A Conceptual Framework of Driving Factors Influencing Older Adults' Smartphone Use Behaviour in Malaysia Using SOR Framework

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ABSTRACT

Malaysia's rapidly aging population presents challenges in digital inclusion, particularly in smartphone adoption among older adults. Despite the numerous benefits of smartphone use—including enhanced communication, access to information, and improved health management—many older Malaysians remain hesitant to embrace this technology. This study applies the Stimulus-Organism-Response (SOR) framework to examine the driving factors influencing smartphone adoption among older adults in Malaysia. Specifically, it investigates the roles of subjective norms, facilitating conditions, self-efficacy, technology anxiety, perceived ease of use, and perceived usefulness in shaping behavioural intention. A mixed-methods approach, combining survey data and qualitative insights, ensures a comprehensive understanding of the issue. Structural Equation Modelling (SEM) will be employed to analyse the relationships among key variables. The findings will provide evidence-based recommendations for policymakers, technology developers, and community organizations to enhance digital literacy, reduce barriers, and promote technology acceptance. By integrating socio-cultural and infrastructural considerations into the SOR framework, this study contributes to the growing discourse on digital inclusion and aging, offering a localized perspective on smartphone adoption in Malaysia. The insights gained can inform strategies to empower older adults, bridge the digital divide, and improve their quality of life through greater smartphone utilization.

Keywords: older adults, smartphones, stimulus-organism-response, technology anxiety

INTRODUCTION

Malaysia, like many other nations, is experiencing rapid demographic aging, with an increasing proportion of older adults. As digital technology becomes deeply embedded in daily life, smartphone use among older adults is growing. However, despite the potential benefits of smartphones such as enhanced communication, access to information, and health management (Lee et al., 2020), many older Malaysians remain reluctant to adopt and use them (Chang, 2024; Liew et al., 2022; Hui, 2016). Studies on smartphone acceptance among older adults have primarily focused on Western (Miller et al., 2021) or East Asian (Chen & Chan, 2014; Guo et al., 2013) contexts, with limited exploration of the Malaysian perspective. This study aims to fill this gap by examining the driving factors influencing older adults' smartphone use behaviour in Malaysia using the Stimulus-Organism-Response (SOR) framework.

Problem Statement

Although smartphones can significantly improve the quality of life for older adults by promoting social engagement, providing health-related applications, and enhancing convenience, a significant portion of the elderly population in Malaysia remains hesitant to adopt this technology (Chang, 2024; Liew et al., 2022; Wong et al., 2020; Wong et al., 2018). Key barriers include technology anxiety (Hsu & Peng, 2022), lack of digital literacy, and limited facilitating conditions (Kuerbis et al, 2017; Harris et al., 2022; Mitra et al., 2022; Nguyen et al., 2021). Additionally, cultural and social norms play a crucial role in shaping technology acceptance among older Malaysians (Marzo, 2020; Merriam & Mohamad, 2000). Existing studies have largely focused on younger populations or international contexts (Nugraha et al., 2024; Yamagishi, 2024; Marzo, 2020), necessitating a localized study that considers the unique socio-cultural and infrastructural factors in Malaysia. The Malaysian context remains underexplored, particularly concerning:

1. The influence of subjective norms, given Malaysia's collectivist culture.
2. The impact of facilitating conditions, including government initiatives and community support.
3. The role of technology anxiety and self-efficacy in smartphone adoption among older Malaysians.

By addressing these gaps, this study contributes to the literature on digital inclusion among older adults in Malaysia and offers policy recommendations for increasing smartphone accessibility.

Research Objectives

Given the problems identified in the previous section, the following are the objectives of this study:

1. To investigate the influence of subjective norms, facilitating conditions, technology anxiety, and self-efficacy on the adoption and sustained usage of smartphones, and
2. To provide evidence-based policy and practical recommendations to enhance digital inclusion and reduce barriers to smartphone adoption among older adults in Malaysia.

LITERATURE REVIEW

SOR Framework

The Stimulus-Organism-Response (SOR) framework, originally introduced by Mehrabian and Russell (1974), has been widely used to explain consumer behaviour and psychological responses to external stimuli. The framework posits that external stimuli (S) influence an individual's internal state (O), which in turn determines their behavioural response (R). This model has been extensively applied across various domains, including psychology, marketing, and technology adoption studies to analyze how various stimuli (such as environmental factors, social influences, or technology) impact individuals' behaviours and attitudes.

Stimuli (S)
- These are external factors that can influence an organism. In the context of smartphone usage, stimuli could include features of the smartphone, social interaction, facilitated by the device, or promotions.

Organism (O)
- This component represents the internal state of the individual, including their emotions, beliefs, and cognitive processes. For older adults, this might encompass their prior experiences with technology, their comfort level with technology, and their motivation for using the device.

Response (R)
- This is the observable behavior or action taken by the organism in reaction to the stimuli. In the case of older adults, responses may include increased smartphone usage for communication or social engagement.

Figure 1 Components of the SOR Framework

SOR framework is rooted in environmental psychology, emphasizing the interaction between external stimuli and human cognitive and emotional processes. The stimulus can be any external factor such as product

features, social influences, or digital interfaces. The organism represents internal cognitive, and emotional processes, including perceptions, attitudes, and emotions. Finally, the response is the behavioural outcome, such as purchase intention, continued usage, or technology adoption. Jacoby (2002) expanded on this theory by incorporating consumer behaviour principles, suggesting that stimuli could include factors such as advertisements, social interactions, and usability aspects of digital platforms. Recent studies have further adapted the model by integrating psychological constructs like self-efficacy, trust, and technology anxiety to explain digital adoption behaviour.

Applications of the SOR Framework the SOR framework has been applied in various research fields, including marketing, e-commerce, and technology adoption.

1. Marketing and Consumer Behaviour:

- In digital marketing, the SOR framework is used to analyze how online advertisements and website aesthetics (S) influence consumer emotions (O) and purchase behaviour (R) (Wu et al., 2021).
- Studies by Arif et al. (2020) and Huang et al. (2022) have demonstrated that social media engagement and user-generated content act as external stimuli affecting consumer trust and purchase decisions.

2. E-Commerce and Digital Platforms:

- Researchers such as Zhu et al. (2020) have utilized the SOR framework to examine how website design and customer reviews (S) shape consumer trust (O) and online shopping behaviour (R).
- Studies on mobile payment adoption (Chen & Zhang, 2022) have also confirmed that facilitating conditions, perceived security, and ease of use serve as stimuli influencing behavioural responses.

3. Technology Adoption Among Older Adults:

- The SOR framework has been adapted to study digital inclusion among the elderly, focusing on smartphone usage (Zhou et al., 2023).
- Factors such as social influence, perceived usefulness, and accessibility (S) impact cognitive attitudes (O) and actual smartphone adoption (R).
- Recent studies have shown that digital literacy programs and user-friendly interfaces can significantly enhance technology adoption among older adults (Park & Choi, 2021).
- A study highlighted that social influence and perceived ease of use were critical factors driving smartphone adoption among older adults. These factors shaped their internal states (the organism), leading to increased engagement with smartphones as a response (Huang, 2023).
- Another research effort focused on understanding how older adults navigate digital environments and what barriers they face in adopting smartphone technology. This study emphasized that cognitive challenges and external support systems play a significant role in shaping their responses to smartphone usage (Jiao, 2023).
- Additionally, findings from a study on smartphone-related digital divides revealed that older adults who received adequate training and support exhibited higher levels of smartphone literacy and engagement. This aligns with the SOR framework by illustrating how targeted stimuli (like training) can positively influence internal states (confidence and competence), resulting in more frequent and effective use of smartphones

Emerging Trends and Future Directions Recent advancements in SOR-based research suggest several key trends:

- Integration with Emerging Technologies: Studies now incorporate artificial intelligence (AI) and Internet of Things (IoT) as stimuli, examining their effects on user emotions and adoption behaviors (Lee & Chen, 2023).

- Cross-Cultural Comparisons: Research is increasingly focusing on how cultural contexts moderate the relationships within the SOR framework, particularly in technology adoption (Rahman et al., 2023).
- Health and Well-Being Applications: With the rise of telehealth and digital healthcare platforms, the SOR model is being used to analyze how digital health tools influence patient engagement and well-being (Gao & Wang, 2022).

Subjective Norms

The theory of Planned Behavior (TPB) was proposed by Fishbein and Ajzen (1975), indicating that subjective norms refer to the perceived social pressure to perform or withdraw from a specific behavior. Within the context of adopting smartphones among older adults, subjective norms play a significant role as the beliefs of close social referents, including family, friends, and neighbors may influence the elders in the decision-making process. Recent studies recommend that close family members significantly influence older adults in smartphone adoption, specifically through encouragement or demonstration related to the benefits of using those advanced devices. For instance, family members always highlighted the importance of smartphones for maintaining social engagement and enhancing safety, particularly during emergencies (Wang et al., 2021). Similarly, trusted friends may motivate older adults by normalizing smartphone adoption and sharing positive experiences with this emerging technology (Zhao et al., 2022). In addition, the role of neighbors in influencing older adults' behavior plays a pivotal role in smartphone adoption. Such positive opinions or encouraging endorsements from the communities might increase a sense of belongingness, reinforcing the perceived necessity of owning and using smartphones among the elders. This interaction of subjective norms is relevant among societies with the collectivist orientation of cultures, where the point-of-view of one's social network carries significant weight (Liu et al., 2023). By understanding the dynamics of subjective norms, this scenario is essential for designing interventions aimed especially at promoting the adoption of smartphones among older adults. By leveraging these social influences, policymakers and technology designers should systematically craft strategies to address older adults' apprehensions and promote the inclusion of technology through family-oriented training programs or community workshops.

Facilitating Conditions

Facilitating conditions, a construct from the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh et al. (2012), refer to the degree to which an individual perceives the availability of resources and support for using a particular technology. In the context of older adults adopting smartphones, facilitating conditions are critical determinants of technology acceptance and sustained usage. The availability of resources, such as financial means to purchase a smartphone and access to reliable internet, plays a foundational role in adoption among elders. For older adults, affordability is a key factor, with lower-cost devices and data plans often being decisive in adoption (Nguyen et al., 2021). Beyond financial resources, physical and cognitive abilities, such as dexterity and ease of understanding smartphone interfaces, also contribute to their perception of facilitating conditions (Chen et al., 2023). Social and technical support further strengthen facilitating conditions. When older adults face challenges using their smartphones, support from family, friends, or caregivers can boost their confidence and willingness to engage with the technology (Li et al., 2022). Formal technical support, such as help desks or community technology training programs, also fosters smartphone adoption by reducing anxiety and improving skills (Kim & Choi, 2023). Policymakers and technology designers can enhance facilitating conditions by developing affordable and senior-friendly devices, promoting digital literacy programs, and ensuring the availability of accessible technical support devices. These measures not only address barriers to smartphone adoption but also empower older adults to fully benefit from the opportunities that digital technology offers.

Self-Efficacy

Compeau and Higgins (1995) indicate self-efficacy refers to the beliefs of people in their proficiency to perform specific duties and is considered a crucial psychological factor that might influence technological adoption and usage. In the framework of elders adopting smartphones, self-efficacy determines their learning and using those digital devices confidently and effectively, even when facing multiple complex challenges.

These adults with high self-efficacy tend to believe they can master the use of smartphones, even if they have zero prior experience. Recent studies display that confidence among them in overcoming initial unfamiliarity impacts their willingness to technological adoption (Park et al., 2021). Furthermore, enhance their perceived self-efficacy through supportive materials tailored to older users such as clear user manuals, step-by-step tutorials, and availability of online resources (Kim & Kang, 2022). Besides, guidance from close social referents should be available to further strengthen self-efficacy among older adults in technological settings. Personalized support may open the door to learning and gradually familiarize themselves with the features of smartphones, eventually promoting unconventionality in usage. Guidance through learning approaches has been found the most significant improvement in technical skills and self-confidence in adopting themselves in using smartphones (Chen et al., 2023). To boost confidence among older adults in smartphone adoption, interventions such as user-friendly interfaces, targeted training programs, and social support system encouragement may enhance their self-efficacy. In addition, by empowering them to believe in their ability of smartphone use and adoption, these measures may help bridge the technological divide and promote huge digital inclusion.

Technology Anxiety

As conceptualized by Hsu and Peng (2022), technology anxiety can be referred to as feelings of nervousness, worry, or discomfort among people who experience using or thinking about technology that emerged swiftly. For older adults, this anxiety, known as technophobia, is a significant discrepancy in smartphone adoption, often caused by a lack of digital familiarity, fear of making mistakes, or perceived device complexity. Nervousness using such advanced smartphones can be associated with cognitive overload, where the elders feel overwhelmed by the wide group of features and functions. This uneasiness may lead to avoidance behaviors, minimizing the opportunities for digital learning and adaptation (Kim et al., 2023). In conjunction with worrying about the possibility of errors, such as accidentally deleting significant information or breaching privacy, further contributes to technological anxiety. Zhao and Li (2022) indicate that older adults regularly perceive smartphones as fragile or even overly intricate, which might exacerbate their fears. In addition, these inappropriate emotions can hinder smartphone adoption, even when external factors such as facilitating conditions or social support are present. In addressing this technological anxiety, targeted interventions, such as simplified user smartphone interfaces, training programs, and encouraging trial-and-error learning environments without having judgment fears (Chen et al., 2023). In alleviating anxiety among older adults, any institution should provide emotional reassurance and emphasize the smartphone benefits. By understanding and minimizing technological anxiety, stakeholders should promote and encourage users to greater smartphone adoption by enabling older adults to reap the benefits of digital technology while enhancing their life quality.

Perceived Ease of Use

In the context of using a mobile device or smartphone, Perceived ease of use (PEOU) refers to the extent to which users believe the device is easy to use. This, in turn, influences their intentions and behaviour's regarding the adoption of the technology (Davis, 1989). Studies show that PEOU plays an important role in shaping smartphone user behaviour, especially in applications involving financial, educational, and entertainment transactions. For example, research by Zhang et al. (2021) found that ease of navigation and intuitive interfaces on mobile banking apps significantly increase users' trust, ultimately driving their loyalty to the app. Something similar is found in educational apps, where PEOU has been shown to improve user engagement through simple interfaces and accessible features (Lee & Kim, 2022). In addition, PEOU also contributes to the adoption of new technologies such as the Internet of Things (IoT) and augmented reality (AR) in mobile devices. Research by Ramli et al. (2023) shows that user-friendly app design can reduce users' learning barriers, and increase their self-confidence.

Perceived Usefulness

In the context of mobile phone use, PU reflects the user's confidence that the device can facilitate communication, access information, and increase productivity (Bujang, Suki & Suki, 2017). The Technology

Acceptance Model (TAM) is often used to understand the factors influencing technology acceptance, including PU and perceived ease of use Moses et al. (2013). A study conducted by Ismail and Mukhtar (2021) examined the acceptance of QR code payments among smartphone users in Malaysia. The results of the study show that performance expectations, which are closely related to PU, have a significant impact on users' willingness to use QR code mobile payments. This indicates that when users find the technology useful and increase efficiency, they are more likely to adopt it. In addition, a study conducted by Jasni et al. (2022) Mobile phone dependency and accessibility among the homeless in Malaysia. The results of the study show that homeless people rely on mobile phones to communicate and access information, confirming the importance of PU in their daily lives. This proves that PU plays a crucial role in determining the level of technology dependency, especially among marginalised communities. In general, the perception of usefulness is a crucial factor in the adoption and use of technology such as mobile phones. When consumers feel that technology provides tangible benefits and improves their quality of life, they are more likely to adopt and rely on it. Therefore, technology developers and service providers should ensure that the products and services offered meet the needs of consumers and provide significant added value.

Behavioural Intention

Behavioural Intention refers to a person's tendency to use something technology based on their beliefs, attitudes, and perceptions towards the use of technology such as mobile phones (Bujang, Suki & Suki, 2017). Studies show that factors such as user experience, design, and technology influence BI on mobile phone use Venkatesh & Davis (2000). The study by Alal wan et al. (2021) found that user satisfaction with the experience of using a smartphone contributes to an increase in behavioural intention to continue using the device. In addition, the aspect of trust in data safety and privacy also impacts BI, especially among users who frequently use mobile phones for digital transactions (Nguyen et al., 2023). Additionally, demographic factors such as age and educational stage influence BI. Younger age groups tend to have higher intentions to use mobile phones because they are more familiar with technology and tend to see it as a tool for productivity and entertainment (Chen & Lin, 2022). In contrast, the older age groups may require more encouragement through education or technology exposure. Overall, BI toward mobile phone use is influenced by a variety of psychological, social, and technical factors. Device makers and service providers should understand these factors to increase the acceptance and use of mobile phone technology among users.
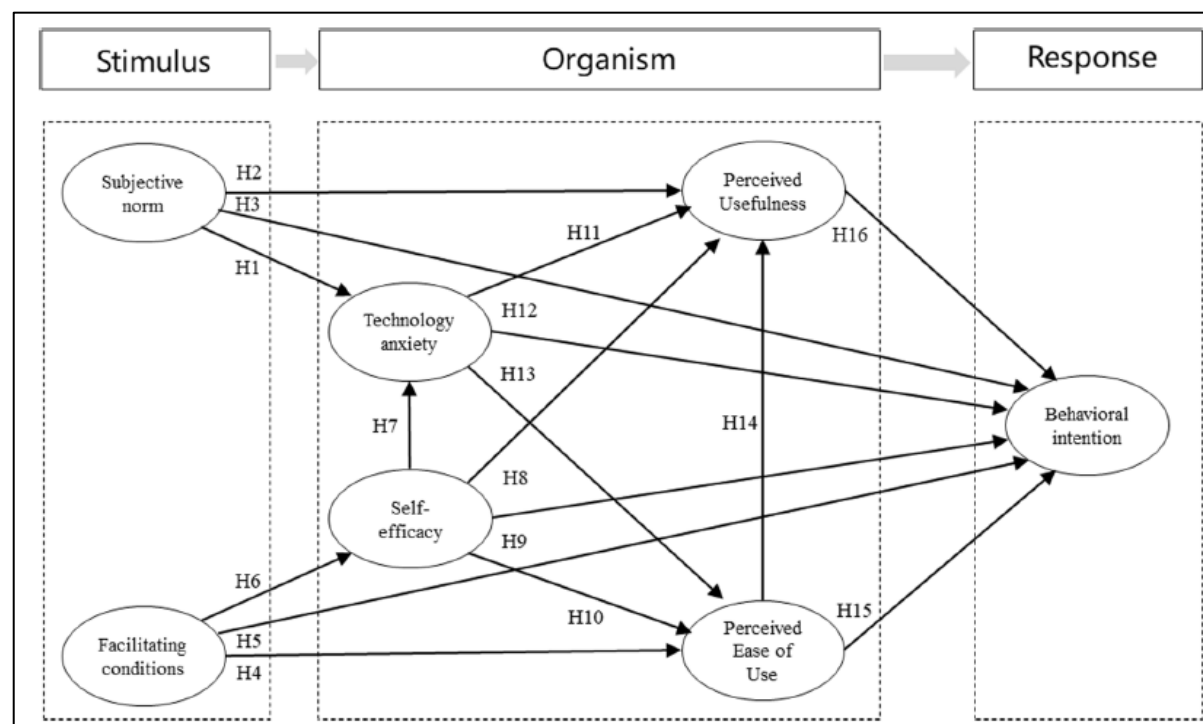
Research Framework

Figure 2: Conceptual Framework

The proposed framework (Figure 2) adopts the Stimulus-Organism-Response (SOR) model to investigate the factors influencing smartphone adoption among older adults in Malaysia. The framework integrates external stimuli, internal psychological states, and behavioural outcomes to explain how socio-cultural, infrastructural, and psychological factors shape technology adoption behaviour. The stimulus (external factors) act as catalysts influencing older adults' internal states, such as subjective norms, which refer to social pressure from family, peers, or community members, and facilitating conditions, which refer to the availability of resources, affordability, technical support, and government initiatives. These stimuli directly or indirectly trigger psychological and cognitive processes (organism). Organism (internal psychological states) represent the internal cognitive and emotional states mediating between stimuli and behavioural responses including self-efficacy, which refers to confidence in using smartphone, technology anxiety, which refers to the fear or discomfort toward a technology, perceived ease of use (PEOU), which refers to the belief that smartphones are easy to use, and perceived usefulness (PU), which refers to the belief that smartphones provide tangible benefits. These organisms then trigger responses that reflect the ultimate behavioural intention or action which refers to older adults' willingness to adopt and use smartphones. The framework posits that stimulus (subjective norms, facilitating conditions) shape internal states (self-efficacy, anxiety, PEOU, PU), collectively determining behavioural intention.

Research Hypotheses

Based on the framework, the following hypotheses are proposed:

H1: Subjective norms positively influence technology anxiety.

H2: Subjective norms positively influence perceived usefulness of smartphones.

H3: Subjective norms positively influence older adults' intention to use smartphones.

H4: Facilitating conditions positively affect the perceived ease of smartphone use among older adults.

H5: Facilitating conditions positively affect the intention of older adults to use smartphones.

H6: Facilitating conditions positively affect self-efficacy in older adults.

H7: Self-efficacy negatively influences technology anxiety.

H8: Self-efficacy positively influences perceived usefulness of smartphones.

H9: Self-efficacy positively influences intention to use smartphones.

H10: Self-efficacy positively influences perceived ease of smartphone use.

H11: Technology anxiety negatively affects perceived usefulness of smartphones.

H12: Technology anxiety negatively affects the intention to use smartphones among older adults. H13: Technology anxiety negatively affects perceived ease of smartphone use.

H14: Perceived ease of use positively influences perceived usefulness of smartphones.

H15: Perceived ease of use positively influences older adults' intention to use smartphones.

H16: Perceived usefulness positively influences older adults' intention to use smartphones.

METHODOLOGY

This study will employ a mixed-methods research design, integrating quantitative and qualitative approaches to provide a comprehensive understanding of smartphone use behaviour among older adults in Malaysia.

Sample and Data Collection

The study focuses on older adults aged 60 years and above residing in Malaysia, specifically targeting individuals capable of independent travel. This criterion ensures participants possess the physical and cognitive autonomy to engage meaningfully with smartphone technology, reflecting real-world usability scenarios. The selection of this demographic aligns with the research objective to address digital inclusion challenges unique to older populations in Malaysia, where aging trends and technological adoption barriers are increasingly salient. Purposive sampling will be employed to recruit participants, ensuring representation across diverse socio-economic backgrounds. This non-probability sampling technique allows researchers to intentionally select individuals who embody key characteristics relevant to the study—such as varying income levels, educational attainment, and urban/rural residency—to capture a holistic understanding of smartphone adoption dynamics. By prioritizing socio-economic diversity, the sampling strategy mitigates bias and enhances the generalizability of findings to Malaysia's heterogeneous elderly population. Data collection will integrate mixed methods to triangulate insights. A structured questionnaire, designed using validated scales from prior literature, will quantitatively measure constructs such as subjective norms, technology anxiety, and behavioural intention. This tool will be complemented by semi-structured interviews, which provide qualitative depth by exploring participants' lived experiences, perceptions, and contextual barriers to smartphone use. The dual approach ensures robustness, combining statistical patterns with nuanced narratives to comprehensively address the research questions.

Measurement Instruments

The study employs validated scales from established theoretical frameworks to ensure methodological rigor and alignment with prior research. Subjective norms, reflecting social influences on technology adoption, are measured using a scale adapted from Fishbein and Ajzen's (1975) Theory of Planned Behaviour (TPB). This adaptation ensures cultural relevance while retaining the core construct of perceived social pressure. Technology anxiety, conceptualized as emotional resistance to digital tools, is assessed using the instrument developed by Hsu et al. (2022), which captures dimensions such as fear of errors and cognitive overload. Perceived usefulness and perceived ease of use, foundational constructs from Davis's (1989) Technology Acceptance Model (TAM), are operationalized through items refined by Venkatesh et al. (2003) to account for evolving technological contexts. These scales evaluate participants' beliefs about smartphones' practicality and usability. Facilitating conditions and behavioural intention are measured using scales adapted from Venkatesh et al.'s (2012) Unified Theory of Acceptance and Use of Technology (UTAUT), ensuring compatibility with infrastructural and motivational factors unique to older adults. Self-efficacy, representing confidence in smartphone use, is assessed via Compeau et al.'s (1995) validated instrument, modified to reflect age-specific challenges. All constructs are evaluated using a 7-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*), balancing sensitivity and simplicity for older respondents. This approach minimizes response fatigue while enabling nuanced quantification of attitudes and intentions. By integrating these robust instruments, the study ensures reliability, comparability, and theoretical coherence across its multidimensional analysis.

Data Analysis

The hypothesized relationships within the research framework will be tested using Structural Equation Modelling (SEM), a robust multivariate statistical technique suited for analyzing complex interdependencies between latent and observed variables. SEM is particularly advantageous for this study, as it allows simultaneous examination of multiple pathways—such as the effects of subjective norms, facilitating conditions, and psychological factors on behavioural intention—while accounting for measurement errors. This approach aligns with the study's goal of validating a holistic model of smartphone adoption among older adults. Data analysis will leverage SPSS for preliminary descriptive statistics, data cleaning, and reliability assessments (e.g., Cronbach's alpha), followed by SmartPLS (Partial Least Squares SEM) to estimate path coefficients and test the structural model. SmartPLS is chosen for its flexibility in handling smaller sample

sizes and non-normal data distributions, common challenges in geotechnology research. Its emphasis on predictive power and exploratory analysis makes it ideal for examining the localized, context-driven hypotheses proposed. To ensure the validity of self-reported data, Harman's single-factor test will be conducted to assess common method bias. This test evaluates whether a single latent factor accounts for the majority of covariance among variables, which could indicate inflated correlations due to measurement artifacts. If the variance explained by the first factor falls below the threshold (typically <50%), it supports the absence of significant bias, thereby reinforcing the integrity of the findings. Together, these analytical strategies ensure methodological rigor and enhance the credibility of the study's conclusions.

Ethical Considerations

The study adheres to stringent ethical standards to safeguard participants' rights and well-being. Informed consent will be obtained from all participants prior to their involvement, ensuring they are fully aware of the research purpose, procedures, potential risks, and benefits. Consent forms will be presented in clear, accessible language, and participants will retain the right to withdraw at any stage without penalty. To protect privacy, anonymity and confidentiality will be rigorously maintained: no personally identifiable information will be collected, and responses will be anonymized during data processing. Data will be stored securely, accessible only to the research team, and destroyed after the study's completion. Additionally, ethical approval will be sought from the institutional review board (IRB) at Universiti Teknologi MARA. These measures collectively uphold the principles of respect, beneficence, and justice, fostering trust and integrity throughout the research process.

Expected Contributions

1. Theoretical Contribution:

o The study will develop a localized smartphone acceptance model tailored to older adults in Malaysia by adapting the SOR framework. This model integrates socio-cultural factors (e.g., collectivist norms, subjective norms) and infrastructural barriers (e.g., affordability, technical support), addressing a critical gap in literature dominated by Western and East Asian contexts.

2. Practical Implications:

o The findings will provide evidence-based policy recommendations for Malaysian policymakers, technology developers, and community organizations. These could include subsidized smartphone programs, senior-friendly interface designs, and nationwide digital literacy campaigns to reduce barriers to adoption.

3. Methodological Advancement:

o The use of a mixed-methods approach (quantitative surveys + qualitative interviews) offers a holistic understanding of older adults' experiences. Additionally, employing SEM with SmartPLS demonstrates robust analytical techniques for modelling complex psychological and behavioural relationships in geotechnology research.

4. Social Impact:

o By identifying strategies to mitigate technology anxiety and enhance self-efficacy, the study promotes digital inclusion among older Malaysians. This empowerment can improve their access to healthcare, social connectivity, and economic opportunities, ultimately enhancing their quality of life.

5. Cross-Cultural Insights:

o The focus on Malaysia's unique socio-cultural dynamics contributes to broader discourse on how collectivist values influence technology adoption, offering comparative insights for other multicultural or aging societies.

These contributions collectively advance academic knowledge, inform targeted interventions, and foster equitable technological participation for older adults in an increasingly digital world.

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REFERENCES

1. Alalwan, A. A., Dwivedi, Y. K., Rana, N. P., & Simintiras, A. C. (2021). Contextual Influences on the Adoption of Mobile Payment Services in the Retail Sector. Journal of Retailing and Consumer Services, 61, 102571.
2. Arif, I., Aslam, W., & Siddiqui, H. (2020). Influence of brand related user-generated content through Facebook on consumer behaviour: A stimulus-organism-response framework. International Journal of Electronic Business, 15(2), 109-132.
3. Bujang, A., Suki, N. M., & Suki, N. M. (2017). Conceptual Study of Mobile Retailing Acceptance Among Malaysian Women. Advanced Science Letters, 23(1), 432-435.
4. Chang, J. Q. (2024). Digital Inclusion among Elderly Consumers in Sarawak: Drivers and Barriers to Adoption of Wearable Health Technology (Doctoral dissertation, Swinburne).
5. Chen, K., & Chan, A. H. S. (2014). Geron technology acceptance by elderly Hong Kong Chinese: a senior technology acceptance model (STAM). Ergonomics, 57(5), 635–652. https://doi.org/10.1080/00140139.2014.895855
6. Chen, H., et al. (2023). Cognitive and physical factors influencing older adults' smartphone use. Geron technology Journal, 22(2), 112-122.
7. Chen, L., et al. (2023). Guided learning approaches for older adults in technology use. Technology & Society, 79, 102218.
8. Chen, L., et al. (2023). Reducing technology anxiety through training programs for older adults. Digital Inclusion Studies, 12(3), 213-227.
9. Chen, Y., & Lin, K. (2022). Behavioural Intention and Mobile Technology Adoption: A Study on Age-Based Preferences. Journal of Technological Trends, 34(3), 45-67.
10. Compeau, D. R., Higgins, C. A. (1995). Computer self-efficacy: Development of a measure and initial test. MIS Quarter, 19(2), 189–211.
11. Davis, F, D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology, MIS Quarter, 13(3), 319–340.
12. Fishbein, M., & Ajzen, I. (1975) Belief, Attitude and Behaviour: An Introduction to Theory and Research. Addison-Wesley, Reading, UK.
13. Guo, X., Sun, Y., Wang, N., Peng, Z., & Yan, Z. (2013). The dark side of elderly acceptance of preventive mobile health services in China. Electronic Markets, 23, 49–61.
14. Harris, M. T., Blocker, K. A., & Rogers, W. A. (2022). Older adults and smart technology: facilitators and barriers to use. Frontiers in Computer Science, 4, 835927.
15. Huang, T. (2023). Using SOR framework to explore the driving factors of older adult's smartphone use behaviour. Humanities and Social Sciences Communications, 10, 1-16.
16. Hui, K. Y. (2016). Determinants of Smartphone Adoption Among Older Adults in Malaysia (Doctoral dissertation, UTAR).
17. Hsu, C-W., & Peng, C-C. (2022) What drives older adults' use of mobile registration apps in Taiwan? An investigation using the extended UTAUT model. Information Health Society Care, 47(3), 258–273.
18. Ismail, F. N., & Mokhtar, A. (2021). Penyelidikan empirikal mengenai penerimaan pembayaran Kod QR dalam kalangan pengguna telefon pintar Malaysia. Jurnal Wacana Sarjana, 5(2), 1–21.

19. Jacoby, J. (2022). Stimulus-organism-reconsidered: An evolutionary step in modelling (consumer) behaviour. Journal of Consumer Psychology, 12(1), 51-57.

20. Jasni, M. A. B., Abu Bakar Ah, S. H., Omar, N., & Che Mohd Nasir, N. (2022). Penerokaan bentuk kebergantungan dan accessibility telephone bimbit dalam kalangan gelandangan menurut perspektif Model TAM dan Teori Ketergantungan Media. Jurnal Komunikasi Borneo, 10, 1–15.

21. Jiao, R. (2023). Is There a Barrier Between Seniors and Smartphone Use in The Internet Age? A Study of Digital Disconnection among Older Adults. SHS Web of Conferences.

22. Kim, H., et al. (2023). Cognitive and emotional barriers to smartphone adoption in older adults. Geron technology, 22(1), 78-91.

23. Kim, J., & Kang, H. (2022). Enhancing self-efficacy in smartphone use for older adults. Geron technology, 21(3), 145-156.

24. Kim, S., & Choi, J. (2023). The role of technical support in older adults' technology use. Technology and Society, 75, 102096.

25. Kuerbis, A., Mulliken, A., Muench, F., Moore, A. A., & Gardner, D. (2017). Older adults and mobile technology: Factors that enhance and inhibit utilization in the context of behavioural health.

26. Lee, J-C., & Chen, X. (2022). Exploring users' adoption intentions in the evolution of artificial intelligence mobile banking applications: the intelligent and anthropomorphic perspectives. International Journal of Bank Marketing, 40(4), 631–658.

27. Lee, J., & Kim, H. (2022). The role of perceived ease of use in educational mobile applications: A user centered approach. Journal of Educational Technology, 39(2), 112-125.

28. Lee, J. Y., Wong, C. P., & Lee, S. W. H. (2020). m-Health views and perception among Malaysian: findings from a survey among individuals living in Selangor. Mhealth, 6.

29. Li, X., et al. (2022). Social support and technology adoption in older populations. Journal of Aging and Digital Inclusion, 3(1), 45-67.

30. Liew, E. J. Y., Teh, P. L., Ewe, S. Y., & Chong, C. L. (2022, December). Understanding Challenges as Needs: Smartphone Usage Among Malaysian Older Women in Rural Areas. In 2022 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM) (pp. 1201-1205). IEEE.

31. Liu, Y., et al. (2023). Subjective norms and smartphone use among older adults in collectivist cultures. Asian Journal of Communication, 33(1), 56-72.

32. Marzo, R. R. (2024). Bridging the Gap: Understanding and Fostering Intergenerational Communication in the Digital Age. In Intergenerational Relations-Contemporary Theories, Studies and Policies. Intech Open.

33. Merriam, S. B., & Mohamad, M. (2000). How cultural values shape learning in older adulthood: The case of Malaysia. Adult Education Quarterly, 51(1), 45-63.

34. Mehrabian, A., & Rusell, J. A. (1974). An approach to environmental psychology., Massachusetts Institute of Technology, Cambridge, MA, 8.

35. Miller, D., Abed Rabho, L., Awondo, P., de Vries, M., Duque, M., Garvey, P., ... & Wang, X. (2021). The global smartphone: Beyond a youth technology. UCL Press.

36. Mitra, S., Singh, A., Rajendran Deepam, S., & Asthana, M. K. (2022). Information and communication technology adoption among the older people: A qualitative approach. Health & Social Care in the Community, 30(6), e6428-e6437.

37. Moses, P., Wong, S. L., Bakar, K. A., & Mahmud, R. (2013). Perceived usefulness and perceived ease of use: Antecedents of attitude towards laptop use among science and mathematics teachers in Malaysia. The Asia-Pacific Education Researcher, 22, 293-299. https://doi.org/10.1007/s40299-012-0054-9

38. Nugraha, Y. D., Permana, R. M. T., & Hadiarti, D. (2024). Impulsive purchase behaviour of Z generation of Muslim women on TikTok shop: the application of SOR framework. Journal of Islamic Marketing, 15(2), 493-517.

39. Nguyen, T., et al. (2021). Financial and resource barriers to smartphone adoption among older adults. Technology & Society, 68, 101756.

40. Nguyen, T. T., Tran, Q. T., & Nguyen, P. H. (2023). Privacy and Trust in Mobile Technology Adoption. Asian Journal of Technology, 16(1), 15-28.

41. Park, S., et al. (2021). Self-efficacy as a predictor of technology adoption among older adults. Digital Inclusion Journal, 7(1), 34-46.

42. Ramli, A., Hassan, N., & Zulkifli, M. (2023). User-friendly design in mobile IoT applications: Enhancing perceived ease of use. International Journal of Smart Technology, 45(1), 67-80.

43. Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Quarterly, 36(1), 157-178.

44. Venkatesh, V., & Davis, F. D. (2000). Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. Management Science, 46(2), 186-204.

45. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS quarterly, 425-478.

46. Wong, C. Y., Ibrahim, R., Hamid, T. A., & Mansor, E. I. (2018). Usability and design issues of smartphone user interface and mobile apps for older adults. In User Science and Engineering: 5th International Conference, i-USEr 2018, Puchong, Malaysia, August 28–30, 2018, Proceedings 5 (pp. 93-104). Springer Singapore.

47. Wong, C., Ibrahim, R., Hamid, T., & Mansor, E. (2020). Measuring expectation for an affordance gap on a smartphone user interface and its usage among older adults. Human Technology, 16(1), 6-34.

48. Wu, S., Wong, I. A., & Lin, Z. C. (2021). Examination of higher education teachers' self-perception of digital competence, self-efficacy, and facilitating conditions: An empirical study in the context of China. Sustainability, 15(14).

49. Yamagishi, K., Canayong, D., Domingo, M., Maneja, K. N., Montoro, A., & Siton, A. (2024). User-generated content on Gen Z tourist visit intention: a stimulus-organism-response approach. Journal of Hospitality and Tourism Insights, 7(4), 1949-1973.

50. Zhang, Y., Li, X., & Zhao, W. (2021). Influence of ease of use on mobile banking adoption: Evidence from China. Journal of Financial Technology, 12(3), 45-60.

51. Zhu, L., Li, H., Wang, F. K., He, W., & Tian, Z. (2020). How online reviews affect purchase intention: a new model based on the stimulus-organism-response (S-O-R) framework. Aslib Journal of Information Management, 72(4), 463-488.