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EXPLORING THE MEDIATING EFFECT OF PERCEIVED EASE OF USE AND PERCEIVED USEFULNESS ON ACTUAL ADOPTION OF MOBILE WALLETS IN MALAYSIA

Yee-Lee Chong[1], Tze-Kiat Lui[2], You-How Go[3]

[1]School of Business, Faculty o1Faculty of Business and Finance, 53300 Universiti Tunku Abdul Rahman, Malaysia
[2]Faculty of Business & Law, School of Accounting & Finance, 47500 Taylor's University Lakeside Campus, Malaysia
[3]Faculty of Business and Finance, 53300 Universiti Tunku Abdul Rahman, Malaysia

***Corresponding author's email:**
goyh@utar.edu.my

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ABSTRACT

Our study examines the actual adoption of mobile wallets (m-wallets) in Malaysia, with a particular emphasis on addressing the factors influencing the selection and efficient utilization of this payment method. We concentrate on the globally recognized Alipay and the locally established GrabPay. Based on the Technology Acceptance Model (TAM), the study investigates consumer-centric and technology-related factors and explores the role of Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) as mediators in influencing the actual adoption of m-wallets. To compare Alipay and GrabPay, the data collection is through a survey of 632 responses and utilizing PLS-SEM and Welch's t-test for analysis. Our findings highlight the significant impact of compatibility on actual adoption, mediated by both PEOU and PU. However, personal innovativeness, mobile payment knowledge, and self-efficacy are found to have a relatively minor effect on actual adoption. GrabPay exhibits higher convenience and compatibility compared to Alipay, while personal innovativeness shows similar patterns for both platforms. Self-efficacy consistently influences adoption for both m-wallets. As compatibility is identified as the most crucial factor leading to m-wallet adoption, it is advisable for m-wallet service providers to offer a variety of services tailored to accommodate the diverse lifestyles of consumers.

INTRODUCTION

Historically, consumers utilized physical currency in the form of notes and coins to complete their commercial transactions with merchants. A novel payment system cantered around consumer preferences has been introduced recently to the market. The prevailing inclination among consumers is now to use mobile devices for conducting payments, commonly known as mobile payment (Shin, 2010). Mobile payment denotes a method of financial transaction wherein monetary transfers are facilitated through a portable device (Kenton, 2021). Mobile Wallet (m-wallet) equally refers to a virtual wallet that affords users a more user-friendly avenue for executing payments by securely storing payment card details on a mobile device (Kenton, 2021). The m-wallet market is home to a variety of payment innovations, including Quick Response (QR) codes and Near Field Communication (Kazan et al., 2018).

According to the Mastercard Impact Study in 2020, Malaysia has contributed to 40% of m-wallet adoption in Southeast Asia. This percentage is followed by 36% in the Philippines, 27% in Thailand, and 26% in Singapore. In fact, the Central Bank of Malaysia has implemented a systematic reform strategy stated in the Financial Sector Blueprint 2011-2020 (FSBP) to support Malaysia's move towards electronic payment (e-payment) (Lee & Daniel, 2018). The Ministry of Finance in Malaysia has actively promoted the use of m-wallets such as a one-time incentive for qualified Malaysians who register with specified m-wallet providers as part of the Annual Budget 2020 (Aziz, 2019). Additionally, approximately 35 % of Malaysian fintech companies were involved in deploying m-wallets and digital payment solutions during the COVID-19 outbreak (The Edge Markets, 2021). This brought attention to the possibility that Malaysians use m-wallets mostly for various transactions involving food and drink, groceries, and convenience stores.

The current Malaysian market is witnessing a proliferation of m-wallets (Gomes, 2022). This abundance of m-wallet options in Malaysia creates a challenge for user adoption and utilization of these platforms to purchase goods and services (DeMers, 2016). The extensive variety of choices tends to confuse consumers, making it difficult for them to select the most suitable m-wallet for their needs. In fact, Malaysia is well-served by cards as there is high penetration of 44.1 million debit cards among the population of 31.6 million (Sinha et al., 2019). The m-wallet providers need to face competition against each other, including debit and credit card providers (Kumar & Krishnan, 2020). Given that cashback offers continue to lead the m-wallet market shares, smaller m-wallet companies must confront the hard fact that they cannot compete with larger players (Mitra, 2019). There are 27% of non-mobile wallet users who could accept m-wallet services in businesses (Tan, 2019). In fact, m-wallets are still in the early stages of deployment, and as a result, have limited adoption. In contrast to traditional payment methods such as cash, credit cards, and debit cards, which are extensively accepted by business entities (Mohd Sah et al., 2021). The limited acceptance by merchants hampers the convenience and compatibility of m-wallet services, thereby deterring potential users from embracing the benefits offered by these platforms.

Furthermore, the majority of Malaysians are hesitant to shift from physical cash usage to m-wallets due to concerns about system failures or security breaches during payment processes (Mohd Sah et al., 2021). This fear of system failure or hacking compromises the trust in m-wallets and discourages users from utilizing these applications for making payments. It is also undeniable that Malaysians also heavily rely on the use of cash. While there is a growing trend towards digital payment methods, particularly in urban areas, cash remains widely used in daily transactions, especially in smaller towns and rural regions. Also, setting up m-wallet accounts may be

challenging and confusing for those who do not acquire basic m-wallet knowledge (Karim et al., 2020). Not to mention the interface of each m-wallet application is also different from each other. In this case, self-efficacy and m-wallet knowledge might play essential roles in adopting the m-wallet. An individual with minor self-efficacy will consider an m-wallet difficult to be used and hence, refuse to adopt the m-wallet. M-wallets are mainly dominant among tech-savvy users compared to those non-tech-savvy users (Kumar & Krishnan, 2020). Tech-savvy users have a higher tolerance for the risk of adopting m-wallets. Therefore, the personal innovativeness of an individual could influence individuals' behavior in adopting m-wallet services.

Prior studies have mostly focused on consumers' intentions to use mobile wallets. In our study, we address the actual usage of m-wallets in Malaysia by focusing on mobile payment system characteristics and individual differences, which are essential for the success of mobile wallet providers. The proposed model of this study shifts the attention from focusing on the intention of m-wallet adoption towards an investigation of their actual usage that goes beyond the current literature gap. Moreover, the study expands upon the Technology Acceptance Model (TAM) by incorporating three consumer-centric factors, including innovativeness, mobile payment knowledge, and self-efficacy, as well as two technology-related constructs, such as convenience and compatibility. The proposed framework aims to deliver an enhanced comprehension of the factors influencing the actual usage of mobile wallets by including these additional considerations. Furthermore, this study will conduct a comparative analysis between two distinct m-wallets, namely Alipay and GrabPay. Despite Alipay's status as the leading global third-party payment system, its adoption in Malaysia still remains comparatively lower than that of GrabPay in the domestic market (Yao et al., 2018). It therefore pinpoints the key factors that significantly affect customers' choices in using the mobile wallets.

Beyond merchants, this study also provides valuable insights for mobile phone software developers, mobile phone manufacturers, and other relevant stakeholders. By understanding the specific characteristics and features that users prefer in m-wallets, these parties can enhance their product and service functionalities accordingly. Moreover, policymakers can leverage the contributions from this study to further promote m-wallet adoption and realize Malaysia's vision of transitioning into a cashless society (Fintech News Malaysia, 2019). Furthermore, financial institutions, including insurance companies and investment banks, stand to benefit from this research. As the industry evolves, partnerships and collaborations between these entities are expected to increase, leading to a clearer distinction between larger and smaller m-wallet players in the market.

In the study, the focus will be on two specific m-wallets, namely Alipay and GrabPay, out of the 43 licensed m-wallets operating in Malaysia. Both Alipay and GrabPay offer in-store and remote payment capabilities to their users (Kazan et al., 2018). GrabPay holds the largest share of approximately 21% among mobile payment system users in Malaysia (Vodus, 2021). Conversely, Alipay, a globally leading third-party payment system, boasts over 700 million annual active users worldwide (PYMNTS, 2018). The aim of the study is to inspect the factors specifically, the characteristics of mobile payment systems and individual preferences that affect the uptake of two different mobile wallets, namely the globally recognized Alipay and the locally established GrabPay.

In Malaysia, there are two prominent mobile payment platforms. First, in May 2017, Alipay was officially launched in Malaysia with the intention of providing tourists, particularly those from China, with an enhanced user-friendly environment and a secure payment experience while traveling within the country (Moorthy et al., 2020). A remarkable observation was made regarding

the implementation of Chinese mobile payment services by approximately 60% of businesses in Kuala Lumpur. Significantly, 88% of these businesses initiated these services from 2017 onwards, primarily driven by the objective of accommodating Chinese tourists. Alipay, a leading global player in the mobile payment industry, achieved significant success in establishing a largely cashless consumer economy in China during the year 2018 (Digitalasia, 2018). In the same year, Alipay captured a substantial market share of 61.2% among mobile payment users worldwide (Abrams, 2018). This notable development has also had a considerable influence on the adoption of m-wallets among certain segments of the Malaysian population (Cheng, 2019). Given the significance of this collaboration and its potential impact on the promotion of m-wallets in Malaysia, Alipay has been selected as a focal point in the study.

Second, in 2012, Anthony Tan co-founded Grab with his partner Tan Hooi Ling in Malaysia. Since its inception, Grab has experienced remarkable growth, expanding its operations to encompass over 30 cities across Southeast Asia (Azhar, 2022). At the heart of Grab's growth strategy lies a cashless payment system, which serves as the cornerstone of the company's expansion efforts. Despite transportation being its core business, Grab has strategically positioned itself as the preeminent mobile transaction platform in Southeast Asia. Furthermore, as a locally-founded enterprise, GrabPay was chosen to participate in the RM450 million e-Tunai Rakyat initiative, which the Federal Government formally launched on January 15, 2020 (Goh, 2019). GrabPay has successfully maintained its dominant position as the most preferred m-wallet among Malaysian consumers, with over 30% of respondents indicating their usage of the platform (Kaissi, 2021).

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Despite the extensive use of the Technology Acceptance Model (TAM) in explaining various studies, researchers continue to explore and enhance the model (Lah et al., 2020; Chaw et al., 2022; Banerji & Singh, 2022). TAM frequently incorporates external exogenous constructs, such as system characteristics and individual differences, to elucidate the patterns of system usage (Taherdoost, 2018). Furthermore, Pertiwi et al. (2020) concluded that TAM serves as a robust model for explaining individuals' intention to use a new information technology system. A framework based on TAM provides a foundational role in comprehending technology acceptance, along with its adaptability for assessing the reception of emerging technologies such as m-wallets.

Our study builds upon TAM and applies perceived ease of use (PEOU) and perceived usefulness (PU) as mediating constructs to examine the adoption of m-wallets in Malaysia. In TAM, the mediating constructs of PU and PEOU are vital as they mediate the impact of independent constructs on users' motivation to accept and use technology. A cross-sectional survey of 401 Nigerian customers was conducted in a study by Daramola and Sopiah (2021) to assess the determinants influencing the acceptance of m-wallets. Their findings reveal that PU and PEOU in TAM significantly influence consumers' adoption of m-wallets.

Past studies on extended TAM are predominantly conducted in developed countries, such as the United States, Canada, and Korea, supporting the significant mediation effect of PU and PEOU on m-wallet adoption. These results emphasize how important it is to include PU and PEOU as mediating constructs since they can impact the likelihood of m-wallet adoption. Therefore, the study examines the interplay between independent constructs, which are mobile payment system characteristics and individual differences,

including the mediating constructs towards the impact on m-wallet adoption in Malaysia. Through the elaboration and extension of the TAM framework, m-wallet adoption in the Malaysian context can be better understood by studying the elements that influence their actual adoption.

Our study incorporates a set of five independent constructs, two mediating constructs, and one dependent construct. The five independent constructs are classified into two categories: mobile payment system (MPS) characteristics and individual differences (ID). Acting as mediators, PEOU and PU are essential constructs within the Technology Acceptance Model (TAM) (Davis, 1989). Perceived usefulness refers to a user's belief that utilizing a certain technology will enhance their capacity to complete their work. On the other hand, perceived ease of use shows how someone feels about how usable a system is and how little work is needed to use it. The dependent construct in the study is m-wallet actual adoption, which pertains to the frequency and extent of an individual's usage of the specific system (Moon & Kim, 2001).

Mobile Payment System Characteristic

Convenience is an integral aspect of mobile payment, providing consumers with timely and location-based utility (Kim et al., 2010). The convenience of mobile payments is made possible by Malaysia's improvements in internet connectivity speed, which may lead to an increase in the desire to use mobile payment methods. In consideration of this factor, the following hypotheses are formulated.

H_{1a}: Convenience has a significant positive relationship to the actual adoption of m-wallet in Malaysia.

H_{1b}: Convenience is interceded by perceived usefulness and perceived ease of use towards the actual adoption in Malaysia.

In Rogers' (1995) terminology, compatibility refers to the extent to which potential users' attitudes, requirements, and experiences align with their perceptions of innovation. When technological development can seamlessly integrate into an individual's daily life, compatibility significantly influences their willingness to embrace innovation (Yang et al., 2012). While previous research in developed countries such as Spain and the US found significant mediation effects of perceived usefulness, studies in developing countries like China, India, Vietnam, and Indonesia showed less emphasis on perceived usefulness in mediating this relationship. Given Malaysia's favourable response to recent technological advancements, the following hypotheses are proposed.

H_{2a}: Compatibility has a significant positive relationship to the actual adoption of m-wallet in Malaysia.

H_{2b}: Compatibility is interceded by perceived usefulness and perceived ease of use towards the actual adoption of m-wallet in Malaysia.

Individual Differences

Personal innovativeness refers to an individual's inclination to explore novel experiences and ideas (Agarwal & Prasad, 1998). The m-wallet users exhibit greater receptiveness to the potential benefits associated with the latest technology and possess a higher level of confidence in adopting it. Based on the several initiatives and rewards programs introduced by the Malaysian government to encourage the adoption of new mobile payment technologies, it can be inferred that Malaysia has demonstrated a rapid uptake of these innovations. Consequently, the following hypotheses are put forward.

: Personal Innovativeness has a significant positive relationship to the actual adoption of m-wallet in Malaysia.

: Personal Innovativeness is interceded by perceived ease of use towards the actual adoption of m-wallet in Malaysia.

The significance of mobile payment knowledge in m-wallet adoption has not been extensively examined in Malaysia as it can be posited that certain Malaysians demonstrate

a hesitancy to acquire an extensive understanding of mobile payments due to perceiving it as challenging to learn. According to Rogers (1995), individuals require sufficient information or knowledge from diverse sources to become aware of an innovation and recognize its potential advantages. Thus, the following hypotheses are formulated:

: Mobile payment knowledge has a significant positive relationship to the actual adoption of m-wallet in Malaysia.

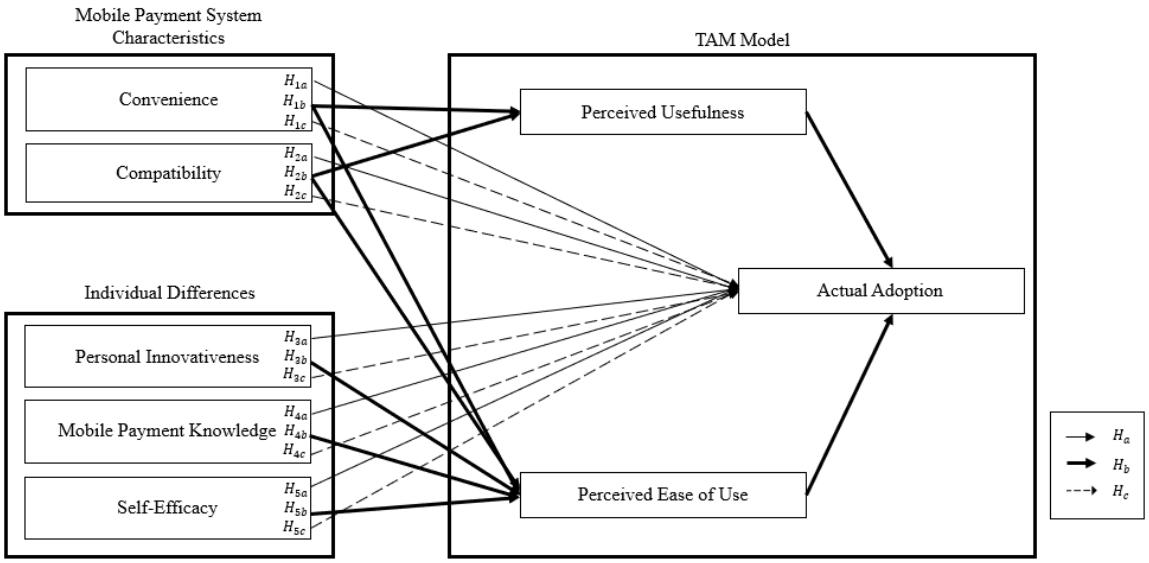
: Mobile payment knowledge is interceded by perceived ease of use towards the actual adoption of m-wallet in Malaysia.

Lastly, self-efficacy refers to a person's confidence in their capacity to carry out a given task or successfully use an invention (Bandura, 2006). In the study, Malaysians who possess self-efficacy in using an m-wallet are considered to be proficient in its utilisation. Hence, the following hypotheses are suggested.

H_{5a}: Self-efficacy has a significant positive relationship to the actual adoption of m-wallet in Malaysia.

H_{5b}: Self-efficacy is interceded by perceived ease of use towards the actual adoption of m-wallet in Malaysia.

Figure 1. Conceptual framework of m-wallet adoption in Malaysia



As depicted in Figure 1, the theoretical framework proposed for this study is built upon the TAM model, serving as a fundamental basis for investigation. The framework incorporates five independent constructs, which are categorised into two domains: mobile payment system (MPS) characteristics and individual differences (ID). Within the mobile payment system, two constructs are considered: convenience and compatibility. The domain of individual differences comprises three constructs: personal innovativeness, mobile payment knowledge, and self-efficacy. Additionally, the framework includes two interceding constructs and one dependent construct, all aimed at examining the adoption of m-wallets in Malaysia.

METHODOLOGY

Sampling Procedure and Data Collection

A purposive sampling approach is employed to specifically target individuals with prior experience using mobile payment systems, as their insights are valuable in understanding the factors that influence m-wallet adoption (Wong et al., 2019). By employing this sampling approach, we can choose individuals who exhibit particular characteristics or have experiences. The study focuses on individuals who own smartphones and have already installed and used an m-wallet application within the last three months. This time frame is considered sufficient for individuals to develop a certain level of proficiency in operating the mobile wallet, given that using m-wallets requires a certain degree of technical competence with smartphones (Amoroso & Magnier-Watanabe, 2012).

With 185.7 cellular phone subscriptions per 100 residents, the Wilayah Persekutuan Kuala Lumpur (WPKL) has been recorded to have the highest mobile phone penetration rate in Malaysia (Statista, 2020). WPKL is a prominent centre for the nation's economy, finances, and cultural activities (World Population Review, 2022). Additionally, WPKL is one of the most densely populated cities in the country, and its residents are known for their early adoption of emerging technologies, including m-wallets (Daramola & Sopiah, 2021). Residents in WPKL have diverse lifestyles, preferences, and behaviors, providing numerous socio-economic and demographic factors influencing individuals' m-wallet adoption. Hence, Suria KLCC, Mid Valley Megamall, Pavilion, Berjaya Times Square, and The Gardens Mall are selected as our sampling locations to observe the perspectives of target respondents.

To obtain high response rates, a self-administered survey was conducted in person on weekdays, involving a total of 650 respondents. Prior to completing the questionnaire, respondents were required to demonstrate that they are current users of m-wallets by presenting their installed Alipay or GrabPay applications on their smartphones. The data collection period spanned a duration of one month in 2019. A total of 641 questionnaires were successfully gathered from the respondents. However, a total of 632 usable questionnaires were selected for further analysis after incomplete questionnaires were excluded, yielding a response rate of 97.23%.

Measures and Procedures for Analysis

The research questionnaire consists of two sections. The first section includes demographic information such as the respondents' gender, age, race, education level, occupation, and income level. The second section includes a total of 38 items to measure 8 constructs using the five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). This scale choice is made to ensure respondents take less time to complete the questionnaire compared to a higher-point scale, reduce confusion, and enhance the response rate, thus leading to higher reliability. The constructs include convenience, compatibility, personal innovativeness, mobile payment knowledge, self-efficacy, PEOU, PU, and actual adoption. To enhance reliability and prevent confusion among respondents, the questionnaire is reviewed by two academic professionals, and their feedback is considered to improve the sentence structures for each item in a clear and concise manner.

Due to its applicability for theory development and prediction applications, the partial least squares-structural equation model (PLS-SEM) is used to ensure the reliability and validity of each construct (Gefen et al., 2000). The analysis involves two steps. The first step is to assess the measurement model based on several evaluation criteria in terms of validity and reliability. Convergent validity shows the degree to which more items of the same construct should be theoretically related. To meet the requirement, factor loading values

must exceed 0.5 to achieve the minimum average variance extracted (AVE) of 0.5 (Hair et al., 2011; Hair et al., 2017). Moreover, discriminant validity is based on three criteria. First, loading values for all items under each construct should be greater than those values for items in other constructs. Second, the Fornell-Larcker criterion requires the square root of AVE for each construct to be greater than the correlations with other latent constructs (Fornell & Larcker, 1981; Hair et al., 2017). Third, the Heterotrait-Monotrait (HTMT) ratio of correlations must be lower than 0.85 or 0.90 to indicate non-perfect measures among constructs (Kline, 2011; Henseler et al., 2015).

To ensure respondents rationally provide their responses on each statement, outer loadings should be at least 0.25-0.5. In the study, composite reliability is used as one of the measures for the internal consistency of reliability in scale items. The composite reliability for each construct must be at least 0.7 to demonstrate adequate convergence or internal consistency (Hair et al., 2017). If the composite reliability value is larger than 0.6, it is considered that the degree of convergent validity of the constructs has been achieved (Fornell & Larcker, 1981; Hair et al., 2017).

After establishing good measures of constructs, Q-squared is used as an indicator of model adequacy in terms of predictive relevance. A value greater than zero for Q-squared indicates the model has adequate predictive relevance, implying that the predictive validity of the model is less than zero (Hair et al., 2017). Using an adequate structural model, the second step involves assessing the structural model by examining the path coefficients and corresponding p-values for hypothesis testing. Effect sizes are estimated using f-squared to further analyze the effects. The f-squared (f 2) values of at least 0.02, 0.15, and 0.35 represent small, medium, and large effect sizes, respectively (Cohen, 1988).

Welch's t-test is referred to as an unequal variance t-test. It is used to compare the regression coefficients between the structural models of Alipay and GrabPay. Due to its capability to compare two samples with different variances or sample sizes, this statistical test has more explanatory power than the traditional t-test (Kassambara, 2019). Welch's t-test is used to compare the effects of m-wallet characteristics on online impulse buying across several groups (Lee et al., 2022).

Demographic and characteristics description.

To provide a demographic description of 632 respondents, Table 1 summarises their demographic profiles. Approximately 57.1 of them are females, and the remaining are males. In addition, 47.8% of respondents who are 25 years old to 39 years old tend to use an m-wallet. The age group is followed by 45.9% of respondents who are 24 years old and below that. For Generation X, only 6% of those respondents are 40 to 54 years old. 0.3% of respondents who are Baby Boomers aged 55 years old and above would use m-wallet. Our respondents in using m-wallet consist of 80.5% of Chinese. It is followed by 13.5% of Malay and remaining 6.5% of respondents are Indian. Since Alipay is using Chinese language as default in the application, Malay and Indian did not use Alipay.

Table 1 shows the respondents' demographic characteristics

		Alipay	GrabPay	Frequency	%
Gender	Male	127	144	271	42.9
	Female	162	199	361	57.1
Age (years old)	24 and below (Generation Z)	121	169	290	45.9
	25-39 (Millennials)	144	158	302	47.8
	40-54 (Generation X)	24	14	38	6.0
	55 and above (Baby Boomers)	-	2	2	0.3
Race	Malay	-	82	82	13
	Chinese	289	220	509	80.5
	Indian	-	41	41	6.5
Education Level	Primary or below	-	2	2	0.3
	High School or Secondary	8	23	31	4.9
	College Diploma	23	20	43	6.8
	Bachelor Degree	240	276	516	81.6
	Master Degree	18	18	36	5.7
	Doctorate Degree	-	4	4	0.6
Occupation	Student	31	131	162	25.6
	Private Employee	233	173	406	64.2
	Retiree or Unemployment	-	2	2	0.3
	Self-employed	14	31	45	7.1
	Civil Servant	11	6	17	2.7
Income Level	RM1,500 and below	28	124	152	24.1
	RM1,501-RM3,000	106	113	219	34.7
	RM3,001-RM4,500	129	66	195	30.9
	RM4,501-RM6,000	18	26	44	7.0
	RM6,001 and above	8	14	22	3.5

For education levels, 81.6% of respondents are bachelor's degree holders. 64.2% of respondents are private employees, 25.6% are students, 7.1% are self-employed, 2.7% are civil servants, and only 0.3% are retirees or unemployed individuals. Last but not least, 34.7% of m-wallet users earn between RM 1,501 to RM 3,000, while the least of them earn RM 6,001 and above. 129 respondents are Alipay users who have income between RM 3,001 and RM 4,500, and 124 respondents are GrabPay users who have the most revenue of RM 1,500.

RESULTS AND DISCUSSION

To examine their actual adoption of m-wallet, all respondents are either Alipay or GrabPay. 343 respondents (54.27%) are GrabPay users, while the remaining 289 of them (45.73%) are Alipay users. As shown in Table 2, the majority of them who use the m-wallet by around 1 -3 times in a month would make up 73.6% of total respondents, while 1.7% of them use the m-wallet more than ten times. Furthermore, 59.7% of them use an m-wallet due to the ease of transactions. Then, 24.5% of them use an m-wallet due to customer loyalty benefits, and 15.8% think that using an m-wallet is easier to access than cash. On the other hand, 60.9% of respondents have experienced less than one year of using an m-wallet. Only 9.8% of them have experience more than three years in using m-wallet.

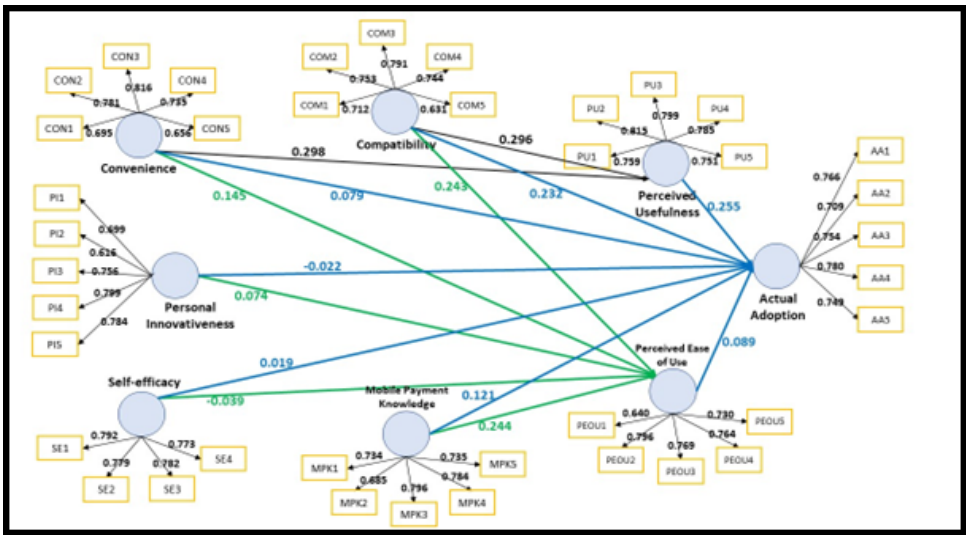
Table 2 shows the respondents' characteristics

		Alipay	GrabPay	Total	%
User Type	Existing User	289	343	632	100
M-wallet Usage Frequency per Month	1-3 times	229	236	465	73.6
	4-6 times	47	77	124	19.6
	7-10 times	11	21	32	5.1
	More than 10 times	2	9	11	1.7
Reason to Use M-wallet	Ease of Transactions	230	147	377	59.7
	Easier Access than Cash	16	84	100	15.8
	Customer Loyalty Benefits	43	112	155	24.5
Experiences in using M-wallet (years)	0-1	231	154	385	60.9
	1-2	46	139	185	29.3
	More than 3	12	50	62	9.8

Assessing the Measurement Model

The validity and reliability of the items for each construct are assessed while analysing the measurement model. Figure 2 demonstrates that the outer loading for the indicators of Actual Adoption (AA) and Perceived Usefulness (PU) is determined to be higher than the threshold value of 0.708. Furthermore, the external loadings of Compatibility (COM), Convenience (CON), Mobile Payment Knowledge (MPK), Personal Innovativeness (PI), and Perceived Ease of Use (PEOU) are lower than the threshold value of 0.708 yet higher than the minimum threshold value of 0.4. Lastly, the external loadings of Self-efficacy (SE) reached the threshold value of 0.708, while SE5 has been eliminated due to its outer loading being lower than the minimum value of 0.4.

Figure 2. PLS-SEM measurement model with path coefficients and outer loadings



There are eight constructs, including convenience (CON), compatibility (COM), personal innovativeness (PI), mobile payment knowledge (MPK), self-efficacy (SE), perceived ease of use (PEU), perceived usefulness (PU) and actual adoption (AA) are found to have Cronbach's alpha values higher than 0.7, indicating that they have high levels of internal consistency. All of the constructs in this study have average variance extracted (AVE) values greater than 0.5 and composite reliability values between 0.8 and 0.9, suggesting their validity and internal consistency. The conditions of the Fornell-Larcker criterion have been met by AA, COM, CON, MPK, PEOU, PI, PU, and SE. This demonstrates that the constructs' discriminant validity exists.

Figure 2 shows that of the items under the category AA, AA4 has the highest loading value, followed by AA1, AA3, AA5, and AA2. The next highest loading value in COM belongs to COM3, which is followed by COM1, COM2, COM4, and COM5. The greatest loading value for CON is discovered to be CON3, followed by CON1, CON2, CON4, and CON 5. MPK3 has the largest loading value of the MPK items, followed by MPK1, MPK2, MPK4, and MPK5. In terms of loading, PEOU2 is the most loaded, followed by PEOU1, PEOU3, PEOU4, and PEOU5. For PI, PI4 has the highest loading value, followed by PI1, PI2, PI3, and PI5. For PU, it is discovered that PU2 has the highest loading value, followed by PU1, PU3, PU4, and PU5. The highest loading value for SE is for SE1. SE2, SE3, and SE4 come behind it.

Table 3 shows the results of HTMT of correlations

	AA	COM	CON	MPK	PEOU	PI	PU	SE
AA								
COM	0.603							
CON	0.509	0.748						
MPK	0.439	0.432	0.393					
PEOU	0.505	0.524	0.460	0.509				
PI	0.283	0.357	0.231	0.648	0.350			
PU	0.632	0.576	0.566	0.535	0.688	0.290		
SE	0.277	0.355	0.273	0.279	0.166	0.108	0.303	

Note: AA = Actual Adoption; COM = Compatibility; CON = Convenience; MPK = Mobile Payment Knowledge; PEOU = Perceived Ease of Use; PI = Personal Innovativeness; PU = Perceived Usefulness; SE = Self-Efficacy

As shown in Table 3, all constructs are found to have HTMT values lower than the threshold value of 0.85, and hence, there is discriminant validity among the constructs. The maximum threshold value for HTMT is 0.85, where higher than the threshold value indicates a lack of discriminant validity.

Assessing the Structural Model

After establishing the adequate measures of constructs of the specified model, the next stage is to assess the adequacy of the structural model. As shown in Table 4, the results demonstrate that constructs exhibit a low degree of multicollinearity, as the variance inflation factor (VIF) values recorded were less than 5.

Table 4 shows the results of VIF

	AA	COM	CON	MPK	PEOU	PI	PU	SE
AA								
COM	1.744				1.636		1.492	
CON	1.627				1.533		1.492	
MPK	1.727				1.580			
PEOU	1.626							
PI	1.458				1.449			
PU	1.831							
SE	1.144				1.126			

Note: AA = Actual Adoption; COM = Compatibility; CON = Convenience; MPK = Mobile Payment Knowledge; PEOU = Perceived Ease of Use; PI = Personal Innovativeness; PU = Perceived Usefulness; SE = Self-Efficacy

As shown in Table 5, compatibility (path coefficient of 0.232 and p-value of 0.000) is determined to be significant to influence actual m-wallet adoption at the level of 1%, while convenience (path coefficient of 0.079 and p-value of 0.064) is significant at the level of 10%. With a coefficient value of 0.232, compatibility is discovered to have the most significant impact on the actual adoption of m-wallets. Mobile payment knowledge is significant at 5% level (path coefficient value of 0.121 and p-value of 0.011). Self-efficacy (path coefficient of 0.019 and p-value of 0.636) and personal innovativeness (path coefficient of -0.022 and p-value of 0.648) are insignificant.

Table 5 shows the results of hypothesis testing for direct effects

Hypothesis			Path Coefficient	P-Value	Supported
	CON → AA		0.079	0.064	No
	COM → AA		0.232	0.000	Yes
	PI → AA		-0.022	0.648	No
	MPK → AA		0.121	0.011	Yes
	SE → AA		0.019	0.636	No

Note: AA = Actual Adoption; COM = Compatibility; CON = Convenience; MPK = Mobile Payment Knowledge; PEOU = Perceived Ease of Use; PI = Personal Innovativeness; PU = Perceived Usefulness; SE = Self-Efficacy.

The f^2 is used as a criterion to capture effect sizes in examining the direct effects in detail. In Table 6, the f^2 value of 0.51 indicates that compatibility exhibits a small effect on actual adoption. Towards influencing actual adoption, the f^2 values of 0.049 and 0.081 indicate that perceived ease of use and perceived usefulness provide a small effect. In examining the mediating effect, convenience is found to provide a small effect on perceived ease of use (f^2 value of 0.020) and perceived usefulness (f^2 value of 0.082). In addition, mobile payment knowledge is found to have a small effect on actual adoption (f^2 value of 0.020) and perceived ease of use (f^2 value of 0.052). Given that the f^2 value is lower than the threshold value of 0.020, personal innovativeness and self-efficacy are demonstrated and could not provide significant effects on actual adoption and perceived ease of use, respectively.

Table 6 shows the results of f^2

	AA	COM	CON	MPK	PEOU	PI	PU	SE
AA								
COM	0.051				0.049		0.081	
CON	0.006				0.020		0.082	
MPK	0.020				0.052			
PEOU	0.008							
PI	0.001				0.005			
PU	0.077							
SE	0.001				0.002			

Note: AA = Actual Adoption; COM = Compatibility; CON = Convenience; MPK = Mobile Payment Knowledge; PEOU = Perceived Ease of Use; PI = Personal Innovativeness; PU = Perceived Usefulness; SE = Self-Efficacy.

Table 7 shows the results of hypothesis testing for mediating effects

Path-related Hypothesis			Path Coefficient	P-Value	Variance Accounted For	
	CON → PU & PEOU → AA		0.100	0.000	Partial Effect	Yes
	CON → → AA					
	COM → PU → AA		0.108	0.000	Partial Effect	Yes
	COM → PEOU → AA					
	PI → PU → AA		0.007	0.268		No
	PI → PEOU → AA					
	MPK → PU → AA		0.022	0.110		No
	MPK → PEOU → AA					
	SE → PU → AA		-0.003	0.485		No
	SE → PEOU → AA					

Note: AA = Actual Adoption; COM = Compatibility; CON = Convenience; MPK = Mobile Payment Knowledge; PEOU = Perceived Ease of Use; PI = Personal Innovativeness; PU = Perceived Usefulness; SE = Self-Efficacy

When considering the mediating effects shown in Table 7, it is observed that PEOU and PU partially mediate the influence of convenience on the adoption of m-wallets. The convenience factor is enhanced by the ease and flexibility of using m-wallets, which increases their portability. In addition, a significant indirect relationship is identified between compatibility and actual adoption, indicating that m-wallets incorporating user-friendly features contribute to their ease of use and usefulness. However, the perceived ease of use does not mediate the impact of personal innovativeness, mobile payment knowledge, and self-efficacy on actual adoption. This suggests that additional support is required, particularly for non-innovative late adopters, to encourage their acceptance of m-wallets. Consumers often lack training and guidance, leading to unfamiliarity with mobile wallet services and the ease of using them. Moreover, the limited acceptance of m-wallets among retailers also hinders their ease of use. These findings conclude the insignificant mediating effect of perceived ease of use in relation to personal innovativeness, mobile payment knowledge, and self-efficacy on the actual adoption of m-wallets.

Table 8 shows the results of Welch's t-test for comparing actual adoption between Alipay and GrabPay

$\mu_A \neq \mu_G$	Difference	P Value	Supported
Convenience affects actual adoption of Alipay and GrabPay differently in Malaysia.	-0.066	0.0000	Yes
Compatibility affects actual adoption of Alipay and GrabPay differently in Malaysia.	0.024	0.0000	Yes
Personal innovativeness affects actual adoption of Alipay and GrabPay differently in Malaysia.	-0.019	0.0010	Yes
Mobile payment knowledge affects actual adoption of Alipay and GrabPay differently in Malaysia.	0.045	0.0000	Yes
Self-efficacy affects actual adoption of Alipay and GrabPay differently in Malaysia.	0.040	0.1230	No

Note: Welch's t-test is chosen instead of normal t-test due to the ability in testing unequal sample sizes and variances. The hypotheses have been set to identify the difference between Alipay and GrabPay as follows: H_0: $\mu_A = \mu_G$ versus H_1: $\mu_A \neq \mu_G$, where μ_A refers to the mean of Alipay while μ_G refers to the mean of GrabPay.

In Table 8, it is surprising to note that all constructs have different effects on Alipay and GrabPay, except for self-efficacy. This discrepancy may arise because Alipay and GrabPay are relatively still new payment methods compared to traditional ones like cash. Therefore, the impact of self-efficacy remains consistent, regardless of the specific type of m-wallet adopted explaining that consumers are required to take the initiative to learn and understand how to use m-wallets or make payments through their smartphones (Kumari & Lodha, 2021). The findings indicate a positive and significant relationship between convenience and both GrabPay and Alipay. However, GrabPay has higher levels of convenience due to its user-friendly interface and greater acceptance among retailers compared to Alipay which is an international m-wallet that is not designed to meet locals' preferences. Moreover, GrabPay aligns with the definition of convenience proposed by Kim et al. (2010) by offering timely and location-based usage for consumers. On the other hand, the differences in compatibility are significant, with GrabPay being better suited to the lifestyle of m-wallet users in Malaysia. GrabPay, specifically designed for the local market, integrates well with popular complementary services like GrabCar and GrabFood, which require the use of GrabPay as a payment method. This finding is supported by Aydin and Burnaz (2016), which highlights compatibility is a primary consideration for non-users when adopting new technologies suited to their lifestyle.

In addition, Alipay and GrabPay differ in terms of mobile payment knowledge. Adopting m-wallets necessitates different levels of initiative and understanding. Alipay and GrabPay vary in terms of usage and application design and thus, insufficient training and knowledge lead users to perceive m-wallets as confusing and difficult to use (Moghavvemi et al., 2021). n. Lastly, the disparity in personal innovativeness between Alipay and GrabPay is relatively minor compared to other constructs. Individuals with higher levels of innovativeness adopt new technologies earlier than others, as they are more receptive to the potential benefits brought by the latest technology and exhibit greater confidence in adopting it. As both Alipay and GrabPay are considered new technologies in the Malaysian market, existing users demonstrate similar levels of innovativeness in adopting m-wallets (Yang et al., 2012).

CONCLUSION

Despite the presence of over 50 mobile wallets in Malaysia, our study exclusively focuses on two specific m-wallets in Malaysia, namely

Alipay and Grabpay. Alipay boasts global recognition and Grabpay enjoys popularity as a local brand, it is important to acknowledge that market dynamics are subject to change. The comparison of the actual adoption of Alipay and Grabpay could offer insights into policy making. For example, extending to other m-wallets such as Touch 'n Go and Boost. Our analysis validates constructs in the Malaysian context by exploring the mediating effect of perceived ease of use and perceived usefulness on actual adoption of m-wallets. Our findings highlight the importance of compatibility in driving m-wallet adoption among Malaysian consumers. In line with this importance, providers are suggested to offer diverse services that align with users' lifestyle. The services can ensure high ubiquity for seamless integration. Alco, retailers can provide reliable network connections.

Partnerships between providers, retailers and financial institutions are expected to emerge with smaller players thriving in niche markets. Efforts to broaden adoption should target diverse demographics, including older generations and foreign workers. Promoting the unified payment network "DuitNow" can facilitate seamless transactions. Utilizing alternative theoretical models such as the Unified Theory of Acceptance and Use of Technology (UTAUT) could offer valuable insights into the factors influencing adoption among this segment of the population. During the post-pandemic, researchers can employ UTAUT to further explore adoption shifts comprehensively, especially among late-adopters. Future studies should encompass a broader spectrum of prominent m-wallets to understand evolving industry dynamics.

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