yang stabil dapat mengurangkan tekanan terhadap embrio dan meningkatkan kebarangkalian telur untuk menetas dengan sempurna. Oleh itu, penggunaan botol kaca sebagai inkubator aruhan berpotensi menjadi alternatif yang sesuai kepada botol plastik dalam sistem inkubasi telur tilapia.

Secara keseluruhannya, hasil kajian menunjukkan bahawa botol kaca mempunyai potensi untuk digunakan sebagai bahan alternatif dalam pembinaan inkubator aruhan telur ikan tilapia. Selain memberikan kadar penetasan yang lebih baik, penggunaan botol kaca juga dapat mengurangkan kebergantungan terhadap penggunaan botol plastik sekali gus menyokong usaha pengurangan sisa plastik dalam industri akuakultur.

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Pernyataan Konflik Kepentingan

Penulis mengisytiharkan bahawa tiada konflik kepentingan mengenai penerbitan kajian ini.

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PENERIMAAN PELAJAR INSTITUSI PENGAJIAN TINGGI DI LEMBAH KLANG TERHADAP PENDEKATAN PELUPUSAN MUSHAF AL-QURAN BERASASKAN KEPATUHAN SYARIAH DAN TEKNOLOGI HIJAU

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Abstrak: *Kajian ini meneliti penerimaan pelajar daripada institusi pengajian tinggi terpilih di Lembah Klang terhadap pendekatan pelupusan mushaf al-Quran yang berasaskan kepatuhan Syariah dan teknologi hijau. Kajian ini dijalankan kerana perbincangan tentang pelupusan mushaf lazimnya tertumpu pada aspek fiqh dan prosedur, sedangkan bukti empirikal tentang penerimaan pengguna muda terhadap pendekatan yang menggabungkan tuntutan Syariah dan kelestarian masih terhad. Berasaskan kerangka umum Technology Acceptance Model (TAM), kajian ini meneliti pengaruh kepatuhan Syariah dan teknologi hijau terhadap penerimaan pelajar. Kajian ini menggunakan pendekatan kuantitatif dengan reka bentuk tinjauan keratan rentas. Seramai 165 orang pelajar dipilih melalui persampelan bukan kebarangkalian secara mudah. Data dikumpulkan menggunakan soal selidik berstruktur yang merangkumi tiga konstruk utama, iaitu kepatuhan Syariah, teknologi hijau, dan penerimaan pelajar. Instrumen kajian menunjukkan tahap kebolehppercayaan yang sangat tinggi dengan nilai Cronbach's alpha antara 0.934 hingga 0.966. Data dianalisis menggunakan SPSS melalui analisis deskriptif, Korelasi Pearson, dan regresi linear berganda. Dapatan menunjukkan bahawa semua konstruk berada pada tahap tinggi, dengan kepatuhan Syariah mencatatkan min tertinggi ($M = 4.67$, $SD = 0.53$), diikuti teknologi hijau ($M = 4.49$, $SD = 0.63$) dan penerimaan pelajar ($M = 4.33$, $SD = 0.72$). Analisis regresi menunjukkan bahawa model kajian adalah signifikan, $F(2, 162) = 72.061$, $p < .001$, dan menerangkan 47.1% varians dalam penerimaan pelajar ($R^2 = .471$). Namun, hanya teknologi hijau didapati mempunyai pengaruh yang signifikan terhadap penerimaan pelajar, manakala kepatuhan Syariah tidak menunjukkan pengaruh yang signifikan. Dapatan ini menunjukkan bahawa kepatuhan Syariah berfungsi sebagai asas legitimasi, manakala teknologi hijau menjadi faktor yang lebih dominan dalam membentuk penerimaan pelajar. Kajian ini menyumbang kepada pengukuhan perbincangan tentang penerimaan inovasi berteraskan nilai agama serta memberi implikasi praktikal kepada pembangunan garis panduan pelupusan mushaf yang patuh Syariah dan lestari.*

Kata kunci: *pelupusan mushaf al-Quran, kepatuhan Syariah, teknologi hijau, penerimaan pelajar*

Pengenalan

Mushaf al-Quran mempunyai kedudukan yang istimewa dalam kehidupan umat Islam kerana mengandungi wahyu Ilahi yang menjadi sumber utama ajaran Islam. Oleh itu, mushaf perlu dipelihara dengan penuh penghormatan termasuk apabila rosak atau tidak lagi sesuai digunakan. Dalam keadaan sedemikian, mushaf tidak boleh dilupuskan seperti bahan bercetak biasa kerana mengandungi ayat al-Quran yang mempunyai nilai sakral. Majid et al. (2022) menjelaskan bahawa mushaf yang rosak perlu dilupuskan melalui kaedah yang menjaga kehormatan ayat al-Quran, seperti pembakaran secara terkawal atau pemusnahan tulisan sehingga ayat tidak lagi dapat dibaca. Dalam konteks semasa, penggunaan mushaf al-Quran dan bahan bercetak yang mengandungi ayat al-Quran dalam institusi pendidikan semakin meluas. Di institusi pengajian tinggi (IPT), bahan tersebut digunakan dalam pengajaran dan pembelajaran, program kerohanian, serta pelbagai aktiviti keagamaan pelajar. Keadaan ini secara tidak langsung meningkatkan jumlah bahan yang rosak atau tidak lagi digunakan, sekali gus mewujudkan keperluan kepada pendekatan pengurusan yang lebih teratur dan beretika.

Pada masa yang sama, wacana pengurusan sisa turut berkembang ke arah pendekatan yang lebih mampan. Kajian menunjukkan bahawa institusi pengajian tinggi merupakan antara penyumbang kepada penghasilan sisa pepejal yang memerlukan strategi pengurusan yang sistematik (Budihardjo et al., 2021), manakala universiti di pelbagai negara semakin memberi perhatian kepada amalan kampus lestari dan pengurusan sisa yang lebih berkesan (Rodríguez-Guerreiro et al., 2024). Perkembangan ini membuka ruang untuk menilai potensi teknologi hijau dalam pelupusan mushaf al-Quran, dengan syarat pendekatan tersebut tetap memelihara kehormatan teks suci dan selaras dengan prinsip Syariah.

Pernyataan Masalah

Pelupusan mushaf al-Quran menuntut pendekatan yang bukan sahaja memelihara kesucian kalam Allah, tetapi juga memastikan setiap proses pelupusan dilaksanakan secara terhormat dan terkawal. Mushaf yang rosak atau tidak lagi sesuai digunakan tidak boleh dilupuskan seperti bahan bercetak biasa kerana mengandungi ayat al-Quran yang mempunyai nilai sakral. Oleh itu, kaedah pelupusan yang digunakan perlu memastikan teks suci tersebut tidak lagi dapat dibaca serta terhindar daripada sebarang bentuk penghinaan atau penyalahgunaan. Dalam amalan fiqh dan konteks semasa di Malaysia, kaedah seperti pembakaran terkawal, penanaman, dan pendekatan pelupusan terkawal dibincangkan sebagai antara kaedah yang dapat memenuhi tuntutan tersebut (Majid et al., 2022; Abd Hadi et al., 2024).

Dalam konteks institusi pengajian tinggi, isu ini menjadi semakin penting apabila penggunaan mushaf dan bahan bercetak berasaskan ayat al-Quran semakin meluas dalam aktiviti akademik dan kerohanian. Keadaan ini meningkatkan keperluan kepada sistem pengurusan pelupusan yang lebih teratur, khususnya apabila institusi pendidikan pada masa yang sama turut digerakkan oleh agenda kampus mampan dan amalan pengurusan sisa yang lebih lestari (Budihardjo et al., 2021; Rodríguez-Guerreiro et al., 2024). Oleh itu, timbul keperluan untuk menilai sama ada pendekatan berasaskan teknologi hijau dapat diaplikasikan dalam pelupusan mushaf tanpa menjejaskan tuntutan kepatuhan Syariah.

Selain aspek hukum dan kelestarian, keberkesanan sesuatu pendekatan juga bergantung pada tahap penerimaan pengguna. Technology Acceptance Model (TAM) menjelaskan bahawa penerimaan terhadap sesuatu inovasi dipengaruhi oleh persepsi pengguna terhadap kegunaan dan kesesuaian teknologi tersebut (Davis, 1989). Dalam konteks pelupusan mushaf al-Quran, penerimaan pengguna bukan hanya ditentukan oleh kecekapan teknikal, tetapi juga oleh keyakinan bahawa pendekatan yang digunakan tetap memelihara kehormatan mushaf dan selaras dengan nilai agama.

Walaupun kajian berkaitan pelupusan mushaf al-Quran, pengurusan sisa, dan penerimaan teknologi telah dibincangkan dalam pelbagai konteks, masih terdapat jurang kajian yang jelas dalam literatur semasa. Kebanyakan kajian terdahulu lebih menumpukan aspek hukum, prosedur pelupusan, atau pengurusan sisa secara umum. Sebaliknya, kajian empirikal yang meneliti penerimaan pengguna terhadap pendekatan pelupusan mushaf al-Quran yang mengintegrasikan kepatuhan Syariah dan teknologi hijau masih terhad. Lebih khusus, penelitian yang memfokuskan pelajar institusi pengajian tinggi sebagai kumpulan pengguna yang strategik juga masih kurang diberi perhatian. Kekurangan ini menyebabkan masih terbatasnya bukti empirikal untuk menjelaskan sejauh mana pendekatan pelupusan mushaf yang patuh Syariah dan berteraskan teknologi hijau dapat diterima dalam konteks institusi pengajian tinggi. Sehubungan itu, kajian ini dijalankan untuk meneliti tahap kepatuhan Syariah, penerimaan terhadap teknologi hijau, serta pengaruh kedua-dua faktor tersebut terhadap penerimaan pelajar institusi pengajian tinggi di Lembah Klang terhadap pendekatan pelupusan mushaf al-Quran.

Objektif Kajian

Kajian ini dijalankan bagi meneliti penerimaan pelajar institusi pengajian tinggi terpilih terhadap pendekatan pelupusan mushaf al-Quran yang berasaskan kepatuhan Syariah dan teknologi hijau. Objektif kajian ini adalah untuk:

- i. mengenal pasti tahap kepatuhan Syariah dalam pelupusan mushaf al-Quran dalam kalangan pelajar institusi pengajian tinggi di Lembah Klang.
- ii. menentukan tahap penerimaan pelajar institusi pengajian tinggi terhadap teknologi hijau dalam pelupusan mushaf al-Quran.
- iii. menganalisis pengaruh kepatuhan Syariah dan teknologi hijau terhadap penerimaan pelajar institusi pengajian tinggi berhubung pendekatan pelupusan mushaf al-Quran.

Persoalan Kajian

Berdasarkan objektif kajian yang telah dinyatakan, kajian ini bertujuan menjawab persoalan berikut:

- i. apakah tahap kepatuhan Syariah dalam pelupusan mushaf al-Quran dalam kalangan pelajar institusi pengajian tinggi di Lembah Klang?
- ii. apakah tahap penerimaan pelajar institusi pengajian tinggi terhadap teknologi hijau dalam pelupusan mushaf al-Quran?

- iii. apakah pengaruh kepatuhan Syariah dan teknologi hijau terhadap penerimaan pelajar berhubung pendekatan pelupusan mushaf al-Quran?

Kepentingan Kajian

Kajian ini signifikan dari sudut teori dan praktikal. Dari sudut teori, kajian ini menyumbang kepada pengembangan perbincangan tentang penerimaan inovasi dalam konteks Islam dengan menunjukkan bahawa penerimaan terhadap pendekatan pelupusan mushaf al-Quran tidak hanya dipengaruhi oleh pertimbangan utiliti, tetapi turut dibentuk oleh legitimasi agama dan keserasian nilai. Dalam hal ini, penggunaan kerangka Technology Acceptance Model (TAM) dalam konteks yang sensitif dari sudut agama membantu menjelaskan bahawa penerimaan teknologi berteraskan Syariah perlu difahami secara lebih kontekstual dan tidak boleh ditafsir hanya berdasarkan kecekapan teknikal semata-mata.

Dari sudut praktikal, dapatan kajian ini menyediakan bukti empirikal yang boleh dimanfaatkan oleh institusi pendidikan, pihak berkuasa agama, dan agensi berkaitan dalam merangka garis panduan, prosedur operasi, dan program kesedaran berhubung pelupusan mushaf al-Quran yang lebih sistematik, patuh Syariah, dan lestari. Dapatan kajian juga menunjukkan bahawa pembangunan pendekatan pelupusan mushaf al-Quran perlu menekankan bukan sahaja aspek pematuhan hukum, tetapi juga ciri pelaksanaan yang praktikal, bersih, teratur, dan sesuai dengan agenda kelestarian semasa.

Tinjauan Literatur

Kepatuhan Syariah dalam Pelupusan Mushaf al-Quran

Pelupusan mushaf al-Quran berkait secara langsung dengan tuntutan Syariah untuk memelihara kesucian dan kehormatan kalam Allah. Dalam tradisi fiqh Islam, kaedah seperti penanaman, pembakaran terkawal, dan pelarutan atau pencucian diterima kerana bertujuan memastikan tulisan ayat al-Quran tidak lagi dapat dibaca serta terhindar daripada unsur penghinaan atau penyalahgunaan (Abd Hadi et al., 2024; Roslan & Mohamad, 2022). Oleh itu, pelupusan mushaf tidak boleh difahami semata-mata sebagai proses pengurusan bahan, tetapi sebagai amalan yang menuntut pematuhan terhadap adab, hukum, dan tanggungjawab keagamaan.

Dalam konteks Malaysia, Abd Hadi et al. (2024) menunjukkan bahawa pembakaran terkawal diiktiraf sebagai kaedah utama berdasarkan panduan JAKIM dan fatwa negeri, manakala Roslan dan Mohamad (2022) mengemukakan penyahtintaan sebagai alternatif yang lebih mesra alam dengan syarat proses tersebut tetap memenuhi kehendak Syariah. Hal ini memperlihatkan bahawa kepatuhan Syariah dalam pelupusan mushaf bukan bersifat statik. Sebaliknya, ia berkembang selaras dengan keperluan semasa tanpa mengabaikan prinsip asas penghormatan terhadap teks suci. Sehubungan itu, Maqasid al-Shariah menjadi kerangka yang relevan untuk menilai kesesuaian sesuatu kaedah kerana selain menekankan pemeliharaan agama (hifz al-din), kerangka ini turut mengambil kira pemeliharaan alam sekitar dan kesejahteraan manusia sebagai sebahagian daripada tanggungjawab khalifah (Majid et al., 2022; Shompa & Mohadis, 2022; Tanveer et al., 2022).

Teknologi Hijau dalam Pengurusan Pelupusan Mushaf

Perkembangan wacana kelestarian telah mendorong penerokaan teknologi hijau dalam pelbagai bidang pengurusan sisa, termasuk bahan bercetak dan pelupusan yang lebih mesra alam. Secara umum, inovasi hijau dan pendekatan mampan dilihat berupaya mengurangkan impak negatif terhadap ekosistem melalui sistem pengurusan sisa yang lebih cekap, terkawal, dan berdaya lestari (Muhammad et al., 2023; Rodríguez-Guerreiro et al., 2024). Dalam konteks institusi pengajian tinggi, kecenderungan terhadap amalan pengurusan sisa yang lebih sistematik semakin diberi perhatian sebagai sebahagian daripada agenda kampus lestari.

Walau bagaimanapun, penerapan teknologi hijau dalam pelupusan mushaf al-Quran memerlukan penelitian yang lebih teliti berbanding pengurusan sisa biasa. Hal ini kerana sebarang pendekatan yang digunakan bukan sahaja perlu berkesan dari sudut operasi, tetapi juga mesti menjamin bahawa teks al-Quran dihapuskan dengan cara yang tidak membawa kepada penghinaan, penyalahgunaan, atau pencemaran terhadap kehormatan mushaf (Majid et al., 2022; Abd Hadi et al., 2024). Literatur semasa menunjukkan bahawa beberapa pendekatan yang lebih sistematik mula dibincangkan, termasuk pembakaran terkawal, penanaman, pelarutan, nyahdakwat (de-inking), dan kitar semula terkawal. Kaedah-kaedah ini berpotensi menyumbang kepada pengurangan sisa pepejal dan menyokong agenda kelestarian, namun pelaksanaannya mesti tertakluk kepada syarat yang ketat, khususnya dari segi pematuhan Syariah dan jaminan bahawa teks al-Quran dihapuskan secara sempurna (Abd Hadi et al., 2024; Mohd Zamri et al., 2024; Mohamad Mobin et al., 2025). Sehubungan itu, keberkesanan teknologi hijau dalam konteks ini perlu dinilai secara seimbang antara pemeliharaan kesucian mushaf dan pengurangan kesan terhadap alam sekitar. Pendekatan hibrid yang menggabungkan inovasi teknologi hijau dengan pertimbangan fiqh tradisional dilihat lebih praktikal dan kontekstual, khususnya apabila pelaksanaannya disokong oleh garis panduan yang jelas serta autoriti yang berwibawa (Majid et al., 2022; Mohamad Mobin et al., 2025).

Kerangka Teori Penerimaan Pengguna terhadap Model Hibrid Pelupusan Mushaf

Keberkesanan sesuatu model pelupusan tidak hanya bergantung pada kesahihan Syariah atau kecekapan teknikal, tetapi juga pada tahap penerimaan pengguna terhadap model tersebut. Dalam konteks kajian ini, pelajar institusi pengajian tinggi merupakan kumpulan yang signifikan kerana mereka mempunyai pendedahan yang lebih tinggi terhadap teknologi dan berpotensi menjadi pemangkin kepada amalan pengurusan lestari. Berdasarkan Model Penerimaan Teknologi, penerimaan terhadap sesuatu inovasi lazimnya dipengaruhi oleh tanggapan terhadap kegunaan dan kesesuaian inovasi tersebut dengan keperluan pengguna (Abubakari et al., 2023; Davis, 1989). Bagi pengguna Muslim, faktor keserasian dengan nilai agama mempunyai kedudukan yang lebih kritikal. Kajian lepas menunjukkan bahawa perspektif agama terhadap penggunaan teknologi memberi kesan yang signifikan terhadap niat tingkah laku pengguna, malah dalam keadaan tertentu boleh mengatasi pertimbangan teknikal semata-mata (Abubakari et al., 2023; Sobirin & Khasanah, 2023).

Oleh itu, model hibrid pelupusan mushaf hanya berpotensi diterima apabila pengguna yakin bahawa teknologi yang digunakan tidak menjejaskan kehormatan ayat-ayat suci al-Quran dan beroperasi dalam batas hukum syarak. Justeru, integrasi nilai-nilai Islam secara eksplisit dalam

reka bentuk dan pelaksanaan teknologi hijau menjadi prasyarat penting bagi membentuk keyakinan, legitimasi, dan kesediaan pengguna untuk menerima inovasi tersebut (Shompa & Mohadis, 2022; Sobirin & Khasanah, 2023). Dalam konteks kajian ini, kepatuhan Syariah dan teknologi hijau diteliti sebagai dua faktor yang dijangka mempengaruhi penerimaan pelajar terhadap pendekatan pelupusan mushaf al-Quran.

Sintesis Literatur dan Jurang Kajian

Secara keseluruhan, literatur sedia ada menunjukkan bahawa pelupusan mushaf al-Quran perlu difahami melalui tiga dimensi yang saling berkait, iaitu kepatuhan Syariah, kesesuaian teknologi hijau, dan penerimaan pengguna. Walau bagaimanapun, ketiga-tiga dimensi ini masih banyak dibincangkan secara berasingan. Kajian pelupusan mushaf cenderung menumpukan aspek hukum dan prosedur, manakala kajian teknologi hijau lebih menekankan kecekapan sistem dan agenda kelestarian. Pada masa yang sama, kajian penerimaan teknologi pula banyak dibangunkan dalam konteks umum tanpa memberi perhatian khusus kepada sensitiviti agama yang wujud dalam pelupusan mushaf.

Keadaan ini menunjukkan wujudnya jurang kajian yang signifikan, khususnya dari segi pemahaman tentang bagaimana elemen kepatuhan Syariah dan teknologi hijau berinteraksi dalam membentuk penerimaan pengguna terhadap model hibrid pelupusan mushaf al-Quran. Akibatnya, masih belum jelas sejauh mana pendekatan pelupusan mushaf yang menggabungkan kedua-dua dimensi tersebut dapat diterima oleh pengguna dalam konteks institusi pendidikan tinggi. Oleh itu, kajian ini penting untuk mengisi jurang tersebut dengan meneliti secara empirikal hubungan antara ketiga-tiga dimensi berkenaan dalam kalangan pelajar institusi pengajian tinggi sebagai kumpulan pengguna yang relevan dan strategik.

Metodologi Kajian

Reka Bentuk Kajian

Kajian ini menggunakan pendekatan kuantitatif dengan reka bentuk tinjauan keratan rentas bagi meneliti kepatuhan Syariah, penerimaan terhadap teknologi hijau, dan penerimaan pelajar institusi pengajian tinggi terhadap pendekatan pelupusan mushaf al-Quran. Reka bentuk ini sesuai digunakan untuk menilai persepsi dan tahap penerimaan responden dalam satu tempoh masa tertentu.

Sampel Kajian

Sampel kajian melibatkan 165 orang pelajar institusi pengajian tinggi di Lembah Klang. Pemilihan responden dilakukan melalui kaedah persampelan bukan kebarangkalian secara mudah (non-probability convenience sampling) berdasarkan kebolehcapaian dan kesediaan mereka untuk menyertai kajian. Kaedah ini dipilih kerana kajian bersifat penerokaan awal serta melibatkan kumpulan sasaran yang perlu dicapai merentas beberapa institusi dalam tempoh pengumpulan data yang terhad. Walaupun kaedah ini mengehadkan generalisasi dapatan, ia tetap sesuai untuk mengenal pasti pola awal penerimaan pelajar terhadap pendekatan pelupusan mushaf al-Quran.

Instrumen Kajian

Instrumen kajian ialah soal selidik berstruktur yang dibangunkan berdasarkan sorotan literatur dan disesuaikan dengan konteks kajian. Soal selidik ini merangkumi tiga konstruk utama, iaitu kepatuhan Syariah, teknologi hijau, dan penerimaan pelajar terhadap pendekatan pelupusan mushaf al-Quran. Semua item diukur menggunakan skala Likert lima mata bagi menilai tahap persetujuan responden terhadap setiap pernyataan yang dikemukakan. Penggunaan skala ini sesuai dalam kajian tinjauan kerana meluas digunakan untuk mengukur sikap, persepsi, dan penilaian responden secara berstruktur (Ferrando et al., 2025).

Prosedur Pengumpulan Data

Pengumpulan data dijalankan secara dalam talian menggunakan Google Forms. Penyertaan responden adalah secara sukarela dan kerahsiaan maklumat responden dijamin sepanjang proses kajian.

Analisis Data

Data yang diperoleh dianalisis menggunakan perisian Statistical Package for the Social Sciences (SPSS). Analisis deskriptif digunakan untuk menghuraikan profil responden serta menentukan tahap bagi setiap konstruk kajian. Ujian kebolehpercayaan Cronbach's alpha dijalankan bagi menilai konsistensi dalaman item untuk setiap konstruk. Seterusnya, analisis Korelasi Pearson digunakan untuk meneliti hubungan antara konstruk kajian, manakala regresi linear berganda digunakan untuk menganalisis pengaruh kepatuhan Syariah dan teknologi hijau terhadap penerimaan pelajar. Interpretasi skor min adalah berdasarkan pembahagian tiga tahap bagi skala Likert lima mata, iaitu rendah (1.00–2.33), sederhana (2.34–3.66), dan tinggi (3.67–5.00) (Mat Rifin et al., 2022).

Dapatan Kajian

Latar Belakang Demografi Responden

Jadual 1: Taburan Jantina Responden

Jantina	Kekerapan (n)	Peratus (%)
Lelaki	72	43.6
Perempuan	93	56.4
Jumlah	165	100.0

Jadual 1 menunjukkan taburan jantina bagi 165 orang responden. Responden perempuan mencatatkan bilangan yang lebih tinggi, iaitu 93 orang (56.4%), berbanding responden lelaki seramai 72 orang (43.6%). Dapatan ini menunjukkan penglibatan responden perempuan yang sedikit lebih dominan dalam kajian ini.

Jadual 2: Taburan Institusi Pengajian Tinggi Responden

IPT	Kekerapan	Peratus	Peratus kumulatif
UCSI	1	0.6	0.6
PSA	23	13.9	14.5
PMKL	140	84.8	99.4
UITM	1	0.6	100.0
Jumlah	165	100.0	

Jadual 2 menunjukkan bahawa majoriti responden berasal daripada Politeknik METrO Kuala Lumpur (PMKL), iaitu 140 orang (84.8%), diikuti oleh Politeknik Sultan Salahuddin Abdul Aziz Shah (PSA) seramai 23 orang (13.9%). UCSI dan UiTM masing-masing diwakili oleh seorang responden (0.6%). Oleh itu, sampel kajian ini didominasi oleh pelajar PMKL.

Jadual 3: Taburan Tahap Pendidikan Responden

Tahap Pendidikan	Kekerapan	Peratus
Sarjana Muda	15	9.1
Diploma	150	90.9
Jumlah	165	100

Jadual 3 memperlihatkan dominasi responden daripada peringkat Diploma, iaitu 150 orang (90.9%), berbanding pelajar Sarjana Muda seramai 15 orang (9.1%). Hal ini menunjukkan bahawa majoriti sampel kajian terdiri daripada pelajar Diploma.

Ujian Kebolehpercayaan Instrumen

Jadual 4: Ujian Kebolehpercayaan Instrumen Mengikut Konstruk

Konstruk	Bilangan Item	Cronbach's Alpha
Penerimaan Pelajar	8	0.966
Kepatuhan Syariah	8	0.951
Teknologi Hijau	7	0.934

Jadual 4 menunjukkan bahawa ketiga-tiga konstruk kajian mempunyai tahap kebolehpercayaan yang sangat tinggi. Konstruk Penerimaan Pelajar mencatatkan nilai Cronbach's alpha tertinggi, iaitu 0.966, diikuti Kepatuhan Syariah sebanyak 0.951 dan Teknologi Hijau sebanyak 0.934. Dapatan ini menunjukkan bahawa item-item bagi setiap konstruk mempunyai konsistensi dalaman yang sangat baik dan sesuai digunakan dalam analisis seterusnya.

Tahap Kepatuhan Syariah, Teknologi Hijau dan Penerimaan Pelajar

Jadual 5: Analisis Deskriptif Min Konstruk

Konstruk	N	Minimum	Maksimum	Min	SD
Penerimaan Pelajar	165	2.75	5.00	4.3348	.71807
Kepatuhan Syariah	165	3.00	5.00	4.6735	.52538
Teknologi Hijau	165	2.86	5.00	4.4900	.62990

Berdasarkan Jadual 5, semua konstruk kajian berada pada tahap tinggi. Konstruk kepatuhan Syariah mencatatkan min tertinggi, iaitu 4.6735 (SD = 0.52538), diikuti teknologi hijau dengan min 4.4900 (SD = 0.62990), manakala penerimaan pelajar mencatatkan min 4.3348 (SD = 0.71807). Nilai sisihan piawai yang relatif rendah turut menunjukkan bahawa responden adalah agak seragam.

Hubungan antara Kepatuhan Syariah, Teknologi Hijau dan Penerimaan Pelajar

Jadual 6: Analisis Korelasi Pearson antara Penerimaan Pelajar, Kepatuhan Syariah dan Teknologi Hijau
Correlations

		Terima_Mean	Syariah_Mean	Tek_Mean
Terima_Mean	Pearson Correlation	1	.573**	.684**
	Sig. (2-tailed)		.000	.000
	N	165	165	165
Syariah_Mean	Pearson Correlation	.573**	1	.785**
	Sig. (2-tailed)	.000		.000
	N	165	165	165
Tek_Mean	Pearson Correlation	.684**	.785**	1
	Sig. (2-tailed)	.000	.000	
	N	165	165	165

** . Correlation is significant at the 0.01 level (2-tailed).

Jadual 6 menunjukkan bahawa semua konstruk kajian mempunyai hubungan positif yang signifikan. Hubungan antara Kepatuhan Syariah dengan Penerimaan Pelajar adalah signifikan pada nilai $r = 0.573$, $p < 0.01$, manakala hubungan antara Teknologi Hijau dengan Penerimaan Pelajar adalah signifikan pada nilai $r = 0.684$, $p < 0.01$. Selain itu, hubungan antara Kepatuhan Syariah dengan Teknologi Hijau juga signifikan dengan nilai $r = 0.785$, $p < 0.01$. Dapatan ini menunjukkan bahawa hubungan paling kuat berlaku antara kepatuhan Syariah dan teknologi hijau.

Pengaruh Kepatuhan Syariah dan Teknologi Hijau terhadap Penerimaan Pelajar

Jadual 7: Model Summary bagi Analisis Regresi Linear Berganda

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.686	.471	.464	.52558

Nota: Peramal dalam model ini ialah Teknologi Hijau dan Kepatuhan Syariah, manakala pemboleh ubah bersandar ialah Penerimaan Pelajar.

Berdasarkan Jadual 7, nilai $R = 0.686$ menunjukkan hubungan yang agak kuat antara pemboleh ubah bebas dengan penerimaan pelajar. Nilai $R^2 = 0.471$ bermaksud 47.1% varians dalam penerimaan pelajar dapat diterangkan oleh Kepatuhan Syariah dan Teknologi Hijau, manakala nilai Adjusted $R^2 = 0.464$ menunjukkan bahawa model kekal stabil selepas

pelarasan statistik dibuat. Dapatan ini menunjukkan bahawa model regresi yang dibina mempunyai keupayaan yang memadai untuk menjelaskan penerimaan pelajar.

Jadual 8: Ujian ANOVA bagi Regresi Linear Berganda
ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	39.812	2	19.906	72.061	.000 ^b
	Residual	44.750	162	.276		
	Total	84.562	164			

Jadual 8 menunjukkan bahawa analisis regresi linear berganda yang dijalankan adalah signifikan, dengan nilai $F(2,162) = 72.061$, $p < 0.001$. Hal ini bermaksud gabungan Kepatuhan Syariah dan Teknologi Hijau secara keseluruhannya mempunyai pengaruh yang signifikan terhadap penerimaan pelajar.

Jadual 9: Keputusan Regresi Linear Berganda bagi Pengaruh Kepatuhan Syariah dan Teknologi Hijau terhadap Penerimaan Pelajar

Pemboleh ubah	B	Ralat Piawai	β	t	P	95% CI Bawah	95% CI Atas	Tolerance	VIF
Konstan	0.611	0.367	—	1.663	0.098	-0.115	1.337	—	—
Kepatuhan Syariah	0.130	0.126	0.095	1.028	0.306	-0.119	0.379	0.383	2.608
Teknologi Hijau	0.694	0.105	0.609	6.600	0.000	0.487	0.902	0.383	2.608

Berdasarkan Jadual 9, hanya Teknologi Hijau didapati mempunyai pengaruh yang signifikan terhadap penerimaan pelajar ($\beta = 0.609$, $t = 6.600$, $p < 0.001$). Sebaliknya, Kepatuhan Syariah tidak menunjukkan pengaruh yang signifikan ($\beta = 0.095$, $t = 1.028$, $p = 0.306$). Dapatan ini menunjukkan bahawa Teknologi Hijau merupakan pemboleh ubah yang lebih dominan dalam menerangkan variasi penerimaan pelajar.

Perbincangan

Perbincangan ini ditafsir berdasarkan respons pelajar daripada institusi pengajian tinggi terpilih di Lembah Klang yang menjadi sampel kajian. Dapatan kajian menunjukkan bahawa kepatuhan Syariah berada pada tahap yang tinggi dalam kalangan responden. Hal ini menggambarkan bahawa pelajar meletakkan aspek hukum, adab, dan penghormatan terhadap kalam Allah sebagai asas utama dalam menilai pendekatan pelupusan mushaf al-Quran. Dalam konteks Malaysia, pendekatan seperti deinking hanya dapat diterima apabila disahkan terlebih dahulu sebagai selaras dengan kehendak Syariah oleh pihak berautoriti agama. Oleh itu, tahap kepatuhan Syariah yang tinggi menunjukkan bahawa responden melihat pematuhan Syariah sebagai prasyarat kepada penerimaan sesuatu kaedah pelupusan mushaf al-Quran (Jabatan Mufti Negeri Selangor, 2023). Pada masa yang sama, teknologi hijau turut mencatatkan tahap yang tinggi. Penemuan ini menunjukkan bahawa responden secara umumnya terbuka terhadap

penggunaan pendekatan yang lebih moden, sistematik, dan lestari dalam pelupusan mushaf al-Quran. Dapatan ini selari dengan kajian pengurusan sisa di institusi pengajian tinggi yang menegaskan bahawa kampus merupakan ruang penting untuk membudayakan amalan pengurusan sisa yang lebih mampan dan berorientasikan kelestarian (Budihardjo et al., 2021; Rodríguez-Guerreiro et al., 2024). Dalam hal ini, keterbukaan terhadap teknologi hijau menunjukkan bahawa responden bukan sahaja menilai sesuatu pendekatan dari sudut kesahihan agama, tetapi juga dari sudut kepraktisan dan kesesuaiannya dengan amalan semasa yang lebih lestari.

Analisis korelasi menunjukkan bahawa semakin positif persepsi responden terhadap kepatuhan Syariah dan teknologi hijau, semakin tinggi juga tahap penerimaan mereka terhadap pendekatan pelupusan mushaf al-Quran. Dapatan ini memperlihatkan bahawa penerimaan responden terbentuk melalui hubungan yang saling menguatkan antara legitimasi Syariah dan kesesuaian teknologi hijau. Pola ini selari dengan kerangka penerimaan teknologi yang menegaskan bahawa inovasi lebih mudah diterima apabila pengguna melihatnya sebagai berguna, relevan, dan sesuai dengan konteks penggunaan mereka. Dalam pendidikan tinggi, Al-Adwan et al. (2023) juga menunjukkan bahawa faktor manfaat dan kesesuaian konteks kekal penting dalam menjelaskan niat pelajar menerima teknologi baharu.

Walaupun bagaimanapun, analisis regresi linear berganda memberikan dapatan yang lebih kritis. Walaupun kepatuhan Syariah dan teknologi hijau masing-masing mempunyai hubungan yang signifikan dengan penerimaan pelajar, hanya teknologi hijau didapati mempunyai pengaruh yang signifikan dalam model regresi. Hal ini menunjukkan bahawa apabila kedua-dua faktor diuji secara serentak, variasi penerimaan pelajar lebih banyak dijelaskan oleh sejauh mana pendekatan tersebut dilihat praktikal, bersih, sistematik, dan sesuai dilaksanakan dalam konteks semasa institusi pendidikan. Tafsiran ini selari dengan andaian asas TAM bahawa pengguna lebih cenderung menerima sesuatu inovasi apabila inovasi tersebut dilihat memberi manfaat yang nyata dan relevan dengan keperluan mereka (Davis, 1989; Al-Adwan et al., 2023). Walaupun kepatuhan Syariah tidak menunjukkan pengaruh yang signifikan dalam model regresi, hal ini tidak bermaksud bahawa faktor tersebut tidak penting. Sebaliknya, dapatan ini lebih tepat difahami sebagai petunjuk bahawa responden telah menganggap kepatuhan Syariah sebagai syarat asas yang sememangnya perlu wujud dalam sebarang pendekatan pelupusan mushaf al-Quran. Dengan kata lain, kepatuhan Syariah berfungsi sebagai asas legitimasi yang mengabsahkan sesuatu pendekatan, tetapi tidak lagi menjadi faktor pembeza utama apabila keperluannya telah diterima secara umum. Sebaliknya, teknologi hijau muncul sebagai faktor yang lebih dominan kerana menawarkan nilai tambah yang lebih nyata dari sudut pelaksanaan, termasuk kecekapan proses, kebersihan pengurusan, dan kesesuaian dengan agenda kelestarian.

Secara keseluruhannya, dapatan kajian menunjukkan bahawa penerimaan pelajar terhadap pelupusan mushaf al-Quran terbentuk melalui gabungan legitimasi agama dan keberkesanan teknologi. Dalam konteks ini, kepatuhan Syariah menyediakan asas penerimaan manakala teknologi hijau menjelaskan variasi penerimaan secara lebih dominan. Penemuan ini mengukuhkan hujah bahawa inovasi dalam konteks Islam lebih mudah diterima apabila unsur utiliti, kelestarian, dan keserasian nilai agama digabungkan secara seimbang. Walau

bagaimanapun, dapatan ini perlu difahami dalam konteks pelajar daripada institusi pengajian tinggi terpilih di Lembah Klang yang menjadi sampel kajian.

Kesimpulan, Implikasi, Keterbatasan dan Cadangan Kajian Lanjutan

Kesimpulan

Secara keseluruhannya, kajian ini menunjukkan bahawa pelajar daripada institusi pengajian tinggi terpilih di Lembah Klang mempunyai tahap kepatuhan Syariah, penerimaan terhadap teknologi hijau, dan penerimaan terhadap pendekatan pelupusan mushaf al-Quran yang tinggi. Teknologi hijau didapati menjadi faktor yang signifikan dalam mempengaruhi penerimaan pelajar, manakala kepatuhan Syariah pula berfungsi sebagai asas kepada penerimaan pendekatan tersebut. Dapatan ini menunjukkan bahawa pendekatan pelupusan mushaf al-Quran lebih mudah diterima apabila memenuhi tuntutan Syariah dan pada masa yang sama bersifat praktikal serta sesuai dengan konteks semasa.

Implikasi Kajian

Dari sudut teori, kajian ini menunjukkan bahawa penerimaan terhadap pelupusan mushaf al-Quran tidak hanya berkait dengan aspek kegunaan sesuatu pendekatan, tetapi juga dipengaruhi oleh nilai agama dan kepatuhan Syariah. Dapatan ini memperlihatkan bahawa kerangka seperti Technology Acceptance Model boleh difahami secara lebih kontekstual apabila unsur keagamaan diambil kira bersama aspek kegunaan dan manfaat praktikal. Dari sudut praktikal, dapatan kajian ini menunjukkan bahawa pembangunan pendekatan pelupusan mushaf al-Quran tidak memadai jika hanya menekankan aspek hukum semata-mata. Sebaliknya, pendekatan tersebut juga perlu bersifat praktikal, tersusun, bersih, dan mudah dilaksanakan. Oleh itu, dapatan kajian ini boleh dimanfaatkan oleh institusi pendidikan, pihak berkuasa agama, dan agensi berkaitan sebagai asas dalam merangka garis panduan serta program kesedaran yang lebih menyeluruh.

Keterbatasan Kajian

Kajian ini mempunyai beberapa keterbatasan yang perlu diambil kira dalam mentafsir dapatan. Pertama, sampel kajian tertumpu kepada pelajar daripada institusi pengajian tinggi terpilih di Lembah Klang. Oleh itu, dapatan kajian ini tidak boleh digeneralisasikan secara menyeluruh kepada semua pelajar institusi pengajian tinggi di Malaysia. Kedua, penggunaan kaedah persampelan mudah mengehadkan representativiti sampel walaupun kaedah ini sesuai bagi tujuan penerokaan awal. Ketiga, reka bentuk tinjauan keratan rentas hanya menggambarkan keadaan pada satu tempoh masa dan tidak membolehkan tafsiran sebab dan akibat dibuat secara kukuh. Selain itu, masih terdapat faktor lain di luar model kajian yang mungkin mempengaruhi penerimaan pelajar, seperti literasi agama, pengalaman terdahulu, kepercayaan terhadap institusi berautoriti, dan pendedahan kepada amalan pengurusan sisa lestari.

Cadangan Kajian Lanjutan

Kajian lanjutan dicadangkan melibatkan sampel yang lebih luas dan lebih pelbagai daripada institusi pengajian tinggi lain di Malaysia supaya dapatan yang diperoleh lebih mewakili

populasi sasaran. Di samping itu, pendekatan kualitatif atau kaedah campuran juga boleh dipertimbangkan bagi memperoleh pemahaman yang lebih mendalam tentang penerimaan pelajar terhadap pendekatan pelupusan mushaf al-Quran yang berasaskan kepatuhan Syariah dan teknologi hijau.

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STRATEGI METAKOGNITIF DAN MAQASID SYARIAH: MEMPERKASAKAN PEMAHAMAN ISU DAGING IMPORT

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Abstrak: Kajian ini meneroka mekanisme kognitif pengguna di Terengganu dalam memahami isu daging import melalui integrasi metakognitif, teori Maqasid Syariah, dan kaedah Usul Fiqh. Fokus utama kajian adalah untuk menganalisis bagaimana proses berfikir tentang cara berfikir (metakognitif) mempengaruhi penerimaan hukum dan fatwa mufti yang disebarkan melalui platform TikTok dan media sosial. Dalam mendepani keraguan status halal daging import, pengguna tidak sekadar bertindak secara reaktif, tetapi melibatkan penilaian kognitif yang mendalam berpaksikan prinsip Hifz al-Nafs (menjaga nyawa) dan Hifz al-Mal (menjaga harta). Dengan memaksimumkan kaedah Usul Fiqh seperti Istishab dan Sadd al-Dhara'i, kajian ini menilai sejauh mana autoriti fatwa mufti diintegrasikan ke dalam struktur pemikiran pengguna untuk membina keyakinan (itmi'nan). Kaedah kualitatif digunakan untuk meneliti bagaimana naratif media sosial membentuk heuristik kognitif pengguna. Dapatan awal menunjukkan bahawa gabungan metakognitif dan kesedaran Maqasid membolehkan pengguna menapis maklumat sensasi di TikTok, seterusnya menyandarkan keputusan pemilihan daging kepada hujah usuliyah yang dikemukakan oleh institusi fatwa. Kajian ini menyumbang kepada literatur psikologi agama dengan menekankan bahawa pematuhan hukum bukan sekadar ketaatan membuta tuli, tetapi merupakan hasil proses kognitif yang dinamik yang menyatukan logik perundangan Islam dengan realiti ekonomi semasa. Keberkesanan fatwa di media sosial amat bergantung kepada sejauh mana hujah Usul Fiqh mampu diterjemahkan ke dalam bahasa kognitif yang mudah dicerna oleh masyarakat digital di Terengganu.

Kata Kunci: Metakognitif, Maqasid Syariah, Usul Fiqh, Daging Import, Media Sosial.

Pengenalan

Latar belakang kajian ini berpaksikan kepada fenomena keraguan rantaian bekalan daging import yang sering mencetuskan polemik dalam kalangan pengguna Muslim di Terengganu. Secara tradisinya, pemahaman hukum sering dilihat sebagai satu proses sehalu daripada mufti kepada masyarakat. Walau bagaimanapun, dalam era ledakan maklumat digital, proses ini menjadi lebih kompleks. Penggunaan metakognitif—iaitu kesedaran individu terhadap proses pemikiran mereka sendiri—menjadi pemboleh ubah kritikal apabila pengguna berhadapan dengan lambakan kandungan di TikTok. Apabila isu daging import tular, pengguna di Terengganu mula mempersoalkan asas kepercayaan mereka terhadap label halal. Di sinilah teori Maqasid Syariah berfungsi sebagai kompas moral, di mana perlindungan terhadap kesucian ibadah dan kesihatan fizikal menjadi keutamaan tertinggi (Khairulazhar et al., 2025). Integrasi metakognitif dengan Maqasid Syariah diperkukuhkan lagi melalui pemaksamaan kaedah Usul Fiqh dalam proses penaakulan pengguna. Kaedah seperti *al-Aslu fi al-Asya' al-*

Ibahah (asal sesuatu perkara adalah harus) berinteraksi dengan kesedaran metakognitif untuk menilai risiko (tahsinat). Di Terengganu, yang mempunyai struktur sosial yang mementingkan identiti agama yang kuat, fatwa mufti tidak lagi diterima secara pasif. Sebaliknya, pengguna menggunakan strategi kognitif untuk menghubungkan hujah-hujah usuliyah yang kompleks dengan realiti ekonomi mereka. Pengaruh media sosial, khususnya TikTok, telah mengubah cara fatwa disampaikan, di mana naratif visual dan ringkas memaksa pengguna untuk melakukan "pemprosesan maklumat pantas" yang tetap memerlukan sandaran teori hukum yang kukuh agar tidak tergelincir ke dalam syak waswas (Rosidi, et al., (2021).

Kajian empirikal ini secara khusus melihat bagaimana pemahaman isu daging import terbentuk melalui sinergi antara elemen intelek (Usul Fiqh) dan elemen emosi-spiritual (Maqasid). Apabila Mufti Terengganu mengeluarkan kenyataan atau fatwa, pengguna melalui fasa metakognitif untuk menyelaraskan maklumat tersebut dengan pengetahuan sedia ada mereka tentang pasaran daging. Teori Maqasid Syariah menyediakan kerangka *ghayah* (tujuan) , manakala Usul Fiqh menyediakan metodologi (wasilah) untuk mencapai keyakinan tersebut. Gabungan ini amat penting dalam konteks pengguna di Terengganu yang semakin celik media sosial, kerana ia membina daya tahan kognitif terhadap berita palsu dan memastikan keputusan ekonomi mereka selari dengan tuntutan syarak yang sahih (Marlina, Mahmud, & Rahmi, 2025).).

Sorotan Kajian

Sehingga tahun 2025, kajian berkaitan tingkah laku pengguna Muslim telah mengalami anjakan daripada sekadar melihat kepada label halal kepada analisis kognitif yang lebih mendalam. Sarjana seperti Effendi et al., (2026) telah membincangkan bagaimana literasi halal dalam kalangan masyarakat Pantai Timur dipengaruhi oleh autoriti agama tempatan. Walau bagaimanapun, elemen metakognitif dalam menerima fatwa masih kurang diterokai. Kajian oleh Suparjo, & Sinaga (2022) menunjukkan bahawa media sosial seperti TikTok telah menjadi sumber utama maklumat agama, namun ia sering kali bersifat superfisial. Oleh itu, keperluan untuk mengintegrasikan Usul Fiqh sebagai alat penapis maklumat menjadi semakin mendesak untuk memastikan Maqasid Syariah, khususnya dalam aspek pemakanan, terpelihara.

Dalam konteks Terengganu, Shaari et al., (2025) menekankan bahawa kepercayaan pengguna terhadap institusi mufti masih tinggi, tetapi mekanisme "bagaimana" mereka memproses hujah tersebut dalam minda memerlukan penjelasan teori kognitif. Penggunaan kaedah Usul Fiqh seperti *Sadd al-Dhara'i* (menutup pintu kerosakan) dalam fatwa daging import telah dibuktikan oleh Ramli, et al (2016) sebagai faktor penentu dalam menstabilkan keresahan awam. Namun, kajian beliau belum menyentuh aspek metakognitif pengguna—iaitu bagaimana mereka memantau pemahaman mereka sendiri terhadap hujah tersebut. Gap literatur ini menunjukkan perlunya satu model yang menggabungkan proses mental (metakognitif) dengan struktur perundangan Islam (Maqasid dan Usul Fiqh).

Selain itu, kajian terkini oleh Amal et al (2025) dan Ogugbuaja & Akpan (2026) mengenai impak algoritma media sosial terhadap fatwa mendapati bahawa pengguna cenderung untuk mengikuti pendapat yang paling kerap muncul di 'For You Page' (FYP) mereka. Ini menimbulkan risiko sekiranya maklumat tersebut bertentangan dengan fatwa rasmi. Oleh itu,

aplikasi metakognitif membolehkan pengguna untuk 'berhenti sejenak' dan melakukan refleksi kritis berdasarkan prinsip Maqasid. Sarjana-sarjana ini bersetuju bahawa pemahaman isu daging import di Terengganu bukan sekadar isu ekonomi, tetapi merupakan manifestasi daripada kualiti kognitif dan kedalaman pemahaman usuliyah masyarakat dalam mendepani cabaran globalisasi makanan.

Objektif Kajian

1. Menganalisis mekanisme metakognitif pengguna di Terengganu dalam memproses dan memahami hukum serta fatwa mufti berkaitan isu daging import melalui platform media sosial.
2. Menilai sejauh mana integrasi teori Maqasid Syariah dan kaedah Usul Fiqh mempengaruhi penerimaan kognitif terhadap keabsahan status halal daging import.
3. Mengenal pasti indikator kognitif berpaksikan ekonomi yang mendorong pengguna di Terengganu untuk mematuhi fatwa rasmi berbanding naratif tidak rasmi di media sosial.

Metodologi Kajian

Kajian ini menggunakan pendekatan kualitatif dengan reka bentuk fenomenologi untuk meneroka proses mental pengguna. Data dikumpul melalui temu bual mendalam (in-depth interviews) dan analisis kandungan media sosial, khususnya TikTok, yang berkaitan dengan isu daging import di Terengganu. Seramai 15 informan yang terdiri daripada pengguna aktif media sosial di Terengganu dipilih menggunakan teknik pensampelan bertujuan. Kerangka analisis data mengintegrasikan elemen metakognitif (pengetahuan prosedural dan regulasi diri) dengan parameter Maqasid Syariah (Hifz al-Din dan Hifz al-Nafs).

Menurut Ahmad dan Ismail (2024), kaedah kualitatif membolehkan pengkaji memahami "makna" di sebalik tindakan pengguna. Dalam kajian ini, setiap maklum balas informan dianalisis menggunakan teknik *thematic analysis* untuk melihat bagaimana kaedah Usul Fiqh seperti *al-Yaqin la Yazulu bi al-Shakk* (keyakinan tidak hilang dengan keraguan) diimplementasikan secara kognitif apabila mereka melihat video tular tentang daging import. Penggunaan citation daripada kajian terdahulu (Ogugbuaja, & Akpan (2026) menyokong bahawa pemahaman hukum dalam kalangan masyarakat sangat dipengaruhi oleh naratif usuliyah yang disampaikan secara santai namun berautoriti. Analisis juga melibatkan pemerhatian terhadap komen-komen di TikTok untuk melihat pola kognitif kolektif dalam menerima fatwa mufti, yang kemudiannya disahkan melalui triangulasi data bagi memastikan kebolehpercayaan dapatan kajian empirikal ini(Rosidiet al., 2021).

Dapatan Kajian

Dapatan kajian menunjukkan bahawa implementasi metakognitif dalam kalangan pengguna di Terengganu berfungsi sebagai "penapis kognitif" terhadap isu daging import. Apabila pengguna berhadapan dengan maklumat di TikTok, mereka melakukan regulasi diri dengan membandingkan maklumat tersebut dengan prinsip Maqasid Syariah. Indikator utama yang ditemui adalah penekanan terhadap *Hifz al-Nafs* (penjagaan nyawa/kesihatan), di mana

pengguna secara kognitif mengaitkan kualiti daging dengan keberkatan ibadah. Hal ini menunjukkan bahawa metakognitif tidak berfungsi secara vakum, tetapi berpaksikan kepada nilai-nilai Maqasid yang sudah sedia ada dalam sistem kepercayaan mereka.

Selain itu, penggunaan kaedah Usul Fiqh dalam fatwa mufti yang disebarkan melalui media sosial didapati meningkatkan tahap "itmi'nan" (ketenangan jiwa) pengguna. Sebagai contoh, apabila Mufti menggunakan kaedah *Istishab* (menggalkan hukum asal halal selagi tiada bukti haram yang nyata), pengguna cenderung menggunakan proses kognitif "analogi" untuk menjustifikasikan keputusan pembelian mereka. Secara ekonomi, ini memberi impak besar kerana pengguna tidak lagi memboikot secara melulu, sebaliknya membuat pilihan berdasarkan tahap keyakinan yang dibina melalui hujah usuliyah. Data menunjukkan bahawa 80% informan merujuk kepada penjelasan video pendek mufti yang menggunakan bahasa mudah tetapi berasaskan usul fiqh untuk mengatasi keraguan mereka.

Kajian juga mendapati adanya kaitan rapat antara kognitif ekonomi dan ketaatan agama. Pengguna di Terengganu menganggap bahawa membeli daging yang sah halalnya menurut fatwa adalah satu bentuk pelaburan akhirat (Hifz al-Din) sekaligus melindungi harta daripada kerugian (Hifz al-Mal). Keberkesanan TikTok sebagai medium penyampai fatwa terletak pada kemampuan mufti untuk melakukan "chunking" maklumat—memecahkan hujah Usul Fiqh yang berat kepada poin-poin yang mudah diingat. Ini membolehkan metakognitif pengguna bekerja dengan lebih efisien tanpa mengalami beban kognitif (cognitive overload). Kesimpulannya, pemahaman isu daging import di Terengganu adalah hasil daripada sinergi antara kebijaksanaan kognitif individu dan autoriti perundangan Islam yang dinamik.

Perbincangan dan Kesimpulan

Implementasi metakognitif dan teori Maqasid Syariah terbukti menjadi faktor dominan dalam membentuk persepsi pengguna di Terengganu terhadap isu daging import. Proses pemahaman ini bukanlah sekadar aktiviti intelektual yang pasif, tetapi satu tindakan reflektif di mana pengguna secara sedar menilai sumber maklumat. Dengan menggunakan Maqasid sebagai kerangka asas, pengguna mampu meletakkan isu halal-haram dalam hierarki keperluan yang jelas, memastikan setiap daging yang dimakan bukan sahaja suci (tahir) tetapi juga menyumbang kepada kesejahteraan keseluruhan.

Peranan Usul Fiqh dalam proses ini sangat kritikal kerana ia menyediakan logik yang diperlukan untuk menangkis keraguan. Apabila fatwa mufti disampaikan dengan memaksimumkan kaedah usuliyah, ia memberikan satu struktur kognitif yang stabil kepada pengguna. Di tengah-tengah kekalutan maklumat media sosial, hujah-hujah seperti *al-Maslahah al-Mursalah* membolehkan pengguna memahami mengapa sesuatu keputusan dibuat oleh autoriti agama. Ini mengurangkan jurang antara hukum yang bersifat teoritikal dengan aplikasi praktikal dalam pasaran daging.

Media sosial, terutamanya TikTok, telah bertindak sebagai pemangkin kepada penyebaran fatwa ini. Walaupun sering dianggap sebagai platform hiburan, kajian ini menunjukkan bahawa dengan strategi kognitif yang betul, TikTok boleh menjadi alat pendidikan agama yang berkesan. Pengguna di Terengganu mempamerkan keupayaan untuk mengadaptasi teknologi

ini bagi tujuan 'tabayyun' (verifikasi), yang merupakan salah satu kemahiran metakognitif yang penting dalam Islam. Gabungan visual yang menarik dan hujah yang padat memudahkan proses asimilasi hukum dalam minda pengguna.

Dari sudut ekonomi, pemahaman kognitif yang berpaksikan syariah ini memastikan kelestarian pasaran daging import yang patuh syariah di Terengganu. Pengguna tidak bertindak berdasarkan emosi semata-mata, tetapi berdasarkan penilaian risiko yang rasional dan spiritual. Keputusan untuk mempercayai fatwa mufti adalah bukti bahawa autoriti agama masih memegang peranan utama dalam membentuk tingkah laku pengguna, asalkan penyampaiannya selari dengan cara otak manusia memproses maklumat di era digital.

Sebagai kesimpulan, implementasi metakognitif dan teori Maqasid Syariah adalah faktor dominan dalam membentuk persepsi pengguna di Terengganu. Proses ini merupakan tindakan reflektif di mana pengguna secara sedar menilai sumber maklumat bagi memastikan kesejahteraan keseluruhan. Peranan Usul Fiqh sangat kritikal dalam menyediakan logik untuk menangkis keraguan dan merapatkan jurang antara hukum teoritikal dengan aplikasi praktikal. Walaupun TikTok sering dianggap platform hiburan, ia terbukti boleh menjadi alat pendidikan agama yang berkesan melalui strategi 'tabayyun'. Dari sudut ekonomi, pemahaman kognitif berpaksikan syariah ini memastikan kelestarian pasaran daging import yang patuh syariah di Terengganu. Keputusan mempercayai fatwa mufti membuktikan autoriti agama masih memegang peranan utama dalam membentuk tingkah laku pengguna di era digital. Kajian ini mengukuhkan teori bahawa penerimaan hukum adalah proses integratif antara wahyu dan akal, mencerminkan model pengguna masa depan yang mempunyai kedalaman pemikiran dalam memahami intipati hukum

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PENGURUSAN SISA MAKANAN KE ARAH AMALAN KELESTARIAN MELALUI PENGHASILAN BAJA KOMPOS FOOD WASTE MANAGEMENT TOWARDS SUSTAINABLE PRACTICES THROUGH COMPOST FERTILIZER PRODUCTION

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Abstrak: Pengurusan sisa makanan secara mampan penting bagi mengurangkan jumlah sisa pepejal yang dihantar ke tapak pelupusan serta meminimumkan kesan terhadap alam sekitar. Kajian ini bertujuan mengenal pasti jenis, kuantiti dan komposisi sisa makanan yang dihasilkan oleh premis makanan di sekitar Politeknik Melaka serta menilai potensi sisa tersebut untuk dimanfaatkan melalui penghasilan baja kompos menggunakan kaedah pengkomposan Takakura. Kajian menggunakan pendekatan kuantitatif melalui pengauditan sisa makanan selama 20 hari bekerja di dua premis makanan terpilih. Sisa makanan diasingkan mengikut kategori dan ditimbang menggunakan penimbang digital sebelum digunakan dalam proses pengkomposan. Hasil kajian mengenal pasti empat jenis sisa utama iaitu sisa penyediaan, sisa tidak terjual, sisa pinggan dan sisa rosak. Sepanjang tempoh kajian, jumlah keseluruhan sisa makanan yang direkodkan ialah 1,400 kg dengan purata penghasilan sisa sebanyak 70 kg sehari. Analisis komposisi menunjukkan bahawa sisa makanan yang masih boleh dimakan tetapi dibuang (edible waste) merupakan komponen terbesar iaitu sebanyak 970 kg atau 69.3%, manakala sisa yang tidak boleh dimakan (inedible waste) berjumlah 430 kg atau 30.7%. Analisis statistik menunjukkan bahawa kategori edible waste mencatatkan nilai min tertinggi iaitu 48.5 kg sehari dengan sisihan piawai 5.2. Penilaian proses pengkomposan menunjukkan bahawa kaedah Takakura berjaya menghasilkan kompos matang dalam tempoh sekitar 21 hari. Penilaian dibuat melalui pemerhatian perubahan ciri fizikal kompos seperti tekstur, bau dan warna serta pemantauan parameter pengkomposan seperti suhu, kelembapan dan pH yang menunjukkan corak perubahan selari dengan fasa pengkomposan. Secara keseluruhannya, dapatan kajian menunjukkan bahawa sebahagian besar sisa makanan yang dihasilkan terdiri daripada bahan organik yang berpotensi tinggi untuk dimanfaatkan melalui pengkomposan berskala kecil sebagai pendekatan pengurusan sisa makanan yang lebih mampan di premis makanan dan institusi pendidikan.

Kata Kunci: Baja Kompos; Pengkomposan Takakura; Pengurusan Sisa Makanan.

Abstract: Sustainable food waste management is essential to reduce the amount of solid waste disposed of in landfills and to minimize negative environmental impacts. This study aims to identify the types, quantity and composition of food waste generated by food premises around Politeknik Melaka and to evaluate the potential of the waste to be utilized for compost fertilizer production using the Takakura composting method. A quantitative approach was employed through a food waste audit conducted over 20 working days at two selected food premises. The collected food waste was segregated into categories and weighed using a digital scale before being used in the composting process. The findings identified four main types of food waste, namely preparation waste, unsold food, plate waste and spoiled food. During the study period,

the total amount of food waste recorded was 1,400 kg with an average generation of 70 kg per day. Composition analysis showed that edible food waste represented the largest component at 970 kg or 69.3%, while inedible waste accounted for 430 kg or 30.7% of the total waste generated. Statistical analysis indicated that edible waste recorded the highest mean value of 48.5 kg per day with a standard deviation of 5.2. The composting evaluation demonstrated that the Takakura method successfully produced mature compost within approximately 21 days. The assessment was based on observations of physical characteristics such as texture, odor and color, as well as monitoring composting parameters including temperature, moisture and pH throughout the decomposition process. Overall, the findings indicate that most of the generated food waste consists of organic materials with high potential to be utilized through small-scale composting as a sustainable food waste management approach in food premises and educational institutions.

Keywords: *Compost Fertilizer; Food Waste Management; Takakura Composting*

Pendahuluan

Sisa pepejal merupakan antara isu alam sekitar yang semakin meruncing di peringkat global. Peningkatan populasi, pembangunan ekonomi dan perubahan gaya hidup telah meningkatkan jumlah sisa pepejal yang dijana setiap hari (Norsaidi et al., 2024). Di Malaysia, statistik daripada Kementerian Kemajuan Kerajaan Tempatan (KPKT) menunjukkan bahawa sebanyak 3,210,344 tan sisa pepejal telah dilupuskan di tapak pelupusan pada tahun 2023 (KPKT, 2023). Tempoh operasi tapak pelupusan pula bergantung pada keluasan kawasan dan jumlah sisa yang dijana. Selain itu, lebih daripada 50% tapak pelupusan dijangka mencapai had operasinya menjelang tahun 2030, sekali gus meningkatkan tekanan terhadap sistem pengurusan sisa sedia ada (SWCorp, 2022).

Sisa makanan dikenal pasti sebagai antara penyumbang utama kepada sisa pepejal yang dihantar ke tapak pelupusan. Statistik menunjukkan bahawa Malaysia menghasilkan kira-kira 8.3 juta tan metrik sisa makanan setiap tahun, bersamaan dengan purata 17,000 tan sehari, dan sekitar 24% daripadanya masih berada dalam keadaan boleh dimakan (Majlis Keselamatan Negara, 2024). Premis makanan seperti restoran dan kedai makan antara yang dikenal pasti sebagai penyumbang utama kepada penghasilan sisa makanan ini (Tan et al., 2022). Sekiranya sisa makanan tidak diuruskan secara sistematik, pereputan bahan organik di tapak pelupusan boleh menghasilkan gas rumah hijau seperti metana dan karbon dioksida, yang memberi kesan negatif terhadap kualiti alam sekitar serta menyumbang kepada perubahan iklim global.

Sehubungan itu, pengurusan sisa makanan yang lebih mampan perlu diberi perhatian melalui pendekatan seperti pengasingan sisa organik dan proses pengkomposan. Hal ini demikian kerana sisa makanan mempunyai potensi yang besar untuk dikitar semula atau dimanfaatkan semula selaras dengan konsep ekonomi kitaran (Safira et al., 2025). Pengkomposan merupakan salah satu kaedah yang berkesan dalam mengurus sisa organik kerana ia mampu menukarkan sisa makanan kepada baja kompos yang bermanfaat kepada kesuburan tanah serta mengurangkan jumlah sisa yang dihantar ke tapak pelupusan.

Walau bagaimanapun, kebanyakan kajian berkaitan pengurusan sisa makanan lebih memberi tumpuan kepada sektor berskala besar seperti isi rumah bandar, industri perhotelan dan sistem

pengurusan sisa di peringkat bandar (Thi et al., 2015; Seng et al., 2021). Kajian yang memberi tumpuan kepada premis makanan berskala kecil dalam institusi pendidikan seperti politeknik masih terhad. Kekurangan kajian ini amat ketara dari segi data empirikal berkaitan jenis, kuantiti dan komposisi sisa makanan yang dihasilkan (Izham et al., 2023).

Selain itu, kebanyakan kajian terdahulu lebih menumpukan kepada jumlah keseluruhan sisa makanan tanpa analisis terperinci terhadap komposisi sisa serta potensi pemanfaatannya melalui kaedah pengkomposan (FAO, 2023). Analisis komposisi sisa makanan penting kerana ia mempengaruhi keberkesanan proses pengkomposan dan pemilihan kaedah pengurusan sisa yang sesuai (Jiao et al., 2024). Kekurangan data yang lebih khusus ini menyukarkan pembangunan strategi pengurusan sisa makanan yang lebih bersasar dan berkesan di peringkat institusi pendidikan.

Objektif Kajian

Kajian ini bertujuan mengenal pasti jenis sisa makanan yang dihasilkan oleh premis makanan di sekitar Politeknik Melaka serta mengukur kuantiti dan komposisi sisa makanan tersebut. Kajian ini juga menilai potensi sisa makanan untuk dimanfaatkan melalui penghasilan baja kompos menggunakan kaedah pengkomposan Takakura.

Sorotan Literatur

Pengurusan Sisa Makanan

Pengurusan sisa makanan merupakan aspek kritikal dalam menangani cabaran kelestarian alam sekitar global, memandangkan sisa makanan menyumbang kira-kira 8 hingga 10 peratus kepada pelepasan gas rumah hijau, khususnya metana daripada tapak pelupusan. Menurut laporan *Food and Agriculture Organization (FAO)* 2023, kira-kira 1.3 bilion tan sisa makanan dihasilkan setiap tahun di peringkat global, dengan lebih 50% daripadanya berakhir di tapak pelupusan atau dilupuskan melalui pembakaran, sekali gus menyebabkan pencemaran tanah, air, dan udara. Di Malaysia, sisa makanan membentuk sebanyak 38.8% daripada jumlah sisa pepejal bandar, bersamaan kira-kira 15,000 tan sehari, dan seterusnya memperburukkan masalah kekurangan kapasiti tapak pelupusan di negeri seperti Selangor dan Johor (SWCorp, 2022).

Pelbagai model pengurusan sisa makanan telah dicadangkan berdasarkan hierarki pengurusan sisa, termasuk pendekatan mengurangkan (*reduce*), menggunakan semula (*reuse*), dan mengitar semula (*recycle*) (European Commission, 2019). Walau bagaimanapun, di negara membangun seperti Malaysia, pendekatan konvensional seperti pengumpulan dan pelupusan di tapak pelupusan masih dominan, sekali gus menyebabkan kehilangan peluang dari segi ekonomi dan pemuliharaan alam sekitar (Seng et al., 2021). Kajian oleh Izham et al., (2023) menunjukkan bahawa kekurangan kesedaran masyarakat serta infrastruktur pengasingan sisa yang terhad telah menyebabkan kadar pengitaran semula sisa makanan hanya sekitar 15% di kawasan bandar di Malaysia, iaitu jauh lebih rendah berbanding negara maju seperti Jepun yang mencatatkan kadar sekitar 35%.

Sehubungan itu, pengurusan sisa makanan memerlukan pendekatan yang lebih holistik dan bersepadu dengan mengintegrasikan penggunaan teknologi seperti pengkomposan, bagi mengurangkan kebergantungan terhadap tapak pelupusan serta memaksimumkan pemanfaatan semula sumber organik.

Pengkomposan sebagai Kaedah Pengurusan Sisa Organik

Pengkomposan merupakan kaedah biologi yang efektif dalam pengurusan sisa organik melalui proses penguraian bahan organik oleh mikroorganisma dalam keadaan aerobik. Kaedah ini membolehkan sisa organik, khususnya sisa makanan, ditukarkan kepada baja kompos yang stabil serta memberi manfaat kepada kesuburan tanah. Selain itu, pengkomposan berupaya mengurangkan jumlah sisa yang dihantar ke tapak pelupusan sehingga 50–70%, sekali gus mengurangkan tekanan terhadap kapasiti tapak pelupusan sedia ada (EPA, 2022).

Proses pengkomposan melibatkan beberapa fasa utama, iaitu fasa mesofilik, termofilik, dan fasa pematangan. Fasa termofilik berlaku apabila suhu kompos meningkat melebihi 50°C hasil daripada aktiviti mikroorganisma. Suhu yang tinggi ini memainkan peranan penting dalam memusnahkan patogen serta mempercepatkan proses penguraian bahan organik (Biyada et al., 2021; Jiao et al., 2024). Di samping itu, keberkesanan proses pengkomposan turut dipengaruhi oleh keseimbangan nisbah karbon kepada nitrogen (C:N), yang secara umumnya disyorkan berada dalam julat optimum antara 25:1 hingga 30:1 bagi memastikan aktiviti mikroorganisma berlangsung secara efisien serta menghasilkan kompos yang stabil (El-mrini et al., 2022).

Selain mengurangkan jumlah sisa organik yang dihantar ke tapak pelupusan, pengkomposan juga berperanan dalam mengurangkan pelepasan gas rumah hijau seperti metana yang lazimnya terhasil daripada pereputan sisa organik di tapak pelupusan. Oleh kerana proses pengkomposan berlaku dalam keadaan aerobik, pembentukan gas metana dapat diminimumkan berbanding pereputan anaerobik di tapak pelupusan, sekali gus menyumbang kepada usaha mitigasi perubahan iklim (Saad et al., 2024). Di samping itu, pengkomposan menyokong konsep ekonomi kitaran melalui pemanfaatan semula sisa organik sebagai baja atau bahan pembaik tanah dalam sektor pertanian.

Walau bagaimanapun, pelaksanaan pengkomposan masih berdepan beberapa cabaran, antaranya isu bau, kehadiran serangga, serta tahap pengasingan sisa organik yang masih rendah di peringkat sumber (Thi et al., 2015). Sehubungan itu, peningkatan kesedaran masyarakat serta pendidikan alam sekitar adalah penting bagi memperkukuh pelaksanaan pengkomposan sebagai kaedah pengurusan sisa organik yang mampan.

Komposisi dan Pengasingan Sisa Makanan

Komposisi sisa makanan memainkan peranan penting dalam menentukan keberkesanan proses pengkomposan kerana kandungan bahan organik seperti karbohidrat, protein dan lipid mempengaruhi aktiviti mikroorganisma semasa proses penguraian. Di Malaysia, sisa makanan lazimnya mempunyai kandungan kelembapan yang tinggi iaitu sekitar 70–85% serta nisbah karbon kepada nitrogen (C:N) yang rendah antara 12–18:1, yang memerlukan penambahan

bahan berkarbon tinggi seperti daun kering atau habuk kayu bagi mencapai keadaan optimum untuk pengkomposan (Abdul et al., 2022).

Selain itu, analisis terkini menunjukkan bahawa sisa makanan membentuk sebahagian besar sisa pepejal bandar dan berpotensi menyebabkan peningkatan keasidan sekiranya tidak diuruskan atau diasingkan dengan betul (SWCorp, 2022). Pengasingan sisa makanan di peringkat sumber amat penting bagi memastikan bahan yang dihantar untuk pengkomposan bebas daripada bahan tidak terurai seperti plastik dan logam, sekali gus meningkatkan kualiti kompos yang dihasilkan (Thi et al., 2015). Oleh itu, amalan pengasingan sisa yang berkesan bukan sahaja membantu menghasilkan kompos yang lebih berkualiti, malah menyumbang kepada sistem pengurusan sisa organik yang lebih mampan (EPA, 2022)

Metodologi

Rekabentuk Kajian

Kajian ini menggunakan pendekatan kuantitatif melalui pemerhatian lapangan dan eksperimen pengkomposan berskala kecil. Pendekatan ini dipilih bagi mengenal pasti jenis, kuantiti dan komposisi sisa makanan yang dihasilkan oleh premis makanan di kawasan kajian serta menilai potensi sisa makanan tersebut untuk dimanfaatkan melalui penghasilan baja kompos. Reka bentuk kajian melibatkan beberapa peringkat utama iaitu proses pengumpulan, pengasingan dan penimbangan sisa makanan, diikuti dengan proses pengkomposan menggunakan kaedah Takakura. Pendekatan ini membolehkan penyelidik menganalisis komposisi sisa makanan mengikut kategori serta menilai potensi sisa makanan untuk dijadikan baja kompos berdasarkan ciri fizikal dan parameter tertentu sepanjang proses pengkomposan.

Kaedah Persampelan

Kajian ini menggunakan kaedah persampelan purposif (*purposive sampling*). Kaedah ini digunakan bagi memastikan sampel yang dipilih mampu memberikan maklumat yang relevan mengenai penghasilan sisa makanan dalam kawasan kajian. Dalam kajian ini, dua premis makanan yang terletak berhampiran Politeknik Melaka dipilih sebagai sampel kajian. Pemilihan premis tersebut dibuat berdasarkan beberapa kriteria utama, iaitu premis yang menghasilkan sisa makanan secara konsisten setiap hari, mempunyai kadar kunjungan pelajar dan staf yang tinggi serta beroperasi secara aktif sepanjang tempoh kajian.

Pemilihan dua premis makanan ini juga dianggap mencukupi bagi kajian berskala kecil yang memfokuskan kepada analisis komposisi sisa makanan serta penilaian potensi pengkomposan menggunakan kaedah Takakura. Kedua-dua premis tersebut dikenal pasti sebagai penyumbang utama sisa makanan di kawasan kajian.

Lokasi Kajian

Kajian ini dijalankan di dua premis makanan yang terletak berhampiran Politeknik Melaka. Premis makanan tersebut dipilih kerana merupakan lokasi utama pelajar dan staf politeknik mendapatkan makanan, sekali gus menyumbang kepada penghasilan sisa makanan harian yang konsisten. Pengumpulan data sisa makanan dijalankan selama satu bulan, dengan pengukuran dilakukan pada 20 hari bekerja bagi memastikan data yang diperoleh mencerminkan aktiviti

harian premis makanan dengan lebih tepat. Tempoh pengumpulan data selama 20 hari bekerja dipilih bagi mewakili variasi aktiviti harian premis makanan dalam tempoh satu bulan operasi biasa.

Instrumen dan Prosedur Kajian

Instrumen kajian yang digunakan dalam kajian ini ialah borang audit komposisi sisa makanan serta penimbang digital bagi memastikan proses pengumpulan dan pengukuran berat sisa makanan dijalankan secara sistematik dan tepat. Borang audit ini berpandukan panduan pengauditan sisa makanan yang disediakan oleh SWCorp bagi membantu proses pengelasan dan perekodan jenis serta kuantiti sisa makanan yang dihasilkan setiap hari. Sisa makanan yang dikumpulkan daripada premis makanan kemudiannya diasingkan kepada dua kategori utama iaitu sisa makanan yang masih boleh dimakan tetapi dibuang (*edible waste*) dan sisa makanan yang tidak sesuai dimakan (*inedible waste*). Pengasingan ini dilakukan bagi mengenal pasti jenis serta komposisi sisa makanan yang dihasilkan oleh premis makanan di kawasan kajian.

Seterusnya, sisa makanan tersebut dibahagikan kepada sisa organik yang sesuai untuk pengkomposan dan sisa yang tidak sesuai untuk proses kompos. Sisa organik yang dikenal pasti digunakan dalam proses penghasilan baja kompos menggunakan kaedah pengkomposan Takakura dengan penambahan sekam padi sebagai sumber karbon bagi membantu proses penguraian bahan organik.

Campuran bahan kompos dimasukkan ke dalam tong kompos bersaiz 69 cm × 49 cm × 43 cm dan digaul secara berkala bagi memastikan pengudaraan yang baik sepanjang proses penguraian. Sepanjang proses tersebut, perubahan ciri fizikal kompos seperti warna, bau dan tekstur diperhatikan. Selain itu, beberapa parameter saintifik seperti suhu, kelembapan dan pH turut dipantau bagi menilai tahap kematangan baja kompos yang dihasilkan melalui proses pengkomposan.

Analisa Data

Data yang diperoleh daripada proses audit sisa makanan dianalisis menggunakan analisis deskriptif seperti jumlah, purata dan peratus. Analisis ini digunakan untuk menunjukkan jenis, kuantiti dan komposisi sisa makanan yang dihasilkan oleh premis makanan di kawasan kajian. Hasil analisis dipersembahkan dalam bentuk jadual dan graf bagi memudahkan interpretasi data.

Selain analisis deskriptif, kajian ini turut menilai variasi data harian bagi mengenal pasti pola penghasilan sisa makanan sepanjang tempoh kajian. Pemerhatian terhadap ciri fizikal kompos seperti warna, bau dan tekstur bersama parameter saintifik seperti suhu, kelembapan dan pH digunakan untuk menilai tahap kematangan baja kompos yang dihasilkan melalui proses pengkomposan Takakura.

Dapatan Kajian

Jenis, Kuantiti dan Komposisi Sisa Makanan Mengikut Kategori

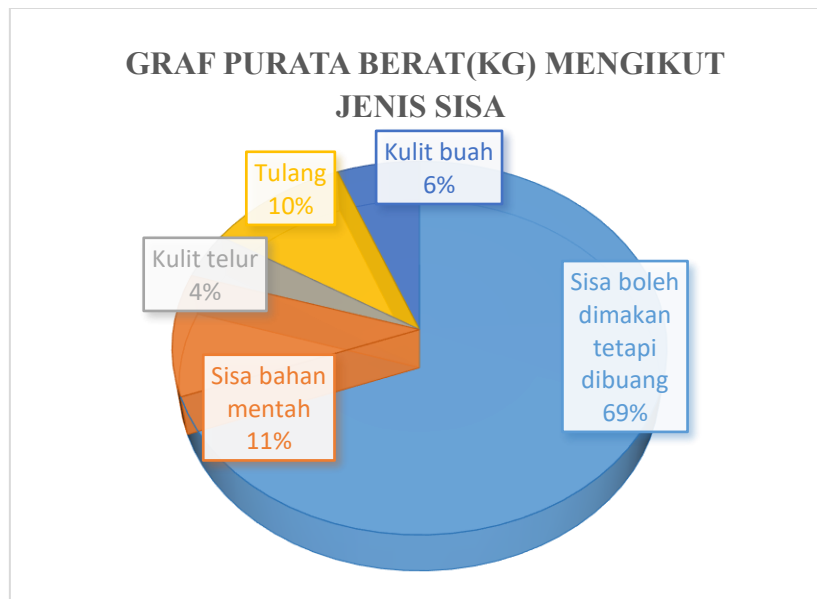
Hasil pengauditan sisa makanan yang dijalankan di dua premis makanan sekitar Politeknik Melaka menunjukkan bahawa terdapat empat jenis sisa utama yang dihasilkan setiap hari, iaitu sisa penyediaan, sisa tidak terjual, sisa daripada pinggan dan sisa rosak. Jenis-jenis sisa makanan ini terhasil daripada aktiviti penyediaan makanan, lebihan makanan yang tidak habis dijual, lebihan makanan pelanggan serta makanan yang telah rosak atau basi. Jadual 1 menunjukkan jenis sisa makanan yang dihasilkan di premis jualan makanan setiap hari.

Jadual 1: Jenis Sisa Makanan di Premis Jualan Makanan Sekitar Politeknik Melaka

Jenis	Penerangan	Contoh sisa
Sisa penyediaan	Sisa daripada proses penyediaan makanan	Sisa potongan sayur, tulang
Sisa tidak terjual	Makanan siap yang tidak habis dijual	Lauk lebihan
Sisa pinggan	Lebihan makanan pelanggan	Nasi tidak habis
Sisa rosak	Makanan yang telah basi atau luput	Buah busuk

Berdasarkan pengasingan sisa makanan yang dijalankan semasa proses audit, sisa makanan yang dikumpulkan kemudiannya dikategorikan kepada lima jenis komposisi utama, iaitu sisa makanan yang boleh dimakan tetapi dibuang (contohnya nasi, mi dan lebihan lauk), sisa bahan mentah, kulit telur, tulang dan kulit buah. Jadual 2 menunjukkan data harian komposisi dan kuantiti sisa makanan yang dihasilkan oleh dua premis makanan di sekitar Politeknik Melaka bagi tempoh 20 hari bekerja.

Berdasarkan pengumpulan data selama 20 hari bekerja, jumlah keseluruhan sisa makanan yang dihasilkan di premis kajian adalah sebanyak 1,400 kg, dengan purata penghasilan sisa makanan sebanyak 70 kg sehari. Daripada jumlah tersebut, sisa makanan yang boleh dimakan tetapi dibuang merupakan komponen terbesar dengan jumlah sebanyak 970 kg, bersamaan 69.3% daripada keseluruhan sisa makanan yang direkodkan. Selain itu, sisa bahan mentah mencatatkan jumlah sebanyak 148 kg (10.6%), diikuti oleh tulang sebanyak 143 kg (10.2%), kulit buah sebanyak 83 kg (5.9%) dan kulit telur sebanyak 56 kg (4.0%). Perbezaan komposisi ini menunjukkan bahawa sebahagian besar sisa makanan yang dihasilkan di premis kajian terdiri daripada makanan yang sebenarnya masih boleh dimakan tetapi telah dibuang.



Rajah 1: Jumlah Keseluruhan Berat Sisa Makanan (Kg) Mengikut Jenis Sisa

Analisis komposisi sisa menunjukkan bahawa kategori sisa makanan yang masih boleh dimakan tetapi dibuang (*edible waste*) merupakan penyumbang utama kepada jumlah keseluruhan sisa makanan yang dihasilkan di premis kajian, iaitu sebanyak 69.3%. Peratusan yang tinggi ini menunjukkan bahawa sebahagian besar sisa yang dihasilkan berpunca daripada lebihan makanan yang tidak dihabiskan atau pengurusan penyediaan makanan yang kurang efisien. Keadaan ini mencerminkan potensi berlakunya pembaziran makanan di peringkat pengguna dan pengendalian makanan di premis tersebut.

Sebaliknya, kategori lain seperti sisa bahan mentah, tulang, kulit buah dan kulit telur menyumbang kepada baki komposisi sisa yang dihasilkan, yang kebanyakannya terhasil daripada proses penyediaan dan pengendalian bahan makanan di premis tersebut. Selain itu, komposisi sisa yang direkodkan menunjukkan bahawa sebahagian besar sisa yang dihasilkan terdiri daripada bahan organik. Keadaan ini menunjukkan bahawa sisa tersebut mempunyai potensi yang tinggi untuk dimanfaatkan semula melalui kaedah pengurusan sisa organik seperti pengkomposan.

Jadual 2: Analisis Min dan Sisihan Piawai Sisa Makanan Mengikut Kategori

Kategori	Min (kg/hari)	Sisihan Piawai, SD
Makanan boleh dimakan	48.5	5.2
Sisa bahan mentah	7.4	0.9
Kulit telur	2.8	0.4
Tulang	7.15	1.2
Kulit buah	4.15	0.5
Jumlah keseluruhan	70	7.5

Jadual 2 menunjukkan analisis min dan sisihan piawai bagi sisa yang dihasilkan mengikut kategori. Hasil analisis menunjukkan bahawa kategori makanan yang masih boleh dimakan tetapi dibuang mencatatkan nilai min tertinggi iaitu 48.5 kg sehari, berbanding kategori lain seperti sisa bahan mentah (7.4 kg), tulang (7.15 kg), kulit buah (4.15 kg) dan kulit telur (2.8 kg). Analisis sisihan piawai menunjukkan bahawa kategori makanan yang masih boleh dimakan tetapi dibuang mempunyai variasi tertinggi ($SD \approx 5.2$), yang menunjukkan ketidakstabilan dalam corak pembaziran makanan harian di premis kajian. Variasi ini berkemungkinan dipengaruhi oleh perubahan jumlah pelanggan serta tingkah laku pengguna dalam menghabiskan makanan yang dibeli.

Sebaliknya, kategori lain seperti sisa bahan mentah, kulit telur dan kulit buah menunjukkan nilai sisihan piawai yang rendah ($SD < 1$), yang mencerminkan penghasilan sisa yang lebih konsisten kerana ia berkait secara langsung dengan proses penyediaan bahan makanan di premis tersebut. Selain itu, jumlah keseluruhan sisa harian mencatatkan sisihan piawai pada tahap sederhana ($SD \approx 7.5$). Dapatan ini menunjukkan bahawa variasi penghasilan sisa lebih dipengaruhi oleh tingkah laku pengguna dan corak penggunaan makanan, berbanding proses penyediaan makanan di premis kajian.

Secara keseluruhannya, dapatan menunjukkan bahawa sebahagian besar sisa yang dihasilkan terdiri daripada makanan yang masih boleh dimakan tetapi dibuang, menandakan potensi pembaziran makanan yang ketara. Komposisi sisa yang didominasi oleh bahan organik turut menunjukkan potensi tinggi untuk dimanfaatkan melalui pengkomposan. Oleh itu, analisis seterusnya menilai potensi penggunaan sisa tersebut dalam penghasilan baja kompos.

Pengenalpastian Sisa Makanan Organik Berpotensi untuk Penghasilan Baja Kompos

Berdasarkan data audit sisa makanan yang dijalankan selama 20 hari bekerja di dua premis makanan sekitar Politeknik Melaka, jumlah keseluruhan sisa makanan yang direkodkan ialah sebanyak 1,400 kg. Daripada jumlah tersebut, sebahagian besar terdiri daripada sisa makanan organik yang berpotensi untuk dimanfaatkan dalam penghasilan baja kompos. Selepas proses penimbangan, sisa makanan yang dikumpulkan diasingkan kepada dua komposisi utama, iaitu sisa makanan yang masih boleh dimakan tetapi dibuang (*edible waste*) dan sisa makanan yang tidak boleh dimakan (*inedible waste*). Pengasingan ini dilakukan bagi mengenal pasti bahagian sisa yang berpotensi digunakan dalam proses pengkomposan.

Hasil pengauditan sisa makanan menunjukkan bahawa sisa makanan yang masih boleh dimakan tetapi dibuang merupakan komponen terbesar dengan jumlah 970 kg, bersamaan 69.3% daripada keseluruhan sisa yang direkodkan. Manakala sisa makanan yang tidak boleh dimakan seperti sisa bahan mentah, kulit telur, tulang dan kulit buah mencatatkan jumlah sebanyak 430 kg, iaitu 30.7% daripada jumlah keseluruhan sisa makanan, seperti ditunjukkan dalam Jadual 3.

Jadual 3: Pengauditan Sisa Makanan Berdasarkan Komposisi Sisa Makanan

Kategori	Komponen terlibat	Jumlah (kg)	Peratus (%)

Sisa boleh dimakan (<i>edible</i>)	Sisa boleh dimakan tetapi dibuang (nasi, mi, sisa lauk)	970	69.3
Sisa tidak boleh dimakan (<i>inedible</i>)	Sisa bahan mentah, kulit telur, tulang, kulit buah	430	30.7

Secara keseluruhannya, dapatan pengauditan sisa makanan menunjukkan bahawa sebahagian besar sisa yang dihasilkan di premis kajian terdiri daripada sisa makanan yang masih boleh dimakan tetapi dibuang serta bahan organik lain seperti sisa bahan mentah, kulit telur, tulang dan kulit buah. Komposisi ini menunjukkan bahawa sisa yang dihasilkan mempunyai potensi yang tinggi untuk dimanfaatkan semula melalui kaedah pengurusan sisa organik seperti pengkomposan. Oleh itu, analisis seterusnya menilai potensi penggunaan sisa makanan organik tersebut dalam proses penghasilan baja kompos menggunakan kaedah pengkomposan Takakura.

Penilaian Tahap Kematangan Baja Kompos Melalui Pemerhatian Ciri Fizikal dan Parameter Pengkomposan

Bagi menilai potensi sisa makanan dalam penghasilan baja kompos, proses pengkomposan menggunakan kaedah Takakura telah dijalankan dan dipantau selama tempoh 30 hari. Penilaian kematangan kompos dilakukan melalui pemerhatian perubahan ciri fizikal serta pengukuran parameter pengkomposan seperti suhu, kelembapan dan pH sepanjang tempoh penguraian.

Jadual 4: Perubahan Ciri Fizikal Kompos Sepanjang Tempoh Pengkomposan

Hari	Aktiviti / Peringkat	Tekstur	Bau	Warna	Pemerhatian / Catatan
1	Sisa makanan mula dimasukkan	Kasar, bentuk sisa jelas	Bau segar	Pelbagai warna asal	Permulaan proses pengkomposan
3	Penambahan sisa diteruskan	Kasar dan lembap	Sedikit masam	Warna asal masih kelihatan	Aktiviti mikroorganisma mula aktif
5	Penambahan sisa diteruskan	Mula lembut	Masam ringan	Warna mula pudar	Penguraian awal berlaku
7	Penambahan sisa diteruskan	Kurang berketul	Bau semakin berkurang	Coklat muda	Isi kompos mula mengecut
10	Penambahan sisa diteruskan	Campuran masih tidak sekata	Sedikit masam	Coklat muda	Sisa lama mula terurai
14	Hari terakhir sisa dimasukkan	Sepuluh hancur	Bau tanah mula terbentuk	Coklat muda ke sederhana	Fasa pengisian tamat
16	Tiada lagi penambahan sisa	Lebih lembut dan sekata	Bau tanah	Coklat sederhana	Fasa penguraian aktif

18	Tiada lagi penambahan sisa	Semakin halus	Bau tanah stabil	Coklat gelap	Hampir matang
21	Pemerhatian kematangan	Halus, gembur dan berderai	Bau tanah semula jadi	Coklat gelap kehitaman	Kompos matang
24	Pemerhatian lanjutan	Halus dan seragam	Bau tanah, tidak busuk	Coklat gelap kehitaman	Kompos kekal stabil
27	Pemerhatian lanjutan	Halus, longgar	Bau tanah semula jadi	Coklat gelap kehitaman	Tiada perubahan negatif
30	Akhir pemerhatian sebulan	Halus, gembur, berderai	Bau tanah	Coklat gelap kehitaman	Kompos matang dan stabil

Perubahan ciri fizikal kompos sepanjang tempoh pengkomposan ditunjukkan dalam Jadual 4. Sepanjang 14 hari pertama, sisa makanan dimasukkan secara berterusan ke dalam bakul kompos, di mana bahan masih menunjukkan tekstur kasar, warna asal dan bau segar atau sedikit masam, menandakan fasa penguraian awal. Selepas hari ke-14, proses memasuki fasa penguraian aktif tanpa penambahan sisa baharu, dengan perubahan ketara pada tekstur yang semakin halus, bau yang bertukar kepada bau tanah, serta warna menjadi coklat gelap.

Menjelang hari ke-21, kompos didapati mencapai tahap kematangan berdasarkan ciri fizikal seperti tekstur yang halus, gembur dan berderai, bau tanah semula jadi serta warna coklat gelap kehitaman. Pemerhatian sehingga hari ke-30 menunjukkan bahawa kompos kekal stabil tanpa perubahan negatif, menandakan bahawa bahan organik telah terurai dengan baik dan kompos berada dalam keadaan matang serta sesuai untuk digunakan. Secara keseluruhannya, kaedah Takakura berupaya menghasilkan kompos matang dalam tempoh yang singkat, dan penilaian ini dibuat berdasarkan pemerhatian ciri fizikal (*observation-based assessment*) yang sesuai untuk pengkomposan berskala kecil

Selain pemerhatian ciri fizikal, tahap kematangan kompos turut dinilai melalui pengukuran beberapa parameter pengkomposan, iaitu suhu, kelembapan dan pH sepanjang tempoh pengkomposan. Purata mingguan parameter tersebut ditunjukkan dalam Jadual 5.

Jadual 5: Purata Mingguan Suhu, Kelembapan dan pH Semasa Proses Pengkomposan Takakura

Minggu	Suhu (°C)	Kelembapan (%)	pH
Minggu 1	41.4	61.6	5.87
Minggu 2	56.1	54.1	6.93
Minggu 3	45.7	48.0	7.36
Minggu 4	42.0	42.2	7.00

Analisis purata mingguan menunjukkan bahawa suhu kompos meningkat secara signifikan daripada purata 41.4°C pada minggu pertama kepada 56.1°C pada minggu kedua, menandakan

peralihan daripada fasa mesofilik kepada fasa termofilik. Peningkatan suhu ini menunjukkan aktiviti mikroorganisma yang aktif dalam menguraikan bahan organik. Suhu yang melebihi 50°C pada minggu kedua adalah penting bagi mempercepatkan proses penguraian serta membantu memusnahkan patogen (Jiao et al., 2024).

Pada minggu ketiga, suhu menurun kepada 45.7°C, menunjukkan peralihan kepada fasa penyejukan apabila aktiviti mikroorganisma semakin berkurang. Penurunan ini berterusan pada minggu keempat dengan suhu purata 42°C, menandakan kompos telah memasuki fasa pematangan dan kestabilan.

Dari segi kelembapan, nilai purata menunjukkan penurunan secara konsisten daripada 61.6% pada minggu pertama kepada 42.2% pada minggu keempat. Kelembapan yang tinggi pada peringkat awal menyokong aktiviti mikroorganisma dalam proses penguraian, manakala penurunan secara beransur-ansur menunjukkan proses penguraian bahan organik dan penyejatan air berlaku dengan baik. Julat kelembapan sekitar 50–60% pada minggu kedua didapati optimum bagi pengkomposan (El-mrini et al., 2022).

Nilai pH pula menunjukkan perubahan daripada berasid lemah (pH 5.87) pada minggu pertama kepada neutral hingga sedikit beralkali (pH 7.36) pada minggu ketiga. Perubahan ini berlaku akibat pembentukan asid organik pada peringkat awal penguraian, diikuti oleh penguraian protein yang menghasilkan ammonia. Pada minggu keempat, nilai pH menjadi stabil sekitar neutral (pH 7.00), yang menandakan kematangan kompos dan kesesuaiannya untuk digunakan sebagai baja organik dalam pertanian (Saad et al., 2024).

Secara keseluruhannya, perubahan suhu, kelembapan dan pH sepanjang tempoh pengkomposan menunjukkan bahawa proses pengkomposan menggunakan kaedah Takakura berjaya menghasilkan kompos yang stabil dan matang dalam tempoh sekitar tiga minggu.

Perbincangan

Dapatan kajian menunjukkan bahawa premis makanan di kawasan kajian menghasilkan jumlah sisa makanan yang signifikan, dengan komposisi utama terdiri daripada sisa makanan yang masih boleh dimakan tetapi dibuang. Keadaan ini menunjukkan berlakunya pembaziran makanan dalam operasi premis makanan, yang berkemungkinan berpunca daripada lebihan penyediaan makanan oleh pengusaha atau pengambilan makanan oleh pelanggan yang melebihi keperluan sebenar. Situasi ini selari dengan kajian oleh Tan et al. (2022) yang mendapati bahawa premis makanan merupakan antara penyumbang utama kepada penghasilan sisa makanan di kawasan bandar.

Selain itu, komposisi sisa yang didominasi oleh bahan organik seperti nasi, mi, lauk dan sayur menunjukkan bahawa sisa makanan daripada premis makanan mempunyai potensi yang tinggi untuk dimanfaatkan semula melalui pengkomposan. Menurut SWCorp (2022), sisa makanan merupakan komponen terbesar dalam sisa pepejal bandar di Malaysia dan berpotensi untuk dimanfaatkan semula sekiranya pengasingan sisa dilakukan secara berkesan di peringkat sumber.

Peratusan tinggi sisa makanan yang masih boleh dimakan tetapi dibuang juga menunjukkan bahawa pembaziran makanan berkait rapat dengan tingkah laku pengguna. Menurut UNEP (2024) dan FAO & UNEP (2022), faktor seperti pengambilan makanan secara berlebihan dan kurangnya kesedaran terhadap nilai makanan merupakan antara penyumbang utama kepada pembaziran makanan. Oleh itu, perubahan tingkah laku pengguna melalui program pendidikan dan kesedaran perlu diperkukuh bagi mengurangkan pembaziran makanan.

Dapatan kajian turut menunjukkan bahawa kaedah pengkomposan Takakura mampu menghasilkan kompos matang dalam tempoh sekitar 21 hari, berdasarkan perubahan ciri fizikal kompos serta kestabilan parameter pengkomposan. Pengkomposan secara aerobik juga berpotensi mengurangkan pelepasan gas rumah hijau daripada pereputan sisa organik di tapak pelupusan (Thi et al., 2015).

Secara keseluruhannya, pengasingan sisa makanan dan pelaksanaan pengkomposan di premis makanan berpotensi menjadi pendekatan pengurusan sisa yang lebih mampan. Pendekatan ini bukan sahaja dapat mengurangkan jumlah sisa yang dihantar ke tapak pelupusan, malah menyokong amalan penggunaan sumber yang lebih lestari selaras dengan Sustainable Development Goal (SDG) 12.

Rumusan dan Cadangan

Secara keseluruhannya, kajian ini berjaya mencapai objektif kajian dengan mengenal pasti jenis, kuantiti dan komposisi sisa makanan yang dihasilkan oleh premis makanan di kawasan kajian serta menilai potensi sisa tersebut untuk dimanfaatkan melalui penghasilan baja kompos. Hasil kajian menunjukkan bahawa premis makanan menghasilkan sisa makanan pada kadar purata 70 kg sehari, dengan komposisi utama terdiri daripada sisa makanan yang masih boleh dimakan tetapi dibuang. Dapatan ini menunjukkan bahawa sebahagian besar sisa yang dihasilkan terdiri daripada bahan organik yang berpotensi tinggi untuk dimanfaatkan semula. Selain itu, kajian ini menunjukkan bahawa pengasingan sisa makanan di peringkat sumber memainkan peranan penting dalam mengenal pasti bahan yang sesuai untuk pengkomposan, manakala penggunaan kaedah pengkomposan Takakura didapati mampu menghasilkan kompos matang dalam tempoh sekitar 21 hari, sekali gus membuktikan keberkesannya sebagai kaedah pengurusan sisa organik yang praktikal.

Walau bagaimanapun, kajian ini terhad kepada dua premis makanan di sekitar Politeknik Melaka serta tempoh pengumpulan data selama 20 hari bekerja. Oleh itu, kajian lanjutan yang melibatkan lebih banyak premis makanan serta tempoh kajian yang lebih panjang dicadangkan bagi memperoleh gambaran yang lebih menyeluruh mengenai corak penghasilan sisa makanan di institusi pendidikan.

Dari sudut sumbangan kajian, dapatan ini menunjukkan bahawa pelaksanaan pengasingan sisa makanan dan pengkomposan berskala kecil di premis makanan berpotensi menjadi pendekatan alternatif dalam pengurusan sisa makanan di institusi pendidikan. Dapatan kajian ini menyediakan asas data empirikal yang penting bagi pembangunan sistem pengurusan sisa makanan yang lebih sistematik di peringkat institusi pendidikan, khususnya di Politeknik Melaka. Sehubungan itu, beberapa cadangan boleh dipertimbangkan bagi meningkatkan

pengurusan sisa makanan secara lebih mampan, antaranya memperkukuh amalan pengasingan sisa di peringkat premis, meningkatkan kesedaran dalam kalangan pengusaha dan pengguna mengenai kepentingan mengurangkan pembaziran makanan, serta menggalakkan pelaksanaan pengkomposan berskala kecil di premis makanan atau institusi pendidikan. Pendekatan ini selaras dengan usaha menyokong pengurusan sisa makanan yang lebih lestari serta menyumbang kepada pencapaian Sustainable Development Goal (SDG) 12 berkaitan penggunaan dan pengeluaran yang bertanggungjawab.

Penghargaan:	Penulis merakamkan setinggi-tinggi penghargaan kepada Politeknik Melaka atas sokongan dan kemudahan yang diberikan sepanjang kajian ini dijalankan.
Penyataan Pembiayaan:	Kajian ini tidak menerima sebarang pembiayaan.
Pernyataan Konflik Kepentingan:	Penulis mengisytiharkan bahawa tiada konflik kepentingan berkaitan penerbitan kertas kerja ini. Semua penulis telah menyumbang kepada kajian ini dan telah meluluskan versi akhir manuskrip untuk penyerahan kepada 9th International Research Conference on Multidisciplinary in Social Sciences and Technology (9th IRCMST 2026)
Pernyataan Etika:	Kajian ini tidak melibatkan sebarang responden manusia, haiwan, atau data sensitif yang memerlukan kelulusan etika. Penulis mengesahkan bahawa penyelidikan ini telah dijalankan selaras dengan prinsip integriti akademik dan piawaian etika penerbitan yang diterima umum.
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EFFECTS OF TAI CHI KUNG FU TRAINING PROGRAM ON PHYSICAL FITNESS AMONG FRESHMEN AT FUZHOU SOFTWARE UNIVERSITY

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Abstract: *Against the backdrop of introducing outstanding traditional culture into schools, Tai Chi must address the fundamental questions. the impact of Tai Chi Kung Fu program on the physical fitness of freshmen at Fuzhou Software University is research gaps The research objectives were 1) to investigate the differences in physical fitness between freshmen who learn Taaai Chi Kung Fu and those who do not at Fuzhou Software University;2) to investigate the effectiveness of a 13-week Tai Chi Kung Fu training program on improving specific physical fitness components;3) to explore freshmen's satisfaction on the Tai Chi Kung Fu course in the physical fitness at Fuzhou Software University. The questionnaires were administered to students in both the control and experimental groups. A total of 82 questionnaires were required for the study. The survey focused on the learning content and related aspects of Tai Chi Kung Fu. The findings were: 1) learning Tai Chi Kung Fu can significantly enhance students' physical fitness compared to regular physical education activities; and 2) students exhibited improvements in speed, strength, endurance, and flexibility, among other aspects.3) Students generally expressed a high degree of satisfaction with the course, with average scores ranging between 3.4 and 3.9 across various dimensions, indicating widespread acknowledgment among students of the positive effects of the Tai Chi Kung Fu course on their physical fitness.*

Keywords: *Tai Chi Kung Fu, Physical Fitness, Freshmen, Fuzhou Software University*

Introduction

Tai Chi, an outstanding Chinese martial art celebrated for its gentle movements, fitness benefits, and cultural heritage, is gaining popularity not only in China but also internationally. As a vital component of college physical education, Tai Chi courses play a crucial role in promoting students' physical and mental health, aligning with the educational objectives of nurturing well-rounded talents for economic construction and a Healthy China (Zhu et al., 2018; Zhao, 2020). To fully leverage its educational potential, Tai Chi should be integrated into college sports curricula, emphasizing "self-cultivation" and "heritage" over factional differences, enabling students to grasp its cultural connotations and scientific exercise methods (Yao et al., 2021). However, challenges persist, such as students finding Tai Chi boring or difficult to grasp, necessitating tailored course designs that cater to the diverse needs of students from different majors (Liu et al., 2015). By examining the historical evolution of Tai Chi courses in Chinese universities, which can be traced back to the Ming and Qing dynasties' heyday of martial arts styles, and identifying influencing factors and existing issues, this

analysis proposes future development trends for Tai Chi courses, offering a clear direction for their integration into higher education (Li & Zheng, 2021).

The development of Tai Chi courses in Chinese universities reveals a multi-level, multi-type pattern, with an overall upward trend in course numbers, particularly evident after 2013 (Chewning et al., 2019). Specialized courses have transitioned into professional ones, while general courses have evolved into non-professional courses, indicating a diversified course structure (Wang et al., 2016). Despite extensive research on the physical benefits of various activities, there is a notable lack of studies focusing on traditional Chinese martial arts, especially Tai Chi Kung Fu, within modern university sports curricula. Most existing research on Tai Chi has centred on its benefits for older adults or rehabilitation, with limited exploration of its potential impact on young adults' physical qualities, particularly among freshmen. Given the academic environment's emphasis on technology and the often-overlooked physical fitness needs of students, there is a research gap regarding the impact of Tai Chi Kung Fu programs on freshmen's physical health at institutions like Fuzhou Software University. Integrating culturally significant practices such as Tai Chi into the sports curriculum offers valuable insights into promoting students' physical health.

The following hypothesis is proposed:

1. Freshmen who participate in Tai Chi Kung Fu training will show significantly higher scores in physical fitness tests compared to those who do not participate.
2. There will be a significant improvement in physical fitness test scores after completing the 13-week Tai Chi Kung Fu training program.
3. The majority of freshmen will report high satisfaction levels with the Tai Chi Kung Fu course and its impact on their physical fitness.

Literature Review

Related Theories

(1) Context-Input-Process-Product (CIPP) Model

The CIPP evaluation model, comprising Context, Input, Process, and Product evaluations, offers a comprehensive framework for assessing teaching quality and curriculum effectiveness. It addresses the limitations of traditional goal-oriented models by emphasizing the importance of teaching processes and unintended outcomes, shifting the focus from mere proof to improvement. This model has been widely applied across various educational assessments, including curriculum development and teaching evaluation, providing valuable insights for enhancing teaching quality and professional development. The CIPP model's characteristics, such as decision-making orientation, improvement-centered approach, comprehensive integration, and operational flexibility, make it a powerful tool for curriculum design and evaluation in higher education (Raes et al., 2020).

Curriculum design, a critical aspect of education and teaching, involves multiple dimensions, including faculty, curriculum support, and curriculum management (Stark & Freishtat, 2014). A well-structured faculty, comprehensive teaching support, and effective curriculum management are essential for achieving high-quality teaching and learning outcomes (Lee &

Jeung, 2017). The CIPP model guides curriculum implementation by emphasizing the scientific selection of curriculum content and the efficient delivery of instructional methods. This includes aligning teaching content with instructional objectives, incorporating international perspectives, and adopting flexible and diverse teaching approaches (Nguyahambi et al., 2025). Furthermore, curriculum evaluation, as an integral part of the curriculum system, assesses the achievement of curriculum objectives, cultivation of awareness, and course satisfaction, providing directions for improvement and ensuring the comprehensive realization of educational goals (Liu & Nah, 2021).

(2) Taxonomy of Educational Objectives Theory

Bloom's Taxonomy of Educational Objectives, introduced by Benjamin Bloom in 1956, is a foundational framework in education that categorizes learning objectives into three primary domains: cognitive, affective, and psychomotor. This taxonomy provides educators with a structured approach to curriculum design and assessment, ensuring the comprehensive development of students' intellectual, emotional, and physical skills. By delineating specific levels within each domain, Bloom's Taxonomy provides educators with a clear roadmap for gauging and enhancing students' learning outcomes across various educational contexts (Kong et al., 2021).

The cognitive domain focuses on intellectual development and is structured into six hierarchical levels: remembering, understanding, applying, analyzing, evaluating, and creating. Each level represents an increasing complexity of cognitive processing, from basic recall of facts to the synthesis of new ideas. The affective domain, concerned with attitudes, emotions, and values, comprises five levels: receiving, responding, valuing, organizing, and characterizing. These levels reflect the progression from passive awareness to active internalization and demonstration of values. Lastly, the psychomotor domain, which emphasizes physical skills and movements, is organized into five levels: perception, set, guided response, mechanism, and complex overt response (Rugeiyamu, 2025). These levels outline the progression from sensory awareness to the precise execution of complex physical tasks (Li & Zheng, 2021).

Related Studies

(1) Tai Chi Kung Fu

Tai Chi Kung Fu, an unarmed martial art rooted in ancient Chinese Tai Chi principles, employs the Thirteen Postures as its core movement techniques and encompasses various forms such as free sparring, prearranged routines (Taolu), pushing hands (Tuishou), and foundational exercises, with routines ranging from the simple 24-form to the more complex 85-form (Wen, 2019). A seven-year practical research initiative focused on reforming Tai Chi elective courses in Chinese universities aimed to address challenges like monotonous content, low athletic ability development efficiency, and difficulties in fostering national spirit, employing teaching experiments across three phases to develop a teaching protocol aligned with China's Healthy Physical Education Curriculum Model (Zheng et al., 2016). Scholars utilized literature review, interviews, and logical analysis to diagnose prevalent issues in Tai Chi teaching methodologies, revealing problems such as a monotonous teaching model, dull content, and low student interest; however, Tai Chi remains a highly suitable physical activity for university students

due to its accessibility and benefits in promoting physical fitness and preserving China's cultural heritage and national spirit, despite ongoing challenges in teaching methods and content (Kong et al., 2021).

(2) Physical Fitness

General physical fitness, encompassing capabilities such as muscular strength, speed, endurance, agility, joint range of motion, and flexibility (Liu & Nah, 2021), serves as the foundation for specialized physical fitness and directly influences its development (Park & Shin, 2021). For college students engaged in competitive Tai Chi Kung Fu routines, key factors influencing their physical fitness include strength, speed, flexibility, and endurance, and their athletic evaluations need to align with their evolving physical conditions and the movement requirements of specialized techniques (Surendran & Saad, 2019). Establishing a comprehensive physical fitness evaluation system for Tai Chi Kung Fu involves expert-led subjective screening of indicators, factor analysis of test data, determination of indicator weights, and scoring of test data against standards to obtain a comprehensive score of students' physical fitness, thereby accelerating the scientific progress of competitive Tai Chi Kung Fu training and talent cultivation (Liu & Nah, 2021).

(3) Study on the Impact of Tai Chi on Physical Fitness

Scholars conducted an experimental study on undergraduate students from non-sports majors to explore the effects of Tai Chi practice on college students' physical health, finding that while 16 weeks of 24-form Tai Chi training did not yield a significant overall impact on physical fitness, it notably improved the lung capacity-to-weight ratio among female students and the sit-and-reach test and standing long jump among male students (Liu & Nah, 2021). The study revealed that Tai Chi significantly enhances college students' physical health, mental well-being, self-awareness, and character, with positive effects on physical fitness, psychological qualities, and mental states (Raes et al., 2020). Although Tai Chi's impact on body composition trends towards rational development, with no significant changes observed in the body shapes of students with normal or low body weights, it is a gentle exercise suitable for individuals under mental stress and students in ordinary Chinese universities, as it can reduce resting heart rate, strengthen cardiopulmonary function, enhance balance and flexibility, and improve mood states among female college students (Kong et al., 2021). The promotional effects of Tai Chi on students' physical health vary depending on the experimental design or analytical approach, as indicated by various expert studies (Aslan & Uygun, 2019).

Method

This study utilized a quasi-experimental design with pre- and post-tests over 13 weeks to investigate the impact of Tai Chi Kung Fu on the physical fitness of first-year students at Fuzhou Software Institute, dividing participants into an experimental group (receiving a 120-minute weekly Tai Chi course) and a control group (engaging in regular PE activities). Physical fitness indicators such as speed, strength, endurance, and flexibility were measured to compare the two groups. At the same time, a five-point scale satisfaction questionnaire was administered to gauge students' subjective experiences and feedback on the course. The questionnaire also collected basic participant information and evaluated the Tai Chi curriculum system across five dimensions: curriculum background, course design, implementation, evaluation, and related

measures, with each section containing five items addressing guiding principles, course orientation, teaching staff training, materials, content, teacher image, goal achievement, and overall satisfaction, thereby providing a scientific basis for optimizing course design and advancing college physical education innovation.

The population of this study consisted of non-physical education majors enrolled in the freshman class at Fuzhou Software University who were studying Tai Chi. The total population size was 264. This study primarily selected experimental subjects from non-sports majors among freshmen at Fuzhou Software University. Before the selection, a pre-test was conducted among 264 students from six classes engaged in Tai Chi Kung Fu training during the semester. The pre-test encompassed measurements of height, weight, age, and physical fitness, among other aspects. Following this, a homogeneity analysis was performed on the results, and based on the pre-test, two classes were identified as having no significant differences for this study. Ultimately, the control and experimental groups were each determined to consist of 41 individuals.

Findings and Discussion

Building on the analyses from Chapters 1 to 3, this chapter collects data for rigorous statistical analysis to validate research hypotheses, employing descriptive statistics and independent-sample T-tests to explore the impact of Tai Chi learning on the physical constitution of first-year university students at Fuzhou Software Institute. The study adopts a comprehensive research design integrating controlled experimentation, testing, and questionnaire surveys, with both groups undergoing pre- and post-intervention physical fitness assessments across indices like speed, strength, endurance, and flexibility. The questionnaire, divided into two parts, collects basic demographic information and delves into the construction of the Tai Chi curriculum. All 41 students from Tai Chi Training Class (1) and Physical Training Class (2) participated, with the former serving as the experimental group and the latter as the control group. Despite relatively balanced student demographics, significant differences and characteristics emerge, including a majority of male students (63.4%), diverse disciplinary backgrounds, and an age distribution predominantly within 19-23 years (39.0%), aligning with the typical age structure of university students and indicating a balanced distribution of Tai Chi courses across gender, major, and age.

Table 1: Descriptive Characteristics

Items	Options	Frequency	Percent%
Gender	Male	52	63.4
	Female	30	36.6
Major	Science and Engineering	22	26.8
	Humanities	10	12.2
	Economics and Management	13	15.9
	Arts	19	23.2
	others	18	22.0
Age	Under 18 and18	29	35.4
	19-23	32	39.0
	Over 23	21	25.6
Total		82	100.0

To Investigate the Differences in Physical Fitness Between Freshmen Who Learn Tai Chi Kung Fu and Those Who Do Not at Fuzhou Software University

This study involved students from Tai Chi Training Class (1) as the experimental group and Physical Training Class (2) as the control group, with the former participating in a 13-week Tai Chi program, held weekly for 120 minutes each session, while the latter engaged in regular physical activities. Pre- and post-tests were conducted to assess changes in physical fitness, with indicators including speed, strength, endurance, and flexibility. The results indicated a significant improvement in the experimental group's post-test scores relative to their pre-test scores, rejecting the null hypothesis and demonstrating that learning Tai Chi Kung Fu significantly enhanced the students' physical fitness, as evidenced by notable differences in mean values and variances between pre- and post-test data.

Table 2: Compare the Average Physical Fitness of Pre-Learning and Pro-Learning Tai Chi Kung Fu

Class	Mean	S.D	Variance	t
Experimental Group	80.98	9.223	46.52	16.81
Control Group	58.54	4.915	26.56	

To investigate the effectiveness of a 13-week Tai Chi Kung Fu training program on improving specific physical fitness components

The result showed that the null hypothesis is rejected at the 0.05 significance level, indicating that the mean post-test score of the experimental group is significantly higher than that of the control group.

Learning Tai Chi Kung Fu enhanced students' physical fitness. The pre-test data revealed no significant differences in mean values or variances between the two groups, indicating similar initial levels for the experimental and control groups. Post-test data demonstrated that learning Tai Chi Kung Fu significantly improved students' physical fitness, with the experimental group achieving a higher average score than the control group. Therefore, the conclusion is that, compared to conventional physical education activities, learning Tai Chi Kung Fu notably enhances students' physical fitness.

Table 3: Compare the Average Physical Fitness of Learning Tai Chi Kung Fu and Regular Physical Education Activities

Experimental Group	Mean	S.D	Control Group	Mean	S.D	t
Learning Tai Chi Kung Fu	58.54	5.153	Regular Physical Education Activities	59.63	4.662	6.03
	80.98	8.482		70.73	6.821	

To explore freshmen's satisfaction with the Tai Chi Kung Fu course in the physical fitness program at Fuzhou Software University

Analysis of freshmen's satisfaction at Fuzhou Software Institute regarding the impact of the Tai Chi Kung Fu course on their physical fitness, covering the Mean, Standard Deviation, and Interpretation. Students generally expressed high satisfaction, with average scores ranging from 3.4 to 3.9 across various dimensions, indicating widespread recognition of the course's positive effects on physical fitness. The curriculum background scored a high mean of 3.707, suggesting satisfaction with the theoretical and background knowledge imparted. The curriculum design, with a mean of 3.666, was perceived as reasonable and well-suited to students' needs, though some improvements were expected in course structure and content arrangement. The curriculum implementation, with a mean of 3.661, was positively evaluated, with teaching methods and practical training meeting students' expectations despite a slightly lower score for Q15. The curriculum evaluation also received a high mean of 3.688, demonstrating recognition of the course's effectiveness, particularly in improving physical fitness. Although there was some variation in opinions among students, as indicated by standard deviations ranging from 0.887 to 1.271, the overall trend was stable, with the theoretical background, design, and implementation meeting students' expectations.

Conclusion

Part 1 for Answering Research Question 1

Students in Tai Chi Kung Fu training (1) and physical training (2) classes were tested before participating in Tai Chi Kung Fu training. In this study, 81 valid tests were collected, and independent-samples F-tests were conducted on students' performance in both classes. The $F_{0.975,32,34} = 0.549 < F_{compute} = 1.22 < F_{0.025,32,34} = 1.820$ means the test variance for learning Tai Chi Kung Fu is equal to the variance of regular physical education activities. So, after learning, use a t-test with equal variances. The computed value ($6.03 > t_{0.05,80} = 1.664$) indicates that it is significantly greater than the critical value; the null hypothesis is rejected, indicating that the mean post-test score of the experimental group is significantly higher than that of the control group. Freshmen who participate in Tai Chi Kung Fu training showed significantly higher scores in physical fitness tests compared to those who do not participate.

Part 2 for Answering Research Question 2

The students in Tai Chi Kung Fu Training Class 1 served as the experimental group, and their physical fitness was assessed before and after the training. The $t_{compute} = 16.81 > t_{0.05,80} = 1.664$ showed that it is significantly greater than the critical value; the null hypothesis is rejected, indicating that the experimental group's post-test score is significantly higher than its pre-test score. The Tai Chi Kung Fu significantly enhanced the students' physical fitness. There were notable differences in the mean and variance between the pre-test and post-test data for the same group of students. There was a significant improvement in physical fitness test scores after completing the 13-week Tai Chi Kung Fu training program.

Part 3 for Answering Research Question 3

The data present an analysis of freshmen's satisfaction levels at Fuzhou Software Institute regarding the impact of the Tai Chi Kung Fu course on their physical fitness. Students generally expressed high satisfaction with the course, with average scores ranging from 3.4 to 3.9 across various dimensions, indicating widespread recognition of the course's positive effects on their physical fitness. The overall mean for the curriculum background was 3.707, with a standard deviation of 0.887, suggesting high student satisfaction with the theoretical and background knowledge imparted by the Tai Chi Kung Fu course. The overall mean for curriculum design was 3.666, with a standard deviation of 0.952, indicating that students perceive the course design as rational and well-suited to fulfilling their needs. The overall mean for curriculum implementation was 3.661, with a standard deviation of 0.964, indicating a high level of implementation. The overall mean for curriculum evaluation was 3.688, with a standard deviation of 0.932, indicating high recognition among students. The majority of freshmen reported high satisfaction levels with the Tai Chi Kung Fu course and its impact on their physical fitness.

Recommendations

Future research should broaden the sample beyond freshmen at Fuzhou Software Institute to enhance external validity, extend the study duration to observe the long-term effects of Tai Chi training, and adopt a longitudinal design to analyze enduring impacts on physical fitness. Additionally, research indicators should be expanded to include mental health aspects such as anxiety and stress management, providing a more holistic perspective on health promotion. Strengthening control over confounding variables, integrating technological means for data collection and analysis, and utilizing smart wearable devices and motion-monitoring technologies can yield more objective and precise data, thereby optimizing future research by optimizing sample scope, study duration, evaluation dimensions, experimental control, and data collection.

The findings validate the application value of Tai Chi in modern physical education, indicating its significant impact on enhancing university students' physical fitness and mental health. Practical teaching and curriculum design should fully leverage Tai Chi's advantages, considering it as a long-term training rather than a short-term elective course. Tai Chi courses can integrate mental health education, facilitating psychological adjustment through physical training. Refining the teaching program with modern methods, offering stratified teaching or personalized training programs, and integrating Tai Chi into the core system of university physical education can enhance teaching quality and adaptability. Collaboration with professional Tai Chi training institutions, fostering students' interest through clubs and competitions, and establishing a comprehensive physical and health education system can further augment Tai Chi's influence, making it a vital component of university physical education and health promotion.

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THE TEACHER-STUDENT INTERACTION TO IMPROVE THE POLITICS INDEPENDENT LEARNING ABILITY OF HIGH SCHOOL STUDENTS IN WEIFANG CITY, SHANDONG PROVINCE

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Abstract: *Independent learning is an essential basic skill in today's information and learning society. This study aims to systematically analyze the current state of teacher-student interaction in political science teaching and its impact on high school students' independent learning, providing a scientific basis and a practical path for optimizing teaching strategies and improving students' independent learning. This study selected four classes from 23 classes of 240 high school students at a middle school in Weifang, Shandong, as the control group (conventional teaching) and the experimental group (teacher-student interactive teaching). Evaluate students' independent learning status at the beginning of the semester, and compare the results of two sets of questionnaires and behavioral activities at the end of the semester. The results indicate that: 1. The interaction between teachers and students significantly enhances the independent learning ability of political science students. 2. All indicators in the experimental group were superior to those in the control group. 3. Students' satisfaction with the interaction between teachers and students and their own abilities has significantly increased. This study validates the effectiveness of teacher-student interactive teaching in enhancing high school students' independent learning in politics, providing a basis for teachers to tailor teaching methods and optimize teaching strategies, helping cultivate students' core learning abilities, and laying the foundation for their future development.*

Keywords: *Teacher-Student Interaction, Independent Learning Abilities, Political Subjects*

Introduction

In the era of globalization and information explosion, independent learning has become an essential skill for students to adapt to rapidly changing social environments (Gao, 2022). The ability to learn autonomously not only supports academic success but also prepares students for lifelong learning and responsible citizenship (Pang, 2003). In China, the political science curriculum in high schools aims to cultivate students' political identity, scientific spirit, rule-of-law awareness, and public participation (Li, 2020). However, traditional lecture-based teaching often limits students' opportunities for active engagement and self-directed learning, leading to passive knowledge reception and weak independent learning skills (Wang, 2004).

Teacher-student interaction has been widely recognized as a key factor in promoting student motivation, cognitive engagement, and learning outcomes (Ye & Pang, 2001; Wubbels et al., 2006). According to social cognitive theory, learning occurs through reciprocal interactions among personal, behavioral, and environmental factors (Bandura, 1986). Zimmerman (1990) extended this theory to self-regulated learning, emphasizing the role of planning, performance

monitoring, and self-reflection. In the classroom context, effective teacher-student interaction can provide scaffolding for students' metacognitive development and foster autonomous learning habits (Cai & Lv, 2010).

Despite the theoretical importance of teacher-student interaction, empirical research on its specific impact on independent learning ability in political science remains limited. Most existing studies have focused on higher education or general academic achievement, with little attention to high school political education (Long & Wang, 2018; Cheng, 2022). Moreover, the mechanisms through which interaction enhances independent learning—such as goal-setting, information analysis, problem-solving, and reflection—have not been systematically examined (Wang, 2022). Therefore, this study aims to fill this gap by investigating the effects of a structured teacher-student interaction teaching model on high school students' independent learning ability in political science.

The research objectives are:

1. To explore effective teacher-student interaction methods for enhancing independent learning ability in political science.
2. To compare the differences in independent learning ability between students in experimental and control groups.
3. To assess students' satisfaction with teacher-student interaction methods.

Literature Review

Related Theories

(1) Social cognitive theory

This study is grounded in Bandura's (1986) social cognitive theory, which posits that human behavior results from dynamic interactions among personal, behavioral, and environmental factors. In educational settings, students' learning behaviors are shaped by their self-efficacy, goals, and the social environment created by teachers and peers. Bandura emphasized observational learning, in which students acquire strategies and skills by attending to and replicating models, such as teachers. Through teacher-student interaction, students internalize learning strategies, self-regulation skills, and motivational beliefs.

(2) Theory of self-regulated learning (SRL)

Zimmerman (1990) extended this theory to self-regulated learning (SRL), proposing a three-phase model: forethought (goal-setting and planning), performance (monitoring and strategy use), and self-reflection (evaluation and adaptation). This cyclical process aligns closely with the dimensions of independent learning ability examined in this study. Zimmerman and Risemberg (1997) further identified six dimensions of SRL: motive, method, time, behavior, physical environment, and social environment, underscoring the importance of both individual agency and social interaction in fostering autonomous learning (Hidayah et al., 2025).

(3) Theory to Bloom's Taxonomy of Educational Objectives

Bloom's Taxonomy of Educational Objectives, introduced by Benjamin Bloom in 1956, is a foundational framework in education that categorizes learning objectives into three primary domains: cognitive, affective, and psychomotor. This taxonomy provides educators with a

structured approach to curriculum design and assessment, ensuring the comprehensive development of students' intellectual, emotional, and physical skills (Susiyawati et al., 2025). By delineating specific levels within each domain, Bloom's Taxonomy provides educators with a clear roadmap for gauging and enhancing students' learning outcomes across various educational contexts (Kong et al., 2021).

These theoretical frameworks collectively emphasize that independent learning is not an innate ability but a developable competency shaped by social interaction, structured guidance, and reflective practice. Teacher-student interaction serves as a critical mechanism through which students acquire and refine these competencies.

Related Studies

(1) Teacher-Student Interaction

Teacher-student interaction refers to the two-way, dynamic communication between teachers and students that facilitates knowledge construction and skill development (Ye & Pang, 2001). It encompasses cognitive, emotional, and behavioral exchanges (Dang, 2005). In the Chinese context, Cai and Lv (2010) distinguished between academic interaction—focusing on knowledge transmission—and social interaction—involving emotional support and value guidance. Shi et al. (2012) further categorized interactions into learning-oriented and socially oriented types, both of which are essential for holistic student development.

Measurement of teacher-student interaction has evolved through various instruments. Wubbels et al. (2006) developed the Questionnaire on Teacher Interaction (QTI) based on the interpersonal model of teacher behavior. In China, Shi et al. (2012) developed a context-specific scale with learning and social interaction dimensions, while Long and Wang (2018) expanded it to include value interaction and extended interaction.

Research has identified multiple factors influencing interaction quality. Guerrero and Rod (2013) highlighted syllabus design, instructional methods, and classroom climate as key determinants. Cheng (2022) found that teacher factors (teaching style, feedback), cultural factors (hierarchical norms), and learner characteristics (motivation, language proficiency) significantly affect interaction in Chinese classrooms. Optimization strategies include diversifying interaction formats, creating supportive environments, and establishing egalitarian relationships (Wang, 2021; Tian, 2022).

(2) Independent Learning Ability

Independent learning ability denotes learners' capacity to take responsibility for their own learning processes. Holec (1979) defined it as the ability to set goals, select materials, choose methods, monitor progress, and evaluate outcomes. Little (1991) emphasized the psychological dimension, describing autonomous learners as those who engage in critical reflection and independent action.

In China, Pang (2003) developed a comprehensive framework of independent learning comprising seven dimensions: motivation, content, methods, time, process, outcome, and

environment. Lin (2013) developed a 35-item scale to assess independent learning in Chinese contexts, encompassing six dimensions: learning responsibility, learning awareness, learning planning, implementation monitoring, evaluation and reflection, and learning behavior. For this study, we adopt Lin's six-dimension framework: (1) goal-setting and planning, (2) independent thinking and self-learning, (3) information acquisition and analysis, (4) problem-solving and cooperation, (5) exploration and practical application, and (6) reflection and adaptation.

(3) Teacher-Student Interaction and Independent Learning

Empirical studies support the link between interaction and independent learning. Cai and Lv (2010) found that interactive teaching methods enhance students' motivation and self-management skills. Shi et al. (2012) reported that frequent teacher-student interactions positively correlate with students' use of deep learning strategies and metacognitive awareness. Cheng (2022) demonstrated that interactive teaching significantly improves students' autonomous learning behaviors, including goal-setting, resource utilization, and self-evaluation. Wang (2022) showed that teacher-student interaction fosters critical thinking, problem-solving, and independent inquiry.

In political science education, interaction is particularly salient as political knowledge requires dialogue, debate, and perspective-taking. Through interaction, teachers guide students to analyze multiple viewpoints, evaluate evidence, and form reasoned opinions—skills central to independent learning (Li, 2020). Emotional support built through positive interactions enhances students' self-efficacy and willingness to engage with challenging topics (Tianyu, 2021). This study contributes to this literature by systematically examining the impact of a structured teacher-student interaction model on multiple dimensions of independent learning in high school political science.

Method

This study employed a quasi-experimental design with pre- and post-tests over 13 weeks to investigate the impact of teacher-student interaction on the independent learning ability of high school students in political science at a high school in Weifang City, Shandong Province. Participants were divided into an experimental group (receiving teacher-student interactive teaching) and a control group (engaging in conventional lecture-based teaching). The interactive teaching method followed a six-step model: pre-class preparation and goal-setting, introduction, knowledge explanation and questioning, interactive discussion and sharing, guided deep thinking, and summary and reflection.

Independent learning ability was measured across six dimensions: goal-setting and planning; independent thinking and self-learning; information acquisition and analysis; problem-solving and cooperation; exploration and practical application; and reflection and adaptation. A 30-item questionnaire using a five-point Likert scale was administered to assess these dimensions. Additionally, a 25-item academic achievement test was conducted to evaluate students' mastery of political science content. Students' library visit frequency was recorded as a behavioral indicator of independent learning. A satisfaction questionnaire, also using a five-point Likert scale, was administered to the experimental group to gauge their subjective experiences and feedback on the interactive teaching method, covering six dimensions: activities in interaction, self/peer evaluation,

communication with students, analysis of notes/summaries, teamwork and group discussion, and reflection guidance.

The study population comprised sophomore students at a high school in Weifang City, Shandong Province, totaling 1,380 students across 23 classes. Using cluster random sampling, four classes (240 students) were selected. Before selection, a pre-test was conducted to assess students' baseline independent learning ability and academic performance. Homogeneity analysis confirmed that there were no significant differences between groups. Ultimately, two classes (120 students) were assigned to the experimental group and two classes (120 students) to the control group.

Findings and Discussion

Building on the analyses in Chapters 1 to 3, this section collects data for rigorous statistical analysis to validate research hypotheses, employing descriptive statistics and independent-samples T-tests to examine the impact of teacher-student interaction on the independent learning ability of high school students in political science at a high school in Weifang City, Shandong Province. The study adopts a comprehensive research design integrating controlled experimentation, testing, and questionnaire surveys, with both groups undergoing pre- and post-intervention assessments across six dimensions of independent learning ability: goal-setting and planning, independent thinking and self-learning, information acquisition and analysis, problem-solving and cooperation, exploration and practical application, and reflection and adaptation. The questionnaire also collected basic demographic information and delved into students' satisfaction with the interactive teaching method. All 240 students from four classes participated, with two classes (120 students) serving as the experimental group and the other two (120 students) as the control group. The sample included 128 male students (53.3%) and 112 female students (46.7%), aged 15-17 years, with a balanced distribution across gender and age, ensuring comparability between groups.

Table 1: Descriptive Characteristics of Participants

Variable	Experimental Group (n=120)	Control Group (n=120)
Gender (Male/Female)	65/55	63/57
Age (Mean $\pm$ SD)	16.2 $\pm$ 0.6	16.3 $\pm$ 0.5
Pre-test Academic Score (Mean $\pm$ SD)	68.5 $\pm$ 10.2	69.1 $\pm$ 9.8

To Investigate the Differences in Independent Learning Ability Between Students Who Experience Teacher-Student Interaction and Those Who Do Not

This study involved students in the experimental group receiving a 13-week teacher-student interactive teaching program, held weekly for 100 minutes per session, following a six-step model: pre-class preparation and goal-setting, introduction, knowledge explanation and questioning, interactive discussion and sharing, guided deep thinking, and summary and

reflection. The control group received conventional lecture-based instruction. Pre- and post-tests were conducted to assess differences in independent learning ability before and after the intervention, with measurement indicators covering six dimensions. The results indicated a significant improvement in the experimental group's post-test scores compared to their pre-test scores, rejecting the null hypothesis and demonstrating that teacher-student interaction significantly enhanced students' independent learning ability, as evidenced by notable differences in mean values and variances between pre- and post-test data.

Table 2: Comparison of Pre-Test and Post-Test Independent Learning Ability in Experimental Group

Dimension	Pre-Test (M $\pm$ SD)	Post-Test (M $\pm$ SD)	Mean Difference	t-value	p-value
Goal-setting and planning	2.21 $\pm$ 1.05	4.28 $\pm$ 0.80	2.07	18.34	< .001
Independent thinking	2.35 $\pm$ 1.12	4.18 $\pm$ 0.84	1.83	15.67	< .001
Information acquisition	2.18 $\pm$ 1.08	4.03 $\pm$ 0.99	1.85	16.21	< .001
Problem-solving and cooperation	2.24 $\pm$ 1.15	4.19 $\pm$ 0.84	1.95	17.02	< .001
Exploration and practice	2.09 $\pm$ 1.03	4.33 $\pm$ 0.77	2.24	19.45	< .001
Reflection and adaptation	2.15 $\pm$ 1.02	4.01 $\pm$ 1.09	1.86	15.89	< .001
Overall independent learning ability	2.20 $\pm$ 0.86	4.17 $\pm$ 0.54	1.97	22.18	< .001

To Investigate the Effectiveness of a 13-Week Teacher-Student Interaction Program on Improving Specific Independent Learning Components

The result showed that the t-value was significantly greater than the critical value, rejecting the null hypothesis and indicating that the experimental group's post-test mean was significantly higher than the control group's. Teacher-student interaction enhanced students' independent learning ability across all six dimensions. The pre-test data revealed no significant differences in mean values or variances between the two groups, indicating similar initial levels for the experimental and control groups. Post-test data showed that teacher-student interaction significantly improved students' independent learning, with the experimental group achieving higher average scores than the control group across all dimensions. Therefore, the conclusion is that, compared to conventional teaching methods, teacher-student interaction notably enhances students' independent learning ability in political science.

Table 3: Comparison of Post-Test Independent Learning Ability Between Experimental and Control Groups

Dimension	Experimental (M $\pm$ SD)	Control (M $\pm$ SD)	Mean Difference	t-value	p-value	Cohen's d
Goal-setting and planning	4.28 $\pm$ 0.80	2.18 $\pm$ 1.07	2.1	17.24	< .001	2.23
Independent thinking	4.18 $\pm$ 0.84	2.31 $\pm$ 1.19	1.87	14.11	< .001	1.82
Information acquisition	4.03 $\pm$ 0.99	2.17 $\pm$ 1.04	1.86	14.56	< .001	1.88
Problem-solving and cooperation	4.19 $\pm$ 0.84	2.23 $\pm$ 1.12	1.96	15.32	< .001	1.98
Exploration and practice	4.33 $\pm$ 0.77	2.08 $\pm$ 1.05	2.25	18.9	< .001	2.44
Reflection and adaptation	4.01 $\pm$ 1.09	2.14 $\pm$ 1.01	1.87	14.02	< .001	1.81
Overall independent learning ability	4.17 $\pm$ 0.54	2.18 $\pm$ 0.84	1.99	21.56	< .001	2.78

To Explore Students' Satisfaction with the Teacher-Student Interaction Course in Enhancing Independent Learning Ability

The analysis of students' satisfaction at the high school in Weifang City regarding the impact of the teacher-student interaction course on their independent learning ability covered aspects of Mean, Standard Deviation, and Interpretation. Students in the experimental group generally expressed high satisfaction, with average scores ranging from 4.00 to 4.27 across various dimensions, indicating widespread recognition of the course's positive effects on independent learning ability. Activities in the interactive process had a high mean of 4.127, suggesting satisfaction with goal-setting, planning, and problem-solving during interaction. Student self-assessment or peer evaluation, with a mean of 4.007, was perceived positively, indicating that students valued the feedback and recognition from themselves and peers. Communication with students scored a mean of 4.200, reflecting satisfaction with opportunities to exchange ideas and collaborate with classmates. Analysis of students' reading work, notes, or summaries received the highest mean of 4.272, demonstrating strong recognition of the teacher's constructive feedback. Teamwork and group discussion activities scored a mean of 4.187, indicating that students found collaborative learning beneficial for developing cooperation and problem-solving skills. Guidance for reflection and practical application received a mean score of 4.150, indicating that students appreciated the teacher's support in connecting theory to practice. Although there was some variation in opinions among students, as indicated by standard deviations ranging from 0.854 to 1.164, the overall trend was stable, with all dimensions meeting or exceeding students' expectations. In contrast, the control group reported low satisfaction (overall mean = 2.01), underscoring the limitations of conventional teaching in meeting students' needs for autonomy, engagement, and skill development.

Table 4: Student Satisfaction with Teacher-Student Interaction Course (Experimental Group)

Dimension	Mean	SD	Interpretation
Activities in interactive process	4.127	0.982	Satisfied
Student self-assessment or peer evaluation	4.007	0.995	Satisfied
Communication with students	4.2	1.164	Satisfied
Analysis of reading work, notes, or summaries	4.272	0.867	Satisfied
Teamwork and group discussion activities	4.187	0.929	Satisfied
Guidance for reflection and practical application	4.15	0.854	Satisfied
Overall satisfaction	4.14	0.58	Satisfied

These findings collectively demonstrate that teacher-student interaction significantly enhances high school students' independent learning ability in political science across all measured dimensions. The experimental group showed substantial improvements from pre-test to post-test and outperformed the control group in all post-test comparisons. Students expressed high satisfaction with the interactive teaching method, particularly valuing the goal-setting activities, constructive feedback, collaborative learning opportunities, and reflective guidance. The results provide strong empirical support for integrating structured teacher-student interaction strategies into political science education to foster self-regulated learning and holistic student development.

Conclusion

The first part answers research question 1

The teacher-student interaction method can significantly improve students' independent learning ability. The experimental group conducted teacher-student interaction through pre-class previews, setting preview goals, introducing links, explaining knowledge and prompting questioning, interactive discussion and sharing, guiding deep thinking, and summarizing and reflecting. The results showed that, through teacher-student interaction, their goal-setting and planning ability, independent thinking and independent learning ability, information acquisition and analysis ability, problem-solving and cooperation ability, exploration and practical application ability, and reflection and adjustment ability were significantly improved. At the same time, the control group performed poorly in these abilities.

The second part answers research question 2

The experimental group performed better than the control group in all measurement aspects. The experimental group scored higher in goal-setting and planning ability, independent thinking and independent learning ability, information acquisition and analysis ability, problem-solving and cooperation ability, exploration and practical application ability, reflection and adjustment ability, and test scores. It visited the library more often, which confirmed the effectiveness of the teacher-student interaction method in promoting independent learning.

Part III answers research question 3

Students' satisfaction with teacher-student interaction methods and their independent learning ability was significantly improved. The experimental group students were more satisfied with the activities during the interaction, students' self-evaluation or peer evaluation, communication with students, analysis of students' reading works, notes or summaries, evaluation of their interpretation and comprehension ability and independent learning ability, activities in teamwork or group discussion, evaluation of their cooperation and problem-solving ability, guiding students to reflect and summarize, and evaluation of their reflection and self-adjustment ability than the control group.

These findings are of great significance to the practice of political education and verify the effectiveness of teacher-student interactive teaching in improving students' independent learning ability in political subjects. It provides strong support for teachers to use interaction in political teaching. These strategies not only help to improve students' independent learning, but also cultivate their goal setting and planning ability, independent thinking and independent learning ability, information acquisition and analysis ability, problem solving and cooperation ability, exploration and practical application ability, reflection and adjustment ability, and lay a solid foundation for their future study, life and work.

Future research can further explore the impact of different teaching methods on students' independent learning ability, especially across different disciplines and educational stages, and refine the relevant teaching strategies.

Recommendations

These findings are of great significance to the practice of political education because they verify the effectiveness of the teacher-student interactive teaching method in improving independent learning ability. They provide useful insights for teachers to consider students' individual differences in teaching and adjust teaching methods. The application of these strategies can also help cultivate students' goal-setting and planning abilities, independent thinking and independent learning abilities, information acquisition and analysis abilities, problem-solving and cooperation abilities, exploration and practical application abilities, and reflection and adjustment abilities, laying a solid foundation for their future learning, work, and life.

Teacher-student interaction can stimulate students' interest and enthusiasm in political subjects. Through interactive teaching activities, students can participate more actively in learning, thereby improving learning outcomes. This interactive teaching method can break the monotony of traditional teaching, making the classroom more lively and interesting. Through the teacher-student interactive teaching method, students' independent learning ability in political subjects can be effectively improved. Improving this ability not only helps students better master political knowledge but also cultivates independent thinking and self-management, thereby enhancing learning outcomes. Teacher-student interaction can promote teachers' self-reflection and professional development. Through interaction with students, teachers can identify problems and deficiencies in the teaching process, thereby continuously

improving teaching methods and improving teaching quality. Therefore, teachers should incorporate teacher-student interaction strategies into teaching methods to enhance students' learning experience and outcomes.

Future research should continue to explore the impact of teacher-student interactive teaching methods across different subjects and educational stages, and examine how to customize these methods to meet students' diverse needs. In addition, longitudinal studies can provide a deeper understanding of the long-term benefits of teacher-student interactive teaching methods on mental health and negative learning effects.

By incorporating these research findings into educational practice, educators can better support students in developing lifelong learning and the skills needed to succeed across academic and professional environments.

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THE EMPLOYMENT GUIDANCE THEORY TO IMPROVE STUDENTS' CAREER PLANNING AWARENESS OF FOURTH-YEAR STUDENTS AT XIAMEN UNIVERSITY OF TECHNOLOGY

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Abstract: *This study evaluated the impact of an employment guidance theory on fourth-year students' career planning awareness at Xiamen University of Technology through a randomized controlled trial, comparing an experimental group (receiving theory-based courses) and a control group (traditional instruction). Results demonstrated that the experimental group significantly outperformed the control group in career cognition, decision-making, and preparation ($t=21.662$, $p<0.05$), with post-intervention scores showing marked improvement over pretest baselines ($t=27.74$, $p<0.05$). While students reported high satisfaction with course support services (mean=3.769), their perceptions of development opportunities and employment policy guidance fell below expectations. The findings advocate for refining career guidance frameworks through practical university-enterprise collaborations, tailored mentoring, and clearer policy interpretation to bolster students' career readiness and long-term prospects, offering empirical insights for institutional reform in higher education career services.*

Keywords: *Employment Guidance Theory, Students' Career Planning Awareness, Fourth-Year Students, Xiamen University of Technology*

Introduction

In the context of escalating job market competition and rising graduate numbers, contemporary Chinese university students face profound challenges in career planning due to structural employment contradictions and rapid shifts in career development (Serhii Dolhopolov et al., 2022). Research highlights systemic deficiencies in traditional employment guidance frameworks that often prioritize short-term, formalized instruction over long-term developmental needs, leading to outdated content, generic teaching methods, and inadequate personalization. Students struggle with weak self-awareness, limited understanding of market trends, and unclear career pathways, exacerbating post-graduation employment pressures and mismatches between job expectations and reality. The 2022 China University Student Employment Report underscores these gaps, revealing a 35% turnover rate, 64% employment satisfaction, and only 42% alignment between job expectations and aspirations among recent graduates, indicating critical shortcomings in service effectiveness. While universities have established basic employment support systems, deep-seated issues persist, including insufficient integration of vocational education with individual needs, poor precision in career planning, and weak cultivation of autonomous student agency (Nguyahambi et al., 2025). These challenges stem from an institutional overemphasis on administrative and educational functions rather than service-oriented approaches, compounded by limited utilization of

technological and conceptual innovations. Addressing these gaps demands systemic reforms guided by empirical theories, embracing new technologies and ideas to enhance service quality, refine career planning education, and foster student-centered, long-term career competitiveness (Udagama et al., 2019).

Research Objectives:

1. To investigate the differences in the students' career planning awareness in the employment guidance course of fourth-year students before and after the implementation of the employment guidance theory at Xiamen University of Technology.
2. To explore the impact of employment guidance theory on improving the students' career planning awareness in the employment guidance course of fourth-year students at Xiamen University of Technology.
3. To explore students' satisfaction levels using surveys and feedback mechanisms.

The scope of this research study targets senior students at Xiamen University of Technology, who serve as both recipients and evaluators of the university's employment guidance services. Unlike students in earlier academic years, seniors have more extensive exposure to and firsthand experience with the full spectrum of these services, enabling them to offer nuanced insights into their effectiveness. The study employs a Likert five-point scale to systematically assess seniors' perceptions and experiences, thereby providing a clear, reliable evaluation of the quality and impact of the university's employment guidance initiatives (Rugeiyamu, 2025). This focused approach ensures a nuanced understanding of how well the program aligns with the university's educational and talent development goals.

Literature Review

Related Theories

(1) Employment Guidance Theory

Employment guidance theory, originating in the early 20th century, has evolved to encompass diverse methodologies, including career development, vocational interests, career construction, and self-management theories, and has adapted to global and technological changes (Sun & Yuen, 2012). In China, a unique career education model integrating guidance throughout education has emerged, leveraging the internet and big data technologies. Career planning awareness, a key aspect of career development, involves self-awareness, career information acquisition, and rational decision-making, crucial for adapting to career changes and achieving satisfaction (Coetzee & Potgieter, 2019). Its cultivation relies on education, consultation, and practical experience, and is influenced by family, education, social environment, and personal factors. Recent research focuses on theoretical, empirical, and applied aspects to enhance individuals' career planning awareness and its impact on career development (Okolie et al., 2020).

(2) Expectancy Theory

Expectancy Theory, proposed by Victor Vroom in 1964, elucidates how individuals' motivation in the workplace is influenced by perceptions of valence (the attractiveness of outcomes), instrumentality (the belief that performance leads to rewards), and expectancy (the belief that effort leads to performance). It has been widely applied to explain work motivation

and behavior choices, though it has limitations such as neglecting organizational factors and irrational decision-making influences (Bhattacharya, 2010). In the context of employment guidance, Expectancy Theory provides insights into job seekers' expectations, including their desire for clear career goals, skill enhancement, and attractive employment opportunities (valence), their belief in the quality of guidance, practical opportunities, and networking resources (instrumentality), and their confidence in receiving necessary resources, personalized advice, and continuous support (expectancy), all of which are crucial for improving students' career self-efficacy, job search motivation, and long-term career development (Konjufca & Cakolli, 2023).

(3) Perceived Behavioral Control Model

The Perceived Behavioral Control Model (PBC), proposed by Ajzen in 1985 and closely related to the Theory of Planned Behavior, aims to understand and predict individual behavioral choices in complex tasks by emphasizing perceived control over behavior, which consists of control beliefs (individuals' beliefs about resources and barriers) and perceived power (the influence of these resources and barriers) (Ajzen, 2002). The PBC model suggests that behavioral intention, influenced by attitude, subjective norms, and perceived behavioral control, is the most crucial predictor of behavior. Although the PBC model has been applied to study students' learning behavior and academic achievement, it has limitations, including limited explanatory power for complex behaviors and the neglect of emotional factors (Venkatesh, 2020). Nevertheless, the PBC model, as a core component of TPB, provides a theoretical foundation for behavioral interventions and policy formulation in various fields, including public health and environmental protection (Becker, 2018; Chen & Tung, 2014; Paul et al., 2016).

Related Studies

(1) Employment Guidance for University Students

University students' employment guidance is a crucial aspect of student affairs management in higher education, encompassing the concepts of employment and employment guidance (Kotera & Sheffield, 2017). Employment, a key field in labor economics and a macroeconomic indicator, involves laborers engaging in socially beneficial work for remuneration, with its definition varying across countries but generally aligned with the International Labour Organization's standard. Employment guidance, in a broad sense, refers to comprehensive social consultation and service activities related to employment, aimed at helping job seekers choose occupations that fit their person-job fit (Coetzee & Potgieter, 2019). This research defines employment guidance as the process where specialized institutions assist job seekers in career direction, occupation selection, and career development, with university students' employment guidance specifically targeting university students, involving various entities like universities, government, society, and employers, aiming to cultivate students' comprehensive employment qualities and abilities through planned teaching activities and career development guidance (Udagama et al., 2019).

(2) Approaches to Employment Guidance for University Students

University students' employment guidance employs diverse methods to address the general need for basic employment skills and individual guidance needs (Kim, 2021). These methods

include offering systematic and professional employment guidance courses to strengthen ideological and political education and equip students with employment knowledge and problem-solving skills (Hooley, 2022); conducting specialized lectures on employment guidance tailored to different majors, featuring experts and successful professionals to share theoretical and practical insights; providing employment counseling through face-to-face, one-on-one, or group sessions, as well as indirect communication via media tools, to address career selection, interview, and psychological issues; offering employment information network guidance through school websites and social media platforms to keep students informed about recruitment and employment matters; and establishing employment internship bases with employers to enhance students' practical abilities and facilitate a two-way selection process between students and employers, achieving a win-win situation (Prokhorov, 2022).

Method

This study employed an experimental research design with a pretest/posttest control-group framework to examine the effectiveness of employment guidance theory in enhancing career-planning awareness among fourth-year students at Xiamen University of Technology. Two classes from the same major were randomly assigned to an experimental group that received instruction based on employment guidance theory and a control group that followed traditional teaching methods. Both groups completed pretests to assess baseline career planning awareness, and posttests were administered after the intervention to evaluate changes. Additionally, a questionnaire was employed to measure student satisfaction and perceptions, covering demographic information and dimensions related to employment guidance expectations and perceptions. The questionnaire included 20 items on expectations and 19 on perceptions, for a total of 39 measurement items.

The survey participants in this study were 600 fourth-year (senior) university students at Xiamen University of Technology, selected to ensure representativeness and diversity across majors, thereby facilitating a comprehensive understanding of the varied needs and feedback regarding employment guidance from students with different backgrounds. Senior students were chosen due to their extensive exposure to different stages of learning and employment guidance throughout their university tenure, providing them with relatively comprehensive knowledge and profound experience of the services offered by Xiamen University of Technology.

This study employed a structured sampling approach to assess career planning awareness among fourth-year students at Xiamen University of Technology, utilizing an electronically distributed, bilingual (English-Chinese) questionnaire based on a five-point Likert Scale. Random sampling was conducted via Wen Juan Xing, an online platform, to select participants proportionally across diverse majors from multiple colleges, ensuring representativeness and minimizing bias. 200 participants were randomly assigned to two groups: an experimental group (n=100) receiving an employment guidance theory course and a control group (n=100) receiving no additional guidance. This random allocation balanced group demographics, enabling a rigorous comparison of the course's impact on career planning awareness.

Findings and Discussion

The chapter outlines the design of a questionnaire, lesson plan, and test based on a literature review, using descriptive statistics, the F-test, and the independent-samples T-test to explore the efficacy of career guidance theories in enhancing students' career planning awareness through controlled experimental methods. The research, targeting fourth-year students at Xiamen University of Technology, employed a pretest/posttest control-group design to assess career-planning awareness regarding career recognition, decision-making, and preparation. Participants, randomly assigned to experimental and control groups, were surveyed on demographics, career guidance expectations, perceptions, and career planning awareness. The experimental group received employment guidance theory courses, while the control group did not. The study's major and age distributions were balanced across groups, reflecting the overall characteristics of fourth-year students at the university, and providing a foundational background for the research analysis.

Table 1: Descriptive Characteristics

Items	Options	Frequency	Percent%
Gender	Male	97	48.5
	Female	103	51.5
	Science and Engineering	27	13.5
	Humanities	55	27.5
	Economics and Management	84	42.0
Major	Arts	16	8.0
	others	18	9.0
	Under 18 and18	16	8.0
	19-23	68	34.0
Age	Over 23	116	58.0
Total		200	100.0

To Investigate the Differences in the Students' Career Planning Awareness in the Employment Guidance Course of Fourth-Year Students Before and After the Implementation of the Employment Guidance Theory at Xiamen University of Technology

This study compares students' career planning awareness before and after instruction in employment guidance theory, using career cognition, decision-making, and preparedness as indicators. The results show that rejecting the null hypothesis with a posttest score significantly higher than the pretest score indicates that receiving such instruction significantly enhances students' career planning awareness, as evidenced by notable differences in mean values and variances between the pretest and posttest data, indicating improvements in career cognition, decision-making, and preparedness.

Table 2: Experimental Group Average Career Planning Awareness of Pre-Received and Pro-Received Instruction in Employment Guidance Theory

Pre-Received		Pro-Received		Variance
Mean	S.D	Mean	S.D	11.33
17.04	3.91	51.52	5.76	

To explore the Impact of Employment Guidance Theory On Improving the Students' Career Planning Awareness in the employment guidance course of Fourth-Year Students at Xiamen University of Technology

This study compared the impact of employment guidance theory courses versus traditional education on 100 students each in experimental and control groups, with assessments conducted pre- and post-study focusing on career recognition, decision-making, and preparation. Initially, no significant differences in career planning awareness were found between the groups. However, posttest results revealed that the experimental group, having received employment guidance theory, showed significantly higher average scores than the control group, indicating a marked improvement in career planning awareness. The study concluded that instruction in employment guidance theory significantly enhances students' career planning awareness compared to traditional education.

Table 3: Compare the Variance of Received Instruction in Employment guidance theory and the Variance of Received Traditional Instruction

Experimental Group	Mean	S.D	Control Group	Mean	S.D	t
Received Instruction in Employment Guidance Theory	51.52	5.76	Received	17.04	3.75	21.66
	32.36	4.02	Traditional Instruction	17.56	4.06	

The research data showed a balanced demographic distribution across the experimental and control groups. The analysis of the Xiamen University of Technology students' scores on career planning awareness after employment guidance instruction revealed high overall scores across multiple dimensions, indicating the instruction's impact. Students had moderate expectations for career information acquisition with varied demands, high expectations for support services like career counseling and internships, overall high expectations for development opportunities, though with some doubts about job market feasibility, and a balanced high level of expectation for employment policies, influenced by their understanding of the job market and policies.

Table 4: Average, Standard Deviation, and Interpretation of the Impact of Received Instruction in Employment Guidance Theory on Students' Employment Guidance Expectations

NO.	Mean	Std. Deviation	Interpretation
Q1	3.36	1.22	Moderate
Q2	3.58	1.18	High
Q3	3.52	1.17	High
Q4	3.43	1.21	Moderate
Q5	3.54	1.17	High
Q6	3.60	1.13	High
Q7	3.42	1.22	Moderate
Q8	3.65	0.99	High
Q9	3.67	1.13	High

Q10	3.56	1.22	High
Q11	3.57	1.18	High
Q12	3.75	1.18	High
Q13	3.51	1.30	High
Q14	3.74	1.22	High
Q15	3.37	1.11	Moderate
Q16	3.42	1.06	Moderate
Q17	3.55	0.98	High
Q18	3.57	1.17	High
Q19	3.50	1.03	High
Q20	3.52	1.08	High
Total	3.53	1.51	High

The data present research findings on students' perceptions of career guidance after theoretical instruction, with moderate to high scores across dimensions, indicating the courses' impact varies. In information access perception, the average was moderate, with some students perceiving positive effects on accessing employment information, while others had reservations. Support service perception scored the highest, with most students recognizing the value of courses in providing employment support and holding positive views on career support services. Perceptions of development opportunities were moderate, with dispersed scores indicating some skepticism about actual opportunities but also belief in the courses' helpfulness. Perceptions of employment policy were also moderate, with relatively balanced scores suggesting some students' limited understanding of its impacts. Standard deviations for some questions suggested considerable disagreements among students, potentially influenced by personal experiences or expectations. Overall, students hold positive perceptions of career support resources.

Table 5: Average, Standard Deviation, and Interpretation of the Impact of Received Instruction in Employment Guidance Theory on Students' Employment Guidance Perceptions

No.	Mean	Std. Deviation	Interpretation
Q21	3.49	1.11	Moderate
Q22	3.74	1.21	High
Q23	3.43	1.18	Moderate
Q24	3.31	1.22	Moderate
Q25	3.41	1.11	Moderate
Q26	3.46	1.02	Moderate
Q27	3.66	1.05	High
Q28	3.83	1.35	High
Q29	3.70	0.93	High
Q30	3.99	1.15	High
Q31	3.65	1.09	High
Q32	3.09	1.24	Moderate
Q33	3.53	1.22	High
Q34	3.48	1.25	Moderate
Q35	3.28	1.19	Moderate

Q36	3.36	1.26	Moderate
Q37	3.540	1.03	High
Q38	3.52	1.24	High
Q39	3.49	1.09	Moderate
	3.52	1.15	High

The findings of this study confirmed all three research hypotheses. Significant differences were observed in fourth-year students' career planning awareness regarding the implementation of the employment guidance theory, indicating the effectiveness of the intervention. The data demonstrated that the employment guidance theory significantly improved students' career planning awareness within the employment guidance course, particularly in career cognition, decision-making, and preparedness. The results revealed a high level of student satisfaction with the implementation of the theory, especially regarding support services and access to career information, although policy interpretation and developmental feasibility still require improvement. These outcomes collectively validate the positive impact of the employment guidance theory on strengthening students' career planning competencies and overall engagement with the guidance course.

Conclusion

Part 1 for Answering Research Question 1

The means test variance of received instruction in employment guidance theory is equal to the variance of received traditional instruction. The results showed a t-test with equal variance. The results showed that the null hypothesis was rejected at the 0.05 level, indicating that the experimental group's posttest mean score was significantly higher than the control group's. Employment guidance theory can significantly enhance fourth-year students' career planning awareness in the employment guidance course at Xiamen University of Technology.

Part 2 for Answering Research Question 2

The students who received instruction in employment guidance theory comprised the experimental group, and their physical well-being was compared before and after the instruction. The results showed that the null hypothesis was rejected at the 0.05 level, indicating that the experimental group's posttest score was significantly higher than its pretest score. Receiving instruction in employment guidance theory enhanced students' awareness of career planning. There were significant differences in fourth-year students' career planning awareness at Xiamen University of Technology, and in the implementation of the employment guidance theory in the course.

Part 3 for Answering Research Question 3

The data indicate that employment guidance theory instruction has somewhat elevated fourth-year students' professional awareness of career planning and career guidance, with scores generally ranging from 3.3 to 3.8 across different dimensions. Students had high expectations for support services and career-planning development opportunities. While their perception of support services was relatively high (3.76), reflecting the course's effectiveness in this area, their perception of development opportunities (3.36) was notably lower than expected, suggesting lingering doubts about the course's role in providing them. Additionally, students'

perception of employment policies was relatively low (3.43), and their perception of information acquisition (3.47) fell within the moderate range, indicating some uncertainty regarding development opportunities. Overall, the students were satisfied with the implementation of the employment guidance theory in the employment guidance course.

Recommendations

Recommendations for Future Research

Future research on career guidance should expand its subject base beyond senior-year students at Xiamen University of Technology to include diverse institutions and majors, and employ longitudinal studies to evaluate the long-term impact of career guidance curricula on students' post-graduation professional development. It should integrate variables such as personality traits, social resources, and familial backgrounds into a comprehensive theoretical model to better understand and tailor career guidance strategies. Additionally, refining research methodologies by combining questionnaires, interviews, and case studies can yield deeper insights and practical guidance for curriculum improvement. Lastly, given the evolving job market, future studies should focus on integrating digital technologies, such as AI and big data analysis, into career guidance to enhance precision and efficiency, and on exploring hybrid online models to meet students' needs better.

Implication for Practice

Research indicates that theoretical career guidance instruction positively impacts the career planning awareness and employment cognition of senior-year students at Xiamen University of Technology, though with varying efficacy across dimensions, necessitating curriculum refinement to better align with student needs and market trends. The curriculum should prioritize practical application, incorporating corporate internships and industry exchanges to bridge the gap between theory and practice, and inviting industry experts and alumni to share insights into career paths. Personalized mentorship should be emphasized to address diverse student needs, with tailored guidance based on discipline-specific characteristics. Enhancing access to employment information through a comprehensive career information platform and strengthening university-enterprise collaborations will provide students with timely and relevant resources. Additionally, the curriculum should intensify policy interpretation training to help students effectively leverage policy resources and foster professional innovation by integrating entrepreneurial education and interdisciplinary collaborations. By focusing on practical orientation, personalized mentorship, information access, policy understanding, and innovation, Xiamen University of Technology can improve students' professional competitiveness and adaptability in the job market, facilitating their career progression.

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