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Original Article

Investigating the Determinants of M-Banking Adoption via QR Code in Malaysia

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Abstract: The rapid expansion of digital transactions and the growing popularity of mobile banking (M-banking) have highlighted the importance of understanding the factors that drive the adoption of QR code technology, both for individual users and financial service providers. This study explores the various determinants that influence the adoption of M-banking through QR codes among Malaysian citizens who use smartphones equipped with M-banking applications. Covering a broad range of demographic groups across Malaysia, from Perlis to Sabah, the research examines the relationship between the adoption of M-banking via QR code (dependent variable) and four independent variables: performance expectancy, effort expectancy, facilitating conditions, and convenience. Utilizing SPSS for comprehensive data analysis, the study confirms the significance of these four factors in influencing the adoption process. By investigating socio-economic, technological, and behavioral aspects, this research provides in-depth insights into the key drivers and barriers that affect the uptake of QR code-based M-banking in Malaysia. The findings offer valuable implications for strategies aimed at increasing the adoption of M-banking technologies, promoting financial inclusion, and contributing to the advancement of Malaysia's digital economy.

Keywords: Mobile Banking (M-banking); QR Code Adoption; Digital Transactions; Performance Expectancy; Financial Inclusion.

1. Introduction

Financial institutions have introduced increasingly convenient methods for conducting everyday transactions to attract more users to adopt and support mobile banking (m-banking) technology. One such innovation is the Quick Response (QR) code payment system. The global proliferation of mobile and smartphone technologies has significantly contributed to the expansion of mobile services, including mobile banking (Gupta & Arora, 2017). Consequently,

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continuous innovation in mobile technologies is essential to enhance user engagement and service effectiveness. This evolution presents numerous opportunities for the banking sector to develop and promote more user-friendly transaction methods. Among the emerging mobile banking solutions, QR code payments have rapidly gained global popularity due to their simplicity, accessibility, and efficiency (Kosim & Legowo, 2021). This method offers advantages that surpass many traditional payment systems, primarily because of its ease of use and compatibility with mobile wallets and apps such as Apple Pay and Google Pay. QR code payments have enabled seamless contactless transactions, which became especially critical during the COVID-19 pandemic. During this period, users increasingly favored QR code payments due to the health safety and convenience they offered.

According to Kosim and Legowo (2021), the increased usage of QR payments during the pandemic, supported by promotional initiatives, significantly boosted user adoption. The simplicity of scanning a QR code using a smartphone camera, and a mobile internet connection has made this payment method widely accessible. Additionally, its compatibility with point-of-sale systems has encouraged businesses to integrate QR code payments, enhancing operational efficiency in payment tracking and inventory management. The QR code's ability to store links, payment details, and product information has made it a vital tool in both online and offline retail environments, thereby enriching the overall consumer experience. Given this context, the present study aims to address existing gaps in the literature by extending the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) with demographic variables such as gender, age, education, and income. This comprehensive framework seeks to enhance understanding of technology adoption across different user groups, particularly in the context of m-banking via QR code. Specifically, the study investigates the relationships between performance expectancy, effort expectancy, facilitating conditions, and convenience on users' behavioral intention to adopt mobile banking through QR code technology.

This paper begins with a global overview of QR code adoption in m-banking, followed by a focus on the Malaysian context and key factors influencing adoption. A literature review then informs the development of the research framework and hypotheses. The subsequent sections present the research methodology, followed by results, conclusions, limitations, and recommendations for future research. Dahlberg, Guo, and Ondrus (2015), in their critical review of mobile payment research, observed that although extensive studies have been conducted on mobile payment adoption worldwide, many have repeatedly focused on similar themes such as consumer acceptance and technological factors. This redundancy has limited the emergence of new insights, particularly concerning the adoption of QR code-based mobile banking. Thus, this study aims to fill that gap by exploring the determinants of QR payment adoption in Malaysia. To develop a nuanced understanding of the Malaysian context, it is beneficial to first examine global trends and responses to this technological shift.

The global movement toward a cashless society has accelerated over recent decades, with traditional cash-based transactions increasingly replaced by electronic alternatives (de Almeida, Fazendeiro & Inácio, 2018). Nevertheless, cash still accounts for 85% of all global transactions (Thomas, 2013). However, several countries have made significant strides toward cashless systems. For instance, Sweden was projected to become one of the most cashless societies by 2020, with only 2% of transactions conducted in cash (CNBC, 2018; The Star Online, 2017). In the United Kingdom, cash constituted only 40% of payments in 2016, with the remaining 60% made through alternative electronic methods (The Guardian, 2018). Furthermore, the European Central Bank (2022) reported a notable rise in mobile payment usage across Europe. Between 2019 and 2022, the share of mobile payments more than tripled in volume from 3% to 10%, and in value from 4% to 11%. These statistics highlight the growing global trend towards adopting cashless and mobile payment technologies, underscoring the relevance and timeliness of this study.

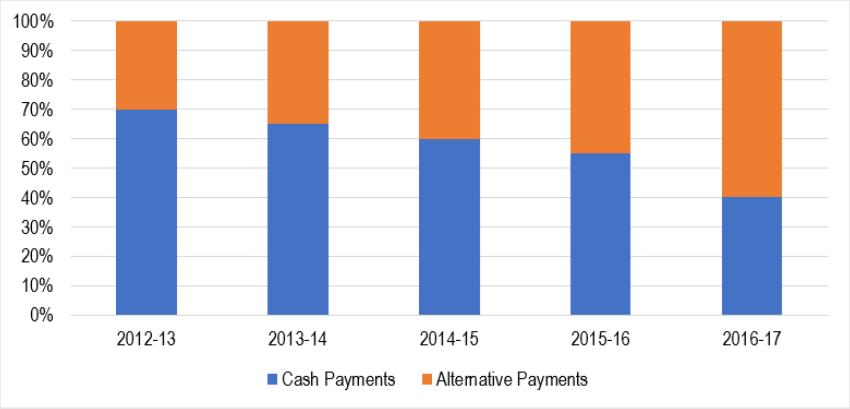

Figure 1. Cash Purchase Statistics
Source: The Guardian (2018)

Figure 1 captures the statistics of cash purchases. QR codes, initially developed and used in Japan, have gained significant popularity in Asia, where they are expected to be more widely adopted than in other regions of the world. Global statistics on QR code usage indicate that East Asia recorded the highest adoption rate, with 15% usage in 2019, surpassing other parts of Asia (QR Tiger, 2023). According to QR Tiger (2023), China has been a leader in the use of QR codes since their early adoption in 2011. At that time, QR codes were already used for various purposes, ranging from renting portable chargers to paying for groceries. Notably, the total value of payment transactions made via QR codes in the Asia region amounted to $550 billion in 2017, a figure that grew fifteen-fold over the next three years, reaching $1.5 trillion in 2019 (QR Tiger, 2023). QR codes are also popular in other Asian countries, with approximately 40% of India's population, 27% of Vietnamese consumers, and 23% of Thai consumers using QR codes for daily transactions (QR Tiger, 2023). In China, the mobile payment sector surpassed the $112 billion U.S. market by 50 times in 2016, reaching a valuation of $5.5 trillion (The New York Times, 2017). The global trend toward cashless transactions, including the widespread adoption of non-cash payment options, is rapidly expanding to other countries, including Malaysia.

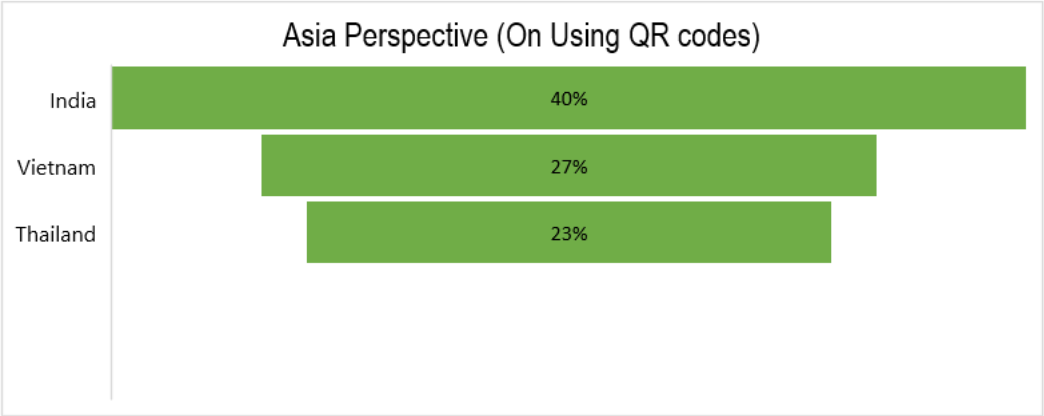

Figure 2. Asia Perspective in adapting towards QR codes payments in 2023
Source: QR Code Tiger (2023)

In 2017, it was recorded that 85% of payments in Malaysia were still made through cash transactions (Maybank, 2017). In response, the Central Bank of Malaysia (Bank Negara Malaysia, BNM) introduced the Financial Sector Blueprint 2011-2020, which outlined strategic initiatives to reduce the volume of cash payments across the nation. These initiatives encouraged the use of debit cards, alternative payment methods, and electronic payment systems such as mobile payments, including QR code-based payments (The Edge Market, 2016). QR code mobile payments have become particularly appealing to mobile banking users due to their ability to streamline the payment process. Unlike other mobile payment methods, which involve multiple steps such as browsing payment websites, logging in, entering seller account details, and acquiring a security PIN, QR payments are quick and efficient, making them more attractive for everyday use (see Figure 2). According to Rahman (2023), 9.5 billion e-payment transactions were completed using QR codes in 2022, reflecting a 25% increase from the 7.2 billion transactions in 2021. In 2022, Malaysians completed an average of 291 electronic transactions per day (Rahman, 2023). Additionally, 100,000 new QR code registrations were made in the final quarter of 2022, bringing the total number of QR code registrations to 1.7 million by the first quarter of 2023. This rapid increase in QR code adoption presents a unique opportunity for researchers to explore the factors influencing the uptake of QR code payments in Malaysia.

The growing use of QR codes is playing a crucial role in financial inclusion, especially for lower-income groups. By simplifying payment processes, QR codes enable individuals from lower-income backgrounds to participate more easily in the economy. This, in turn, facilitates the establishment of small businesses, such as mini grocery stores, which can operate without the need for costly debit or credit card terminals. This is particularly beneficial for entrepreneurs who may not have access to traditional banking infrastructure. While research on the use of QR codes in various applications such as advertising, product authentication, food labeling, and mobile marketing has been conducted (Bacarella, 2015), the use of QR codes in mobile payments remains an emerging and relatively under-explored area (Liébana-Cabanillas, Ramos de Luna, & Montoro-Ríos, 2015). Despite this, mobile payment services using QR codes are expected to become a significant development in the digital payment landscape (Koenig-Lewis, Marquet, Palmer & Zhao, 2015). Theories such as the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Technology Acceptance Model (TAM) offer solid frameworks for understanding the acceptance of mobile payments. This study aims to apply these theories in a new context—the adoption of QR code mobile payments in Malaysia.

Given that QR code-based mobile payments are still in their early stages of adoption, it is essential to understand the factors that influence their uptake among consumers. This study will review existing literature on mobile banking

and QR code payment adoption to identify key determinants. The literature analysis will focus on factors such as performance expectancy, effort expectancy, facilitating conditions, and convenience, to determine which are most influential in encouraging the adoption of mobile banking payments via QR codes in Malaysia. This research seeks to address the gap in knowledge by investigating the factors influencing the intention to use QR code-based mobile payments among Malaysian consumers. By examining various socio-economic, technological, and behavioral factors, this study aims to provide valuable insights into the drivers and barriers to the widespread adoption of mobile banking through QR code transactions in Malaysia.

2. Literature Review

2.1. Underpinning Theory

The Theory of Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) are widely recognized frameworks for explaining how individuals come to accept and incorporate technology into their daily routines. These theories are closely related, both addressing the acceptance and use of technology. In the context of this research, TAM serves as the primary theoretical foundation, although other related theories, particularly those focusing on technology adoption, also contribute to the evolving understanding of the topic. TAM, along with its associated models, is well-regarded for its effectiveness in predicting and explaining technology acceptance behaviors across various research domains, including the mathematical and natural sciences. The theory remains relevant as long as studies examine both technological systems and the behavioral aspects of individual acceptance.

2.1.1. Technology Acceptance Model (TAM)

Davis (1989) introduced the Technology Acceptance Model (TAM), which posits that users' adoption of a computer system is primarily determined by their behavioral intention to use the system. This intention, in turn, is influenced by two key beliefs: perceived ease of use and perceived usefulness. Davis (1989) based these concepts on the Theory of Reasoned Action (TRA) developed by Fishbein and Ajzen (1975). According to TAM, when users encounter a new software or technological system, multiple factors influence their decision on how and when to use it. Specifically, Davis defined the variables as follows: Perceived Usefulness (PU) is described as "the degree to which an individual believes that using a specific system would enhance their job performance," while Perceived Ease of Use (PEOU) is defined as "the degree to which an individual believes that using a particular system would require minimal effort" (Davis, 1989).

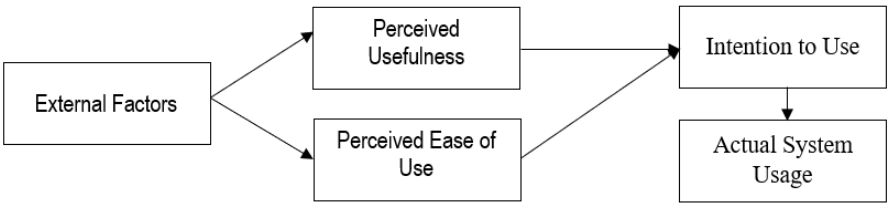

Figure 3. Technology Acceptance Model (TAM)

Figure 3 captures the Technology Acceptance Model (TAM), if users perceive a specific technology as beneficial, they are likely to believe that there is a positive relationship between usage and performance. Since effort is a limited resource, users are more inclined to adopt an application if they perceive it as easier to use compared to others. As a result, educational technologies that exhibit a high level of perceived usefulness (PU) and perceived ease-of-use (PEOU) are more likely to generate positive perceptions. The relationship between PU and PEOU suggests that PU mediates the effect of PEOU on attitudes and intended use. In simpler terms, while PU directly influences attitudes and usage, PEOU indirectly affects these factors by influencing PU. In the domain of information technology, TAM proposes that users develop a positive attitude toward technology when they perceive it as both useful and easy to use (Davis, 1989). TAM has become a widely applied model for predicting the acceptance and usage of information systems in daily life across various research fields. It has been utilized in studies examining social influence and cognitive processes (Venkatesh & Davis, 2000), control, intrinsic motivation, and emotions (Venkatesh, 2000), as well as risk and acceptance integration in e-commerce (Pavlou, 2003). With the advent of the internet and the World Wide Web (WWW), researchers have adapted TAM to the electronic environment and internet adoption, producing results that confirm its applicability.

2.1.2. Unified Theory of Acceptance and Use of Technology (UTAUT)

Another relevant theory for this study is the Unified Theory of Acceptance and Use of Technology (UTAUT), proposed by Venkatesh (2003). UTAUT offers a significant advantage by integrating constructs from eight different theoretical models of user behavior, including the Theory of Reasoned Action, TAM, the Motivational Model, the Theory of Planned Behavior, a hybrid model combining TAM and the Theory of Planned Behavior, the Model of PC Utilization, the Innovation Diffusion Theory, and the Social Cognitive Theory. The UTAUT framework identifies four direct drivers of usage intention and behavior: performance expectancy, effort expectancy, social influence, and facilitating conditions, as shown in Figure 4 The model also incorporates four moderators—gender, age, experience, and voluntariness of usage—that are expected to mediate the effects of these drivers on usage intention and behavior. Like TAM, UTAUT is considered a suitable model for this study because of its focus on understanding user intentions to adopt information systems and their subsequent behavior (Venkatesh, 2003). The following sections will provide an overview of relevant research, culminating in the development of hypotheses for further investigation.

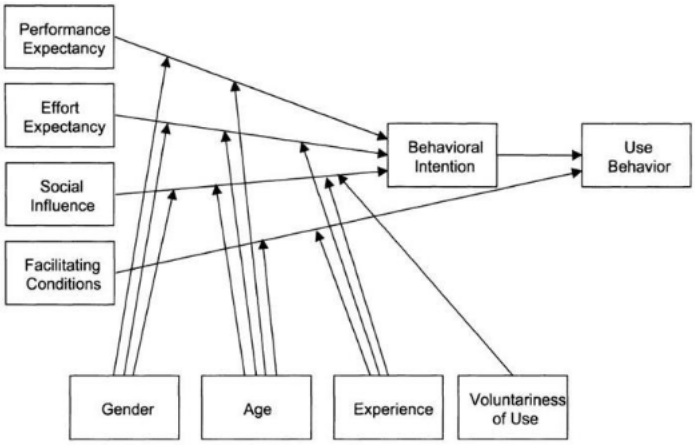

Figure 4. Unified Theory of Acceptance and Use of Technology (UTAUT)

In the study of mobile banking (m-banking) adoption through QR codes, the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) offer particularly relevant theoretical frameworks. The TAM framework, widely recognized for its simplicity and clarity, emphasizes key factors such as perceived usefulness (PU) and perceived ease of use (PEOU). In the context of m-banking, TAM is particularly valuable for understanding consumers' perceptions of the utility of QR codes in financial transactions, as well as how easily they can incorporate this technology into their banking activities. Its effectiveness has been extensively validated across numerous studies, reinforcing its reliability as a tool for exploring technology adoption. On the other hand, UTAUT provides a more comprehensive framework by integrating concepts from several established theories, including TAM. It offers a broader perspective on technology adoption by incorporating factors such as performance expectancy, effort expectancy, social influence, and facilitating conditions. Moreover, UTAUT's inclusion of moderators such as gender, age, experience, and voluntariness of use makes it particularly relevant in examining the diverse factors influencing m-banking adoption. Given the complexity of QR code usage within m-banking, UTAUT's flexible structure enables a more nuanced investigation of the various determinants influencing user behavior. In essence, both TAM and UTAUT present valuable insights, with distinct advantages. TAM's focus on fundamental elements such as ease of use and utility makes it ideal for understanding basic user perceptions, while UTAUT's broader, integrative approach and incorporation of moderating factors provide a more detailed understanding of technology adoption. These frameworks will be applied in this study to examine user behavior and acceptance in the evolving m-banking landscape, particularly concerning QR code adoption in Malaysia.

2.2. Adoption of Mobile Banking via QR Code

According to Qasim and Abu-Shanab (2015), mobile payment (m-banking) is a system that combines online payment capabilities with mobile technology, allowing consumers to pay for goods and services. These systems enable customers to initiate, authorize, and complete financial transactions through wireless communication or mobile networks (Slade, 2015). Zhou (2013) identifies two distinct types of mobile payments: proximity mobile payment (PMP) and remote mobile payment (RMP). In proximity mobile payment, users must be near the merchant to complete a transaction (Humbani & Wiese, 2017). Transaction details are stored on the phone and exchanged over short distances using barcode scanning or radio-frequency identification (RFID) technology (Qasim & Abu-Shanab, 2015). This method facilitates direct interaction between the buyer and the seller in close physical proximity. In Malaysia, common proximity mobile payment systems include TouchnGo e-Wallet and WeChat Pay. On the other hand, remote payments allow

users to conduct transactions for services such as mobile internet payments and mobile banking, facilitated by distant servers (Humbani & Wiese, 2017). In this scenario, the buyer and seller do not need to be physically near each other, and PayPal is a prime example of an RMP system, where personal data is stored on servers to facilitate digital money transfers for online transactions.

As technology evolves, mobile banking has seen innovations such as QR code-based payments. QR code mobile payments combine elements of both proximity and remote payments. To make a payment via QR code, customers can interact directly with the seller (proximity), but the smartphone application scans the QR code to encode payment information, enabling a contactless transaction (remote). Despite the recognition of mobile payment's value, adoption in Malaysia remains limited (Ibrahim, Hussin & Hussin, 2019). This has led to significant research into the factors influencing the uptake of mobile payment systems (Ibrahim, Hussin & Hussin, 2019). Numerous studies have explored the key determinants of mobile payment adoption. Koenig-Lewis, Marquet, Palmer, and Zhao (2015) found that perceived utility and social influence are crucial factors in the adoption of mobile payments by young consumers. In contrast, Thakur and Srivastava (2014) identified adoption readiness, personal innovativeness, and perceived risk as significant predictors of users' intentions to adopt mobile payments. While various models explain consumer technology adoption behavior, the Technology Acceptance Model (TAM) remains one of the most influential frameworks for understanding this behavior. It is widely regarded for its robustness (Ibrahim, Hussin & Hussin, 2019) and is frequently applied in studies of mobile payment technology adoption.

In both developed and developing nations, mobile banking is recognized as a critical feature that enhances traditional banking services. In societies with sufficient banking infrastructure, low computer costs, and stable political environments, the absence of mobile banking has little impact, as alternative banking methods are available. Mobile banking allows individuals to perform banking tasks quickly and efficiently (Rosli et al., 2020). Malaysia, a politically stable and moderately developed nation, benefits from a robust infrastructure that supports mobile banking. This makes mobile banking a safe and effective tool for conducting financial transactions. Furthermore, the widespread availability of computers allows Malaysians to engage in online banking, and mobile banking provides an added benefit of speed and efficiency (Yazid, 2022). QR code payments complement mobile banking and are increasingly popular in Malaysia for bill payments, transportation, and banking transfers. The shift from cash to digital payment methods, particularly mobile payments, has been significant in recent years. QR code-based mobile payments are widely used, with services like Maybank QR Pay, Boost, and Touch & Go Mobile Wallet gaining popularity. However, despite their widespread availability, the adoption of QR code-based mobile payments in Malaysia remains low. Therefore, it is important to examine the factors influencing Malaysians' acceptance of mobile banking through QR code technology.

2.3. Performance Expectancy

Performance expectancy is a critical determinant of behavioral intention and planned behavior, which ultimately influences actual behavior. Understanding individuals' attitudes toward adopting mobile banking via QR codes is essential, as a positive attitude can either promote or hinder technology adoption. This is particularly relevant in the context of mobile banking adoption through QR codes. Scholars have emphasized the role of performance expectancy, as outlined in the Unified Theory of Acceptance and Use of Technology (UTAUT) model, in improving job performance. Similarly, the concept of perceived usefulness in the Technology Acceptance Model (TAM) is crucial in motivating Malaysian millennials to embrace innovative technologies that add value to their daily transactions. Empirical research consistently supports the positive impact of performance expectancy in UTAUT or perceived usefulness in TAM on the intention to adopt new technologies.

Moreover, ease of use is a key factor in the adoption process. While individuals may perceive a technology as useful, they are less likely to adopt it if it is perceived as difficult to use (Venkatesh, Morris, Davis & Davis, 2003). In the case of Malaysian millennials considering QR code-based e-wallet transactions, perceived ease of use is particularly important. When users find the process of making payments easy and effortless, their expectations for successful outcomes increase, leading to the adoption of the technology for their daily transactions. Previous research has consistently demonstrated the role of performance expectancy, also known as perceived usefulness in TAM, as an influential factor in the technology adoption process. In conclusion, understanding performance expectancy and its alignment with perceived usefulness is crucial for motivating tech-savvy Malaysian millennials to adopt and integrate innovative technologies into their financial transactions.

2.4. Effort Expectancy

In the context of this study, understanding effort expectancy is crucial for the successful acceptance and practical application of the technology being examined. Positive attitudes, recognized as key motivators in shaping actions, emphasize the importance of considering perceived ease of use within the study. Effort expectancy refers to the degree to which a system is perceived as easy to use. This can be further defined as the perception that engaging with a technology requires minimal mental and physical effort. Effort expectancy captures individual users' perceptions of how

effortless it is to use a particular technology (Venkatesh, Morris, Davis & Davis, 2003). For Malaysian millennials, who are often driven by process-oriented considerations, effort expectancy becomes a significant factor, potentially even more critical than performance expectancy when evaluating information systems. Previous studies have consistently affirmed the positive relationship between effort expectancy and the intention to adopt new technologies. Suki, Ramayah, Kow, and Suki (2011) argue that when a system is perceived as easy to use, users are more likely to express an intention to adopt it. Over the past several decades, research has shown that effort expectancy positively influences consumers' intention to embrace mobile payments.

Zhong, Dhir, Nieminem, Hamalainen, and Laine (2013) identified a significantly positive relationship between perceived ease of use and consumers' intention to adopt mobile payments in China. This finding is supported by empirical research conducted in various settings, consistently highlighting the significant impact of effort expectancy on technology adoption intentions. In the specific context of mobile banking via QR code, effort expectancy directly influences users' perceptions of the simplicity involved in financial transactions. A user-friendly and straightforward experience with QR code-based mobile banking positively shapes users' intentions to adopt the technology. Research by Venkatesh, Tong, and Xu (2012) reinforces the idea that perceived ease of use, or effort expectancy, plays a significant role in users' acceptance and use of technology. A seamless, uncomplicated user experience with QR codes increases the likelihood of technology adoption, which aligns with the core principles of TAM and is substantiated by empirical evidence in the literature.

2.5. Facilitating Conditions

Facilitating conditions play a crucial role in the acceptance of mobile banking via QR codes, and understanding their importance is essential for the smooth integration of this innovative technology into users' financial routines. In technology adoption models such as the Unified Theory of Acceptance and Use of Technology (UTAUT), facilitating conditions refer to users' perceptions of the availability of resources and support for a specific behavior. For QR code-based mobile banking, these conditions relate to the presence of necessary tools and infrastructures that simplify and support the use of this digital financial service. The creators of UTAUT assert that facilitating conditions directly affect users' intentions and behaviors when adopting new technologies. When users perceive that the resources, support, and infrastructure required for QR code mobile banking are available, their confidence and comfort in using the technology increase. Empirical evidence from past studies has also shown the positive impact of facilitating conditions on the behavioral intention to adopt mobile payment systems in Taiwan. In essence, facilitating conditions act as catalysts, easing the adoption process for users and ensuring that essential resources and support systems are in place to foster a positive and supportive environment for technology adoption (Venkatesh, Tong & Xu, 2012).

2.6. Convenience

Poon (2008) defines convenience as the perception of flexibility in time and location that a system offers, making transactions seamless and effective. This concept involves the accessibility and mobility aspects of the system, such as the ability to complete payments from any location, whether through the internet or mobile devices. Such flexibility not only saves time but also enhances overall accessibility and portability, contributing to the broader notion of convenience. In the context of e-banking, convenience becomes particularly significant, as it plays a key role in shaping users' attitudes and behaviors toward mobile and electronic banking services (Laukkanen, 2007). The integration of mobile devices, applications, network providers, and financial institutions enables consumers to make payments and transfer money quickly and conveniently. Convenience stands out as a defining characteristic of mobile devices, offering a notable advantage over traditional payment methods by allowing transactions to be completed rapidly. Kavak and Anwar (2019) define convenience as processes that streamline transaction times, underscoring its role in improving the efficiency of financial transactions. Meanwhile, Nie and Amarayoun (2019) describe convenience in terms of ease and comfort of use. Despite the widespread adoption of mobile payments, the intention to use m-payments, particularly about perceived convenience, remains an area that requires further exploration, especially concerning QR code-based payments (Boden et al., 2020). In the realm of m-payments, users consistently perceive the technology as timesaving, easy to use, and offering greater availability and flexibility (Kavak & Anwar, 2019). Significant studies conducted in Australia by Gao and Waechter (2017) highlight convenience as a crucial factor influencing consumers' intention to use mobile payments.

2.7. Hypothesis Development

2.7.1 Performance Expectancy

Performance expectancy, which is conceptually similar to perceived usefulness in the Technology Acceptance Model (TAM), refers to the extent to which individuals believe that utilizing technology will enhance their ability to perform certain tasks (Venkatesh, Thong, & Xu, 2012). As mobile payment systems offer an alternative to traditional cash

transactions, individuals may be influenced by their perceptions of performance expectancy when deciding to adopt such technology. Previous studies by Heyman (2017) and Dmitrii (2018) have found a positive relationship between performance expectancy and the behavioral intention to adopt mobile payment systems. Based on these findings, the following hypothesis is proposed: H1: Performance expectancy significantly influences the adoption of mobile banking via QR code.

2.7.2. Effort Expectancy

Effort expectancy, also referred to as perceived ease of use in the Technology Acceptance Model (TAM), denotes the perceived ease with which users can engage with a given technology (Venkatesh, Thong, & Xu, 2012). This concept emphasizes the simplicity and ease of operation associated with using a particular system (Davis & Davis, 2003). For mobile payment technology, the degree of effort required to use the system is a critical consideration. A more seamless and user-friendly experience increases the likelihood of adoption. Dmitrii (2018) found that effort expectancy positively influences users' behavioral intention to adopt mobile payments. Consequently, the following hypothesis is posited:
H2: Effort expectancy significantly influences the adoption of mobile banking via QR code.

2.7.3. Facilitating Conditions

Facilitating conditions refer to the availability of resources and support that enable consumers to engage in a particular behavior (Venkatesh, Thong, & Xu, 2012). In the context of mobile payments, the presence of adequate resources and infrastructure is essential to ease the adoption and use of the technology. A study by Yeh and Tseng (2017) demonstrated that facilitating conditions positively affected the behavioral intention to adopt mobile payments in Taiwan. Thus, the following hypothesis is formulated: H3: Facilitating conditions significantly influence the adoption of mobile banking via QR code.

2.7.4. Convenience

The appeal of technology is often greatest when it simplifies users' lives (Handarkho & Harjoseputro, 2019). In today's marketplace, consumers increasingly prioritize companies that offer value through convenient access to and use of products and services. Convenience, which combines time and place utility, plays a crucial role in shaping consumers' decisions to adopt specific systems (Pal, Vanijja, & Papasratorn, 2015). The ease of use and convenience associated with mobile payment systems is expected to positively influence users' adoption of mobile banking via QR code (Pham, Tran, Misra, Maskeliunas, & Damasevicius, 2018). Based on this rationale, the following hypothesis is proposed: H4: Convenience significantly influences the adoption of mobile banking via QR code.

2.8. Research Framework

The research framework explores the relationships between four elements of the UTAUT model: performance expectancy, effort expectancy, facilitating conditions, and convenience, as independent variables that influence behavioral intention to adopt mobile banking via QR code. Convenience is an additional modified variable introduced in this study. In this framework, the four independent variables are examined for their impact on the dependent variable, which is the adoption of mobile banking via QR code. Based on the literature reviewed in the previous section, this study hypothesizes that all independent variables will have a positive relationship with the adoption of mobile banking via QR code (Lim, Ahmad & Talib, 2018). Furthermore, it is anticipated that performance expectancy will play a mediating role in the relationship between effort expectancy and the adoption of mobile banking via QR code, particularly among millennials in Malaysia. On the basis of literature reviewed, the following research framework has been developed for this study:

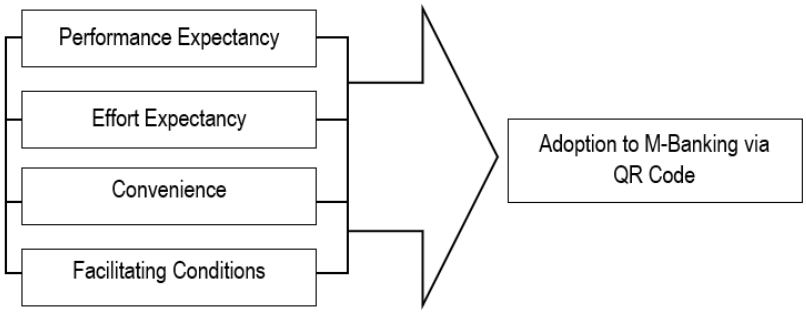

Figure 5. Research Framework

Figure 5 illustrates the research framework of this study. The theoretical framework, based on the Unified Theory of Acceptance and Use of Technology (UTAUT), has been adapted and modified to suit the context of this research. The UTAUT framework is appropriate for this study as its variables, to a certain extent, aid in explaining the factors that influence consumers' behavioral intention towards the adoption of mobile banking through QR codes. This, in turn, can enhance the penetration rate of mobile banking via QR codes in Malaysia. By examining behavioral intention and its determinants, this framework also provides valuable insights into the key areas of focus necessary to improve users' behavioral intention.

3. Materials and Methods

This study aims to investigate the factors influencing the adoption of mobile banking via QR codes among Malaysian consumers. This chapter provides an overview of the research design, data collection methods, variables and their measurements, population, sampling techniques, and data analysis procedures, offering a clear understanding of how the study was conducted and how the results were derived.

3.1. Research Design

As reported by Ibrahim, Hussin, and Hussin (2019), Malaysia has approximately 25.2 million smartphone users, which serves as the population size for this study. Purposeful sampling will be employed throughout the research. The study utilizes established multi-item scales from previous studies to measure variables related to factors influencing the intention to use QR mobile payments. A five-point Likert scale will be used for all items. Primary data will be collected through an online survey using Google Forms. According to Malhotra (2012), online, home, and workplace surveys have proven effective in improving response rates, saving time, reducing costs, and enabling the collection of data from many respondents. A non-probability sampling technique will be applied due to limited access to precise data from the bank. Additionally, purposive sampling is deemed appropriate for this investigation. The target population consists of smartphone users in Malaysia, with a focus on individuals aged 18 to 54, as this demographic is most likely to possess purchasing power and engage in QR mobile payments. To ensure diversity in the sample, quota sampling will be used to include individuals from various genders, ethnicities, education levels, incomes, and professions, as these factors are critical to the study and contribute valuable demographic insights (Taheerdost, 2016). This sampling strategy also ensures that appropriate statistical analyses can be performed. The survey will be distributed online via a Google Form link shared through popular smartphone applications such as WhatsApp, Facebook, and Instagram. This online distribution method ensures a faster, more convenient, and broader outreach, which also increases the likelihood that participants will complete the survey accurately, thereby enhancing data validity.

3.2. Data Collection Technique

Data accumulation, as defined by Sekaran and Bougie (2016), refers to the process of gathering and preparing data. In this study, self-administered questionnaires will be distributed through online communication platforms like WhatsApp, Facebook, and Instagram. The questionnaire will consist of two sections: the first section will collect basic demographic information from the respondents, while the second section will include questions designed to measure the variables relevant to the research. The full questionnaire and its design are provided in the appendix.

3.3. Variables and Measurements

Measurement, as defined by Stevens (1946), involves assigning numerals to objects or events based on certain rules. Various scales and measurement methods have been developed for this purpose. Demographic variables will be measured using Stevens' scale, which includes four categories: nominal, ordinal, interval, and ratio scales. Five demographic questions will be included in the questionnaire, with gender, race, and marital status measured using the nominal scale; age measured using the interval or ratio scale; and education level measured using the ordinal scale. The study will also use a five-point Likert scale to measure responses to the questions related to the key research variables. Respondents will be asked to select the response that best reflects their opinion, with the scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.4. Sampling Design

Sampling involves selecting a representative subset from the population to estimate the population parameter (Sekaran & Bougie, 2016). This technique reduces the time and cost required for data collection. The study will employ a non-probability sampling technique due to limitations in accessing exact data from the bank. Purposive sampling is chosen because it is suitable for this type of research. The study targets smartphone users in Malaysia, specifically those aged 18 to 54, as they are more likely to possess purchasing power and use QR mobile payment systems. This

demographic is also more sensitive to technological advancements. Additionally, quota sampling will be used to ensure diversity in the sample, encompassing various gender, ethnic, educational, income, and professional backgrounds, which will increase the variation within the sample.

3.5. Sample Size

The sample size refers to the total number of participants included in the research study. In this study, the sample size will be determined using G-Power, a statistical software that aids in conducting power analysis for various statistical tests. This software helps determine the minimum number of participants necessary to detect a meaningful effect with a given level of statistical significance. G-Power calculates the required sample size by considering factors such as effect size, desired significance level, and the statistical test being used. For this study, a sample size of 129 is considered appropriate, considering the four independent variables involved.

3.6. Data Analysis

Data analysis will be conducted using the Statistical Package for the Social Sciences (SPSS), a powerful tool for statistical analysis and data management. Before proceeding with the analysis, reliability and validity tests will be performed to ensure the consistency and accuracy of the data collected for both dependent and independent variables. Descriptive statistical analysis will be used to summarize the characteristics of the sample and examine the correlations between the independent and dependent variables. Additionally, Pearson correlation analysis will be employed to assess the strength and direction of the relationships between the variables. These analytical techniques will help draw meaningful conclusions and insights from the collected data.

4. Results

4.1. Descriptive Statistics Analysis

Descriptive statistics are essential for simplifying complex datasets, thereby enhancing their comprehensibility. In this study, the mean, standard deviation, and percentage distribution across each category of the Likert-type scale were utilized as the primary analytical tools. The Likert-type scale, ranging from 1 to 5, was defined as follows: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The results for each category are presented in the following summary.

Table 1. Descriptive Statistics of Variables (n=200)

Variables	No. of items	Mean	Std. Deviation	Decision
Adoption to m-banking Via QR Code	4	4.0529	0.74853	High
Performance Expectancy	4	4.0175	0.90487	High
Effort Expectancy	5	4.216	0.76883	High
Facilitating Conditions	5	3.876	0.66274	High
Convenience	4	4.2775	0.77484	High

Table 1 captures an overview of key factors influencing the adoption of mobile banking via QR Code, based on responses from 200 participants. The variables assessed include Adoption to m-banking via QR Code, Performance Expectancy, Effort Expectancy, Facilitating Conditions, and Convenience, each with its respective mean score, standard deviation, and decision category. For Adoption to m-banking via QR Code, the mean score of 4.0529 indicates that respondents generally have a positive view of adopting this technology. With a standard deviation of 0.74853, there is moderate variation in responses, suggesting some diversity in opinions. The "High" decision category confirms that adoption is strongly supported. Performance Expectancy, with a mean of 4.0175 and a standard deviation of 0.90487, suggests that respondents believe mobile banking would enhance their performance, though the higher standard deviation indicates some variability in how strongly this factor is perceived. Again, the "High" decision indicates a positive influence on adoption.

Effort Expectancy, with a mean score of 4.216 and a standard deviation of 0.76883, shows that respondents generally believe using m-banking via QR Code is easy and requires minimal effort. The moderate variability in responses indicates some differing opinions, but the "High" decision indicates that ease of use is a significant factor in adoption. Facilitating Conditions, with a mean of 3.876 and a standard deviation of 0.66274, suggests that most respondents feel that the necessary infrastructure and conditions are available for using m-banking. Although the mean is slightly lower compared to other variables, the standard deviation indicates relatively consistent responses, and the "High" decision reflects that facilitating conditions are still seen as a favorable factor for adoption. Lastly, Convenience, with a mean of 4.2775 and a standard deviation of 0.77484, indicates that respondents strongly perceive m-banking via

QR Code as convenient. While there is moderate variation in responses, the "High" decision confirms that convenience is a key motivator for adoption. Overall, the table demonstrates that all factors are seen in a positive light, with respondents generally agreeing that mobile banking via QR Code is beneficial, easy to use, and convenient, with adequate supporting conditions in place.

4.2. Reliability Analysis

The reliability of the questionnaire items was evaluated using the alpha coefficient, which ranges from 0 to 1. A higher coefficient indicates a greater level of reliability. In this study, the reliability analysis was performed using SPSS, applying Cronbach's alpha as the measure of internal consistency. As noted by Sekaran (2003), Cronbach's alpha represents the degree of positive correlation among items within a construct, thereby indicating the internal consistency and reliability of the instrument used in the study.

Table 2. Summary of Cronbach's Alpha Values

Cronbach's Alpha	Level of Internal Consistency
$\alpha \geq 0.9$	Excellent
$0.7 \leq \alpha \leq 0.9$	Good
$0.6 \leq \alpha \leq 0.7$	Acceptable
$0.5 \leq \alpha \leq 0.6$	Poor
$\alpha < 0.5$	Unacceptable

Table 2 elucidates the criteria for assessing the internal consistency of Cronbach's alpha. Sekaran (2003) further emphasizes that a measure's reliability is indicative of the absence of errors or biases in the data, ensuring consistency in measurement over time and across different items of the instrument. Consequently, the reliability test serves to ascertain the consistency and stability of the instrument's conceptual measurement, thereby aiding in determining the measure's utility.

Table 3. Result of Reliability Statistics of Variables

Variables	Number of items	Cronbach's Alpha
Adoption to m-banking Via QR Code	4	0.933
Performance Expectancy	4	0.830
Effort Expectancy	5	0.951
Facilitating Conditions	5	0.714
Convenience	4	0.940

Table 3 presents the reliability statistics of variables, showcasing the Cronbach's Alpha values for each variable. The Cronbach's Alpha coefficient is a measure of internal consistency, indicating how closely related the items within each variable are. In this context, a higher Cronbach's Alpha value suggests greater internal consistency and reliability of the questionnaire items associated with the variable. For the variable "Adoption to m-banking Via QR Code" comprises 4 items and demonstrates a Cronbach's Alpha value of 0.933, indicating excellent internal consistency among the items. This implies a strong positive correlation among the items within this variable, reflecting a high level of reliability in measuring the construct of adoption to m-banking via QR code. Similarly, the variable "Effort Expectancy" consists of 5 items with a Cronbach's Alpha value of 0.951, signifying excellent internal consistency. This indicates that the items measuring effort expectancy exhibit a high degree of coherence and reliability, suggesting robustness in measuring the construct of effort expectancy. On the other hand, the variable "Facilitating Conditions" presents a Cronbach's Alpha value of 0.714, falling within the "good" range based on the criteria provided in Table 4.14. While still demonstrating acceptable internal consistency, it is slightly lower compared to the other variables. This suggests that there may be some variability among the items within this variable, but overall, the items are reliably measuring the construct of facilitating conditions.

4.3. Correlation Analysis

This study employed a Pearson correlation test to explore the relationships between attitude, self-efficacy, knowledge, government support, and startup intention. The Pearson correlation coefficient (r) was utilized to assess both the strength and direction of these associations. An r value of zero indicates no correlation, while a value of 1.0 represents a perfect positive or negative correlation. Cohen (1988) provided guidelines for interpreting correlation

coefficients, ranging from 0 (indicating no correlation) to 1 (indicating a perfect correlation). According to Cohen's framework, correlations between 0.10 and 0.29 are considered weak, between 0.30 and 0.49 suggest a moderate correlation, and values of 0.50 or higher indicate a moderately strong correlation. Furthermore, Hair et al. (2006) offers additional benchmarks for interpreting correlation coefficients. They assert that coefficients between 0.91 and 1.00 reflect an exceptionally strong correlation, those ranging from 0.71 to 0.90 indicate a high correlation, values between 0.41 and 0.70 suggest a moderate correlation, correlations between 0.21 and 0.40 represent a small but definitive correlation, and coefficients between 0.01 and 0.20 signify a minimal correlation. These guidelines assist in understanding the significance and magnitude of the observed correlations in the analysis. The following subsection presents a detailed discussion of the relationships between the independent and dependent variables, as shown in Table 4.

Table 4. Result of Correlation Matrix

Variables	AMB	PE	EE	FC	C
Adoption to m-banking Via QR Code (AMB)	1.000				
Performance Expectancy (PE)	0.815	1.000			
Effort Expectancy (EE)	0.879	0.849	1.000		
Facilitating Conditions (FC)	0.794	0.816	0.828	1.000	
Convenience (C)	0.927	0.822	0.896	0.838	1.000

Table 4 presents the results of the correlation matrix, which examines the relationships among five key variables: Adoption of Mobile Banking via QR Code (AMB), Performance Expectancy (PE), Effort Expectancy (EE), Facilitating Conditions (FC), and Convenience (C). The results reveal strong positive correlations between AMB and all other variables, indicating that these factors significantly influence users' adoption of mobile banking services via QR codes. The highest correlation is observed between AMB and Convenience ($r = 0.927$), suggesting that perceived convenience plays a critical role in promoting the adoption of mobile banking. When users find the service easy and practical to access, their likelihood of adopting the technology increases significantly. This is followed by the correlation between AMB and Effort Expectancy ($r = 0.879$), which indicates that the easier the system is perceived to use, the more likely users are to adopt it. Similarly, Performance Expectancy also shows a strong positive correlation with AMB ($r = 0.815$), implying that users are more inclined to adopt mobile banking if they believe it will enhance their performance and efficiency. Facilitating Conditions also show a substantial correlation with AMB ($r = 0.794$), demonstrating that the availability of supportive resources, such as smartphones, internet connectivity, and technical assistance, contributes positively to the adoption process.

In addition to the relationships with AMB, the matrix reveals strong interrelationships among the independent variables themselves. Effort Expectancy and Performance Expectancy are highly correlated ($r = 0.849$), indicating that users who perceive the system as easy to use also tend to see it as beneficial to their performance. Similarly, Effort Expectancy is closely related to Facilitating Conditions ($r = 0.828$), and Performance Expectancy is also significantly associated with Facilitating Conditions ($r = 0.816$), suggesting that a supportive environment enhances users' perceptions of both ease of use and performance benefits. Moreover, Convenience shows strong correlations with EE ($r = 0.896$), FC ($r = 0.838$), and PE ($r = 0.822$), reinforcing the idea that a convenient mobile banking experience is often linked to user-friendly systems, adequate infrastructure, and positive performance outcomes. Thus, the correlation matrix highlights the importance of Convenience, Effort Expectancy, Performance Expectancy, and Facilitating Conditions in influencing users' adoption of mobile banking via QR codes. Among these, Convenience emerges as the most influential factor. These findings suggest that financial institutions aiming to boost m-banking adoption should prioritize enhancing convenience, simplifying the user interface, emphasizing the benefits of the service, and ensuring that adequate support systems are in place.

4.4. Regression Analysis

Multiple regression analyses were performed to evaluate the predictive power of the independent variables on the dependent variable. The model's goodness of fit was assessed using the coefficient of determination (R^2), which reflects the proportion of variance in the dependent variable explained by the independent variables. Based on Cohen's (1988) guidelines, an R^2 value of 0.02 is considered weak, indicating a poor model fit and suggesting limited explanatory power of the independent variables. An R^2 value of 0.13 represents a moderate fit, implying that the independent variables account for a reasonable portion of the variance. Meanwhile, an R^2 value of 0.26 or above indicates a strong model fit, signifying a substantial explanatory contribution by the independent variables. These evaluations of model fit offer critical insights into the effectiveness of the predictors and enhance the interpretation of the study's results.

Table 5. Result of Hypothesis Test using Multiple Linear Regression

Variable(s)	Beta	t-stats	Sig.
Constant		3.460	0.001
Performance Expectancy	0.110	2.096	0.037
Effort Expectancy	0.200	3.085	0.002
Facilitating Conditions	0.420	3.018	0.014
Convenience	0.693	11.062	0.000
R		0.935	
R^2		0.874	
Adjusted R^2		0.871	
F-Stats		38.29	
Sig.		0.000	

The results presented in Table 5 demonstrate that the multiple linear regression model used in this study is statistically significant and has strong explanatory power. The constant term is significant ($t = 3.460$, $p = 0.001$), indicating that the dependent variable has a meaningful baseline value even when all predictors are zero. Among the independent variables, all four, e.g., Performance Expectancy, Effort Expectancy, Facilitating Conditions, and Convenience, show significant positive relationships with the dependent variable. Performance Expectancy has a beta coefficient of 0.110 and is statistically significant ($t = 2.096$, $p = 0.037$), suggesting that individuals' beliefs about the benefits of using a system positively influence their behavioral intention or usage. Effort Expectancy also shows a significant positive effect ($\beta = 0.200$, $t = 3.085$, $p = 0.002$), indicating that the perceived ease of use encourages adoption or performance. Facilitating Conditions yield a beta value of 0.420 with a significant t-statistic ($t = 3.018$, $p = 0.014$), highlighting that the availability of resources and support significantly enhances users' engagement or technology adoption. The strongest effect is observed for the Convenience variable, with a high beta of 0.693 and a highly significant t-statistic ($t = 11.062$, $p < 0.001$), implying that ease, accessibility, and practicality play a dominant role in influencing user behavior. The model's overall performance is strong, as indicated by the correlation coefficient ($R = 0.935$), which shows a very strong relationship between the predictors and the outcome variable. The coefficient of determination ($R^2 = 0.874$) reveals that 87.4% of the variance in the dependent variable is explained by the model, while the adjusted R^2 (0.871) confirms that this high explanatory power is not due to model overfitting. Furthermore, the F-statistic value of 38.29 with a significance level of $p < 0.001$ confirms that the model is statistically valid, and the predictors collectively have a significant impact on the dependent variable. In conclusion, the regression model provides robust evidence that the variables under study significantly contribute to the outcome, with Convenience emerging as the most influential factor.

5. Discussion

5.1. Performance Expectancy

Performance expectancy has been identified as a significant determinant influencing individuals' behavioural intention to adopt mobile payment systems. This finding aligns with prior research conducted by Heyman (2017) and Dmitrii (2018), who both established a positive correlation between performance expectancy and the intention to embrace mobile payment technologies. Their studies suggest that when users perceive the technology as beneficial in enhancing performance, they are more likely to incorporate it into their daily routines. Accordingly, the results of this study support Hypothesis 1, confirming that performance expectancy significantly affects individuals' willingness to adopt mobile payment methods.

5.2. Effort Expectancy

The analysis indicates that effort expectancy plays a crucial role in influencing the adoption of mobile banking via QR code. Consistent with the findings of Dmitrii (2018), this study reveals that users are more inclined to adopt mobile payment solutions when the technology is perceived as easy to use and requires minimal effort. The findings demonstrate that when individuals perceive the system as user-friendly and efficient, they are more likely to integrate it into their financial transactions. Thus, the results substantiate the acceptance of Hypothesis 2, highlighting that users' perceptions of ease of use and convenience positively impact their intention to adopt mobile banking via QR code.

5.3. Facilitating Conditions

The third hypothesis, which posits that facilitating conditions significantly influence the adoption of mobile banking via QR code, is supported by the study's findings. Facilitating conditions refer to the availability of resources, support,

and infrastructure that ease the adoption and usage of new technology. This is in agreement with the research of Yeh and Tseng (2017), who demonstrated that favourable facilitating conditions positively affect users' behavioural intention toward mobile payment adoption. Based on the empirical evidence and prior literature, Hypothesis 3 is accepted, confirming that facilitating conditions play a vital role in encouraging the use of m-banking via QR code.

5.4. Convenience

The study also examines the role of convenience in influencing the adoption of mobile banking via QR code. Convenience, defined as the simplicity and ease of accessing and using a technology, is shown to have a substantial impact on user adoption. This finding is consistent with the work of Pham, Tran, Misra, Maskeliunas, and Damasevicius (2018), who highlighted that convenience significantly enhances users' acceptance of mobile payment systems. In line with their findings, the present study confirms that when users perceive mobile banking via QR code as convenient, they are more likely to adopt the technology. Therefore, Hypothesis 4 is accepted, affirming the crucial role of convenience in driving the adoption of mobile banking via QR code in the Malaysian context.

6. Conclusions

This study aimed to explore the adoption of mobile banking through QR codes in Malaysia, examining the influencing factors and identifying potential barriers to widespread usage. The findings underscore the growing relevance of QR code technology in shaping the future of digital financial services in the country. Despite the promising potential, the study revealed several critical factors influencing adoption, including trust, perceived security, usability, and user awareness. While Malaysia is progressively embracing digital transformation in financial services, there remains a need to address user-specific concerns and infrastructural challenges to achieve more inclusive adoption. The insights gained provide a foundation for stakeholders, particularly financial institutions, developers, and policymakers—to design more effective strategies and systems that cater to the diverse needs of the Malaysian population.

6.1. Limitations

Throughout the research process, several limitations emerged that may have influenced the outcomes of the study. One significant constraint was the limited timeframe for data collection, which was restricted to just one month. This short duration hindered the ability to gather a larger and more representative sample, potentially affecting the comprehensiveness of the findings. Additionally, the study encountered challenges related to respondent cooperation, as many participants showed limited interest or were unavailable, resulting in a lower response rate and a narrower range of perspectives. Geographical dispersion also posed a challenge, particularly as the study targeted smartphone users of mobile banking applications across Malaysia, including remote regions such as Sabah. The wide geographical coverage made outreach and data collection logistically complex, especially in rural and less-connected areas. Furthermore, the research was constrained by financial and logistical limitations, which restricted the use of more expansive and potentially more effective data collection tools and methodologies.

6.2. Recommendations for Future Research

To address these limitations and build upon the findings of this study, future research should consider several important directions. First, extending the timeframe and increasing the sample size would allow for a more comprehensive and accurate understanding of user behavior and technology adoption trends over time. Additionally, incorporating personal and cultural dimensions—such as individual innovativeness and societal values—could offer deeper insights into the motivations and hesitations surrounding QR code payment adoption. It would also be beneficial to evaluate the user interface and experience of mobile banking applications, as usability and design play a crucial role in shaping adoption behavior. Moreover, further investigation into security concerns and trust factors is necessary, particularly in relation to users' perceptions of data privacy and safety. Research should also examine the policy and regulatory environment to better understand its impact on service development, user confidence, and system interoperability. Lastly, including broader geographic and demographic representation, particularly from rural and underserved communities, will ensure a more inclusive and accurate portrayal of the adoption landscape in Malaysia. By exploring these areas, future studies can contribute more effectively to the advancement and equitable implementation of mobile banking technologies in the country.

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References

Arif, I., Afshan, S., & Sharif, A. (2016). Resistance to adopt mobile banking in a developing country: Evidence from modified TAM model. *Journal of Finance and Economic Research, 1*(1), 24–41. https://doi.org/10.20547/jfer1601104

CNBC. (2018). Sweden: Cashless future sounds alarm bells for the central bank. Available at https://www.cnbc.com/2018/05/03/sweden-cashless-future-soundsalarm-bells-for-the-central-bank.html

Cohen, J. (1988). Statistical power analysis for the behavioural sciences (Second Edi). Lawrence Erlbaum Associates. https://doi.org/10.16309/j.cnki.issn.1007- 1776.2003.03.004

Cohen, J. (1992). Statistical power analysis. Current Directions in Psychological Science, 1(3), 98–101. https://doi.org/10.1111/1467-8721.ep10768783

Dahlberg, T., Guo, J. & Ondrus, J. (2015). A critical review of mobile payment research. *Electronic Commerce Research and Applications 14*(5): 265–284.

Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly 13*(3): 319-339.

Davis. B, and Davis. F. D. (2003). "User Acceptance of Information Technology: Towards a Unified.

de Almeida, P., Fazendeiro, P., & Inácio, P. R. (2018). Societal risks of the end of physical cash. *Futures*, *104*, 47-60.

Dmitrii. (2018) "Determining Factors of Adoption of Digital Device Wallets by Russian Consumers", St.Petersburg University.

Faul, F., Erdfelder, E., Lang, A.-G. & Buchner, A. (2007). G*Power 3: A flexible sta-tistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175-191.

Frimpong, K., Al-Shuridah, O., Wilson, A., & Sarpong, F.A.A., (2017). Effect of inherent innovativeness and consumer readiness on attitudes to mobile banking. *Journal of Financial Services Marketing, 22*, 187–201.

Frohlich, M. T. (2002). Techniques for improving response rates in OM survey research. *Journal of Operations Management*, *20*(1), 53-62.

Gao, L., & Waechter, K. A. (2017). Examining the role of initial trust in user adoption of mobile payment services: an empirical investigation. *Information Systems Frontiers*, *19*, 525-548. https://doi.org/10.1007/s10796-015-9611-0

Gupta, A., & Arora, N. (2017). Consumer adoption of m-banking: A behavioral reasoning theory perspective. *International Journal of Bank Marketing, 35*(4), 733–747. https://doi. org/10.1108/IJBM-11-2016-0162

Hair Jr., J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS-SEM or CB SEM: updated guidelines on which method to use. *International Journal of Multivariate Data Analysis, 1*(2), 107. https://doi.org/10.1504/ijmda.2017.10008574

Handarkho, Y. D., & Harjoseputro, Y. (2020). Intention to adopt mobile payment in physical stores: Individual switching behavior perspective based on Push–Pull–Mooring (PPM) theory. *Journal of Enterprise Information Management*, *33*(2), 285-308.

Heyman. (2017) "Promoting Payment Digitisation in Ghana via Mobile Money", https://www.projektor.aau.dk

Ibrahim. M. H., Hussin. S. R. & Hussin. S.H. (2019). Factors Influencing Malaysian Consumers' Intention to Use Quick Response (QR) Mobile Payment. *Jurnal Pengurusan 57(2019)*. https://doi.org/10.17576/pengurusan-2019-57-02

Kavak, W., & Anwar, K. (2019). Technological innovation in mobile payment solutions Retrived from http://kth.divaportal.org/smash/get/diva2:1372142/FULLTEXT01.pdf

Koenig-Lewis, N., Marquet, M., Palmer, A. & Zhao, A.L. (2015). Enjoyment and social influence: Predicting mobile payment adoption. *Service Industries Journal 35*(10): 537–554.

Kosim, K. P., & Legowo, N. (2021). Factors affecting consumer intention on QR payment of mobile banking: a case study in Indonesia. *Journal of Asian Finance, Economics and Business*, *8*(5), 391–401. https://doi.org/10.13106/jafeb.2021.vol8.no5.0391

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and psychological measurement*, *30*(3), 607-610.

Laukkanen, T. (2007). Internet vs mobile banking: comparing customer value perceptions. *Business process management journal*, *13*(6), 788-797.

Lim, F. W., Ahmad, F., & Talib, A. N. B. A. (2018). The state of the art of e-wallet utilization via QR code: an empirical analysis on M40 millennials in Malaysia. *International Journal of Advanced Studies in Social Science and Innovation*, *2*(4), 42-63. https://doi.org/10.30690/ijassi.24.04

Luarn. P., Lin. H. H & Wang. Y.S. (2006). Predicting consumer intention to use mobile service. *Information Systems Journal 16*(2), 157-179.

Malhotra, N.K. (2012). Basic Marketing Research: Integration of Social Media. 4th ed. Upper Saddle River, N.J.; Harlow. Pearson

Mallat. N., Rossi. M., & Tuunainen. V. K. (2004). Mobile Banking Service. 5 Communications Of The Acm. Malaysia Communication and Multimedia Commission (MCMC) (2006) Hand Phone Survey 2006: Facts & Figures – Statistics & Records [online] http://www.mcmc.gov.my

Maybank. 2017. Maybank introduces cashless payments using QR code. Available at https://www.nst.com. my/ business/2017/12/314527/maybank-introducescashless-payments-using-qr-code

Munnukka, J. (2007). Characteristics of early adopters in mobile communications markets. *Marketing Intelligence & Planning, 25*(7), 719–731

Nie, J., & Amarayoun, W. (2019). The factors influence the intention use of mobile payment in Thailand e-commerce. *5th International Conference on Information Science and Control Engineering 2018*, 561–568. https://doi.org/10.1109/ICISCE.2018.00122

Pal, D., Vanijja, V., & Papasratorn, B. (2015). An empirical analysis towards the adoption of NFC mobile payment system by the end user. Procedia Computer Science. https://doi.org/10.1016/j. procs.2015.10.002

Pham, Q. T., Tran, X. P., Misra, S., Maskeliūnas, R., & Damaševičius, R. (2018). Relationship between convenience, perceived value, and repurchase intention in online shopping in Vietnam. *Sustainability*, *10*(1), 156. https://doi.org/10.3390/su10010156

Poon, W. C. (2007). Users' adoption of e-banking services: the Malaysian perspective. *Journal of business & industrial marketing*, *23*(1), 59-69.

Porter, C. E., & Donthu, N. (2006). Using the technology acceptance model to explain how attitudes determine Internet usage: The role of perceived access barriers and demographics. *Journal of Business Research, 59*(9), 999–1007.

Qasim H., Abu-Shanab E. (2016). Drivers of mobile payment acceptance: The impact of network externalities. *Information Systems Frontiers, 18*(5), 1021–1034.

Rosli, N. F. A., Ibrahim, R., Yahya, Y., Zainuddin, N. M., Yaacob, S., & Yusoff, R. C. (2020). Consumers' intention to use mobile payment: a case of quick response (QR) code applications. *Mathematical Sciences and Informatics Journal*, *1*(1), 20-34. http://www.mijuitmjournal.com

Sekaran. U, & Bougie .R. (2016). Research methods for business: a skill building approach, 7th ed. Wiley.

Stevens, S. S. (1946). On the theory of scales of measurement. Science, New Series, 103(2684), 677–680. https://doi.org/10.1126/science.103.2684.677

Suki, N. M., Ramayah, T., & Ming, M. K. P. (2012). Job searches via social networking sites: Employed job seekers intentions. In *Handbook of Research on Business Social Networking: Organizational, Managerial, and Technological Dimensions* (pp. 418-432). IGI Global Scientific Publishing.

Sulaiman, A., Lim, C. H., & Wee, A. (2005). Prospects and Challenges of E-Banking In Malaysia. *The Electronic Journal of Information Systems in Developing Countries*, *22*(1), 1–11. https://doi.org/10.1002/j.1681-4835.2005.tb00139.x

Tabachnick, B. G., & Fidell, L. S. (2007). Using multivariate statistics (5th ed.). Using multivariate statistics 5th ed. https://doi.org/10.1037/022267

Taherdoost, H. (2016). Sampling methods in research methodology; how to choose a sampling technique for research. *International Journal of Academic Research In Management,* 5(2):18-27

Tan, K. S., Chong, S. C., Loh, P. L., & Lin, B. (2010). An evaluation of e-banking and m-banking adoption factors and preference in Malaysia: a case study. *International Journal of Mobile Communications*, *8*(5), 507.https://doi.org/10.1504/ijmc.2010.034935

The Edge Market. 2016. Bank Negara reviews Financial Sector Blueprint. The Edge Markets. Available at http://www.theedgemarkets.com/article/banknegara-reviews-financial-sector-blueprint

Tiwari. R., Buse. S., & Hertsatt. C. (2007) Mobile Services in Banking Sector: The Role of Innovative Business Solutions in Generating Competitive Advantage. Technologie- und Innovations management

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.

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS quarterly*, 157-178.

Yazid. Z. E. (2022). The Determinants of Behavioural Intention Towards Using Mobile Banking Of Islamic Banking Institutions Moderated By Demographic Variables. Universiti Utara Malaysia.

Yeh. M.L. and Tseng. Y.L. (2017). "The College Students' Behaviour Intention of Using Mobile Payments In Taiwan: An Exploratory Research", *Proceedings of IASTEM Conference*, Singapore.

Zhong, J., Dhir, A., Nieminen, M., Hämäläinen, M. & Laine, J. (2013). Exploring consumer adoption of mobile payments in China. *Proceedings of the 17th International Academic MindTrek Conference: "Making Sense of Converging Media"*, 1-4 October. Tampere, Finland.