RESEARCH ARTICLE

Mobile banking adoption and usage among Generation Y Malaysians [version 1; peer review: 1 approved with reservations]

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Abstract

Background: By 2018, Malaysian mobile banking services made the third-largest amount of banking transactions, following credit card and Internet banking. In addition, it significantly contributes to the banking industry by providing easier transactions to banking consumers.

This study examined factors affecting the intention to use, and the actual use of mobile banking services in Malaysia.

Methods: Two main theories of the unified theory of acceptance and use of technology (extended version, UTAUT2), and the model of perceived risk, were used to propose a modified framework. Based on the non-probability sampling method, the data were collected from 504 respondents. The data was analyzed using SPSS and PLS-SEM to derive the findings.

Results: The study's findings revealed that the independent variables could explain 55.3% of the variance in mobile banking use and 60.3% of variance in intention to use variables. Moreover, it demonstrated that common factors that have significantly affected the actual use and intention to use mobile banking were habit, facilitating condition, and interface design quality. In contrast, perceived risk and intention to use were found to only have significant impacts on the use of mobile banking, while effort expectancy was found to only have a significant impact on the intention to use.

Conclusions: The findings of this study provide significant new knowledge on mobile banking, from which mobile banking providers and interface designers can develop potential solutions to increase the usage of mobile banking services in Malaysia. However, using a qualitative method, the proposed model could only explain 55% of actual use and 60% of intentional use. Thus, additional variables and qualitative techniques may help increase the understanding on the actual use and intention to use.

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Any reports and responses or comments on the article can be found at the end of the article.

Keywords

Mobile banking, Information system quality, UTAUT2, Interface design quality

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Introduction

With the development of technology, financial technology (fintech) innovations profoundly changed the customer experience and delivered financial products and services. The growth of fintech start-ups shows that in 2006 alone, their numbers had doubled by more than 2,000.

The continued growth was highly expected, as innovators tap into the preferences of millions of millennials, who are technology savvy and more interested in the new ways of using financial services (BNM, 2016).

Mobile banking is a subcategory of online banking. Online banking, Internet banking, or e-banking are based on the same concept of allowing the banking services such as monitoring, payment, and transfer to be available to the banks' customers via a secure website. Mobile banking is the other side of the coin of Internet banking, but instead of using desktop Internet applications, it uses intelligent device applications (Aithal and Kumar, 2016). Moreover, developers and practitioners have designed and added multiple new alternatives of banking solutions, which are more practical, flexible and easy to use than traditional banking services.

Contemporary banking services have become essential for all generations, especially customers from generation Y, who were born between 1981 and 1996 (Hui-Chun *et al.*, 2003). As stated by the Asian Institute of Finance in 2015, "Generation Y in Malaysia's business domain are an enormous pie of the consumer's national cake. They will rapidly occupy the governance and high-level managerial positions in today's business. Therefore, the banking industry has an excellent opportunity to develop and offer creative solutions to satisfy these influential technology-guru consumers needs and behaviour" (Asian Institute of Finance, 2015).

According to the 2018 report issued by the Bank Negara of Malaysia, among the amounts of money transferred through various payment channels such as Internet banking, mobile banking, ATM payment transaction, credit card, charge card and debit card between 2005 to 2018, the Internet banking channel had the highest-value transaction channel in 2018, i.e., RM607.5 billion (equivalent to USD146.24 million). In comparison, mobile banking had the third-ranking over-payment channel value, with RM 78.36 billion in the same year.

Noticeably, the trend of Internet banking value started falling from 2017 to 2018, while the value of mobile banking showed a dramatic four-fold upsurge trend between 2015 and 2018. The number of transactions using the mobile banking channel is substantial. Statistics show that the number of transactions increased naturally, except for the volumes of the mobile banking channel. However, they revealed a swift increase starting from 2012 and continuous growth, reaching 1688.8 million transactions in 2018, and surpassing the volumes of both credit cards (366.4 million transactions) and Internet banking (557.2 million transactions).

Although the mobile banking channel has been welcomed by most countries worldwide, including Malaysia, many challenges are faced in terms of privacy, security, bank customers' sophistication, banking infrastructure, and governmental regulation. In terms of the adoption of mobile banking services, limited studies were done in Malaysia (Amin *et al.*, 2007; Cheah *et al.*, 2011; Ewe and Yap, 2012; Krishanan *et al.*, 2015; Shaikh and Karjaluto, 2014).

The lack of trust in financial technology may lead to a low volume of payments made through mobile banking and electronic banking (Sun *et al.*, 2017). David Carf (2012) studied the operational risks of mobile banking and put forward the existence of significant operational risks: mobile phone operation risk, information asymmetry risk, credit risk, and mobility risk. Afshan and Sharif (2016) analyzed the security structure of mobile banking, the quality of mobile communications technology, making a significant contribution to the use of mobile banking. Lin (2013) studied the relationship between trust in mobile banking and mobile banking payment process, using diffusion of innovation and trust theories. Their results showed that the relative advantage and perceived ease of use strongly influence mobile phone users' attitudes towards mobile banking.

Mobile devices that serve as channels for accessing banking services have presented a critical concern for many financial organizations. Using mobile devices, customers can access other third-party services from multiple agencies via the Internet (Kalkbrenner and McCampbell, 2011). The quality of the information provided through mobile banking technologies is seen as one of the most critical factors towards organizational achievement and success. Currently, there is a lack of research on the framework for evaluating the quality of interface design for mobile banking. The evaluation of information quality on mobile interface design for banking services is unclear (Zamzami *et al.*, 2012). The interface design quality of mobile banking services is examined in this research.

This work investigated the phenomenon of the inefficient use of mobile banking service among Malaysian citizens; this study will emphasize the roles of perceived risk and interface design quality, among other technical and human factors.

Hence, this study aims to bridge the gaps in previous literature and provide valuable guidelines to determine the factors that influence the intention to use mobile banking among banking users in Malaysia.

This study is structured as follows: the next section discusses the study's theoretical background; the third section presents the study's conceptual framework; the fourth section highlights the methodology used; the fifth section describes the interpretations and discussion of the analyses. Finally, the sixth section highlights the concluding remarks and future directions of the study.

Theoretical background

Two main theories contribute to the construction of the proposed model, its variables and relations. Those two theories are the unified theory of acceptance and use of technology – extended version (UTAUT2) and model of perceived risk. In addition, the interface design quality variable was added for its importance in mobile applications.

When the founder of the UTAUT model, Venkatesh *et al.* (2003), attempted to develop a new model, they examined eight known models that could explain up to 53% of the behavioural intention to use and actual use. While Venkatesh *et al.* (2003) proposed the UTAUT model by integrating the concepts of eight related models and frameworks, empirical results show that the model can explain 70% of the variance in the behavioural intention to use and actual use. The UTAUT model is comprised of four factors: performance expectancy, effort expectancy, social influence, and facilitating conditions, to predict behavioural intention of using and actual use of technology. Venkatesh, Thong, and Xu (2012) proposed an extension of their previous model by adding three new variables to comprehend the coverage of consumer context. These additional three variables were “hedonic motivation”, “price value”, and “habit”.

Featherman and Pavlou (2003) expanded the scope of the e-services adoption decision by including the potentially harmful use (potential risks), to determine the importance of risk perceptions to the e-services adoption and use. The potential risks were defined and integrated with the technology acceptance model (TAM). The newly proposed model was then empirically tested using the second-order confirmatory factor analysis, to measure the relative importance of each potential risk, using a structural equation modelling for overall fit to the model. Figure 2 shows an infographic of the concepts and relations. The model is built upon TAM model assumptions, as it has the three variables mentioned earlier: usefulness, ease of use, and behavioural intention. The new dimension is perceived risk with seven sub-dimensions. Within the model, adoption intention towards electronic systems is influenced by perceived usefulness and ease of use. Perceived ease of use relates to perceived usefulness and perceived risk, which is the predictor of perceived usefulness. The model assumption is that the more perceived risk the consumer encounters, the less they perceive a usefulness from the desired electronic system. The seven sub-dimensions of perceived risk are “performance risk, financial risk, privacy risk, time risk, psychology risk, and social risk” (Featherman and Pavlou, 2003).

Interface design quality concept refers to techniques and methods to facilitate information display and presentation (Bharati and Chaudhury, 2004). The primary and first act in mobile banking is looking at a small screen, therefore making an excellent first impression is critical to appealing to consumers (Everard and Galletta, 2005). Likely, Everard and Galletta (2005) stated that decent interface design quality such as appearance, format, and processing quality increase mobile banking adoption. Several studies have measured similar factors such as display colours, display formats, graphical design and how these elements affect adoption and satisfaction (Everard and Galletta, 2005; Lohse and Spiller, 1998, among others).

Conceptual framework

Featherman and Pavlou (2003) expanded the scope of the e-services adoption decision by including the potentially harmful use (potential risks), to determine the importance of risk perceptions on e-services adoption and use. The potential risks were defined and integrated with the technology acceptance model (TAM). The newly proposed model was then empirically tested using the second-order confirmatory factor analysis, to measure the relative importance of each potential risk, using a structural equation modelling for overall fit to the model. Figure 2 shows an infographic of the concepts and relationships. The model was built upon TAM model assumptions, as it comprised the three following variables: usefulness, ease of use, and behavioural intention. The new dimension was perceived risk, with seven sub-dimensions. Within the model, adoption intention towards electronic systems was influenced by perceived usefulness and ease of use. Perceived ease of use relates to perceived usefulness and perceived risk, which is the predictor of perceived usefulness. The model assumption was that the more perceived risk the consumer encounters, the less perceived usefulness from the desired electronic system they will experience. The seven sub-dimensions of perceived risk are “performance risk”, “financial risk”, “privacy risk”, “time risk”, “psychology risk”, and “social risk” (Featherman and Pavlou, 2003).

Interface design quality concept refers to techniques and methods employed to facilitate information display and presentation (Bharati and Chaudhury, 2004). The first action in mobile banking use is looking at a small screen, therefore making an excellent first impression is critical to appeal to consumers (Everard and Galletta, 2005). Likely, Everard and Galletta (2005) stated that decent interface design quality such as appearance, format, and processing quality increased mobile banking adoption. Several studies have measured similar factors such as display colours, display formats, graphical design, as well as how these elements affected adoption and satisfaction (Everard and Galletta, 2005; Lohse and Spiller, 1998).

This study proposes a modified framework with eleven variables: “actual use”, “behavioural intention”, “performance expectancy”, “effort expectancy”, “social influence”, “facilitating conditions”, “hedonic motivation”, “price value”, “habit”, “perceived risk”, and interface design quality”.

Hypotheses development

Performance expectancy and intention

The performance expectancy concept is defined as the extent to which individuals believe that the desired technology will offer a better reward and benefits (Venkatesh *et al.*, 2003). Yang (2013) indicated that performance expectancy positively affects students' mobile learning adoption. Also, Raman and Don (2013) mentioned that performance expectancy significantly impacts consumer behavioural intention. Furthermore, Kit *et al.* (2014) found that performance expectancy influences behavioural intention in adopting mobile applications. Based on the above, it is hypothesized that:

H1: Performance expectancy has a positive influence on behavioral intention.

Effort expectancy and intention

According to Kit *et al.* (2014), Effort Expectancy (EE) influences behavioural intention to adopt mobile applications. The effort expectancy concept is defined as the extent to which an individual believes that he will encounter a technology that is simple, easy and that fits within his skills (Venkatesh *et al.*, 2003). Cheah *et al.* (2011) found that perceived ease of use was positively related to adopting mobile banking services. This result is supported by Tan and Leby Lau (2016), who mentioned that EE is considered a strong predictor of intention to adopt mobile banking. Based on the above, it is hypothesized that:

H2: EE has a positive influence on behavioral intention.

Social influence and intention

The social influence concept is defined as the extent of pressure an individual can encounter from society or surrounding people regarding the new technology use and adoption (Venkatesh *et al.*, 2003). Phonthanikitithaworn, Sellitto, and Fong (2015) found that the subjective norm significantly affects consumer adoption of mobile payment services in Thailand. This result was consistent with Yang (2013), who indicated that social influence positively affects students' mobile learning adoption. Moreover, social influence had a significant impact on the behavioural intention to use Moodle, known as Learning Management System, designed to assist educators at University Utara Malaysia (Raman and Don, 2013). Similarly, AbuShanab and Pearson (2007) found that the social influence variable significantly predicted customers' intention to adopt Internet banking in Jordan.

Based on the above, it is hypothesized that:

H3: Social influence has a positive influence on behavioral intention.

Hedonic motivation and intention

The hedonic motivation concept is defined as the extent individuals believe that using the desired technology will provide fun, enjoyment, or pleasure (Venkatesh *et al.*, 2003). A study by Raman and Don (2013) indicated that hedonic motivation is considered as a predictor of behavioural intention. In addition, Yang (2013) indicated that hedonic motivation positively affects students' mobile learning adoption. Kit *et al.* (2014) found that hedonic motivation influences behavioural intention in adopting mobile applications for mobile banking in Malaysia. Alalwan *et al.* (2017) found that the influence of Hedonic motivation positively predicts behavioral intention, which, in turn, positively influenced the adoption of mobile banking. Based on the above, it is hypothesized that:

H4: Hedonic motivation has a positive influence on behavioral intention.

Price value and intention

Price value was one of the most significant factors that influenced behavioral intention to adopt mobile banking (Slade *et al.*, 2013). The price value concept is defined as the extent consumers believe that any additional cost of using the technology is worthy, meaning the consumer will evaluate whether the perceived benefits deserve any additional cost (Venkatesh, Thong, and Xu, 2012). Individual intention to adopt mobile banking was significantly influenced by perceived financial cost (Yu, 2012). Similarly, Phonthanikitithaworn *et al.* (2015) indicated that consumer adoption of mobile payment and mobile banking services in Thailand were significantly influenced by perceived cost. Based on the above, it is hypothesized that:

H5: Price value has a positive influence on Behavioral Intention.

Habit and intention

The habit concept is defined as the routine and dependency of the consumer towards using the desired technology and is usually related to the consumer's prior use of the system (Venkatesh, Thong, and Xu, 2012). Based on empirical analysis of young users of 'smart devices', Kit *et al.* (2014) found that Habit influences behavioural intention to adopt mobile applications. On the contrary, Raman and Don (2013) found that habit does not influence behavioural intention to accept the Learning Management System designed for educators at University Utara Malaysia. This result is consistent with the findings of Yang (2013), who found that the habit of using a mobile device has an insignificant influence on the students' intention to use mobile learning. Based on the above, it is hypothesized that:

H6: Habit has a positive influence on behavioral intention.

H7: Habit has a positive influence on system use.

Facilitating conditions and intention

The concept of facilitating conditions is defined as the extent to which individuals believe that the technical and organizational infrastructures are enough and ready for use and adoption of the new technology (Venkatesh *et al.*, 2003). The study by Raman and Don (2013) indicated that facilitating conditions are considered a predictor of behavioural intention. However, according to Kit *et al.* (2014), facilitating conditions do not influence behavioural intention to adopt mobile applications. Likewise, Alalwan *et al.* (2015) found that the facilitating conditions can positively predict behavioral intention, which, in turn, positively influences the adoption of mobile banking. Moreover, Zhou *et al.* (2010) revealed consistent findings that facilitating conditions could significantly affect a user's mobile banking adoption. Based on the above, it is hypothesized that:

H8: The facilitating conditions concept has a positive influence on behavioral intention.

H9: The facilitating conditions concept has a positive influence on System Use.

Perceived risk and intention

Featherman and Pavlou (2003) defined "perceived risk" as "the potential for loss in the pursuit of the desired outcome of using an e-service". They identified seven types of potential risks: performance risk, financial risk, time risk, psychological risk, social risk, privacy risk and overall risk. Wong *et al.* (2009) investigated whether the perceived risk would influence e-banking trust and the willingness to use e-banking. They found that perceived risk has a direct influence on a consumer's intention to use e-banking. Furthermore, consumers who have a low perceived risk when using the Internet for transactions generally show more intention to use e-banking. In a study of customer risk perceptions of Internet banking in Turkey, Demirdogen *et al.* (2010) showed that financial, psychological, and safety risks are more evident among customers not using Internet banking than in e-banking users. In another study by Khraim *et al.* (2011), perception was one of the most influential factors affecting consumers' adoption of mobile banking services. Based on the above, it is hypothesized that:

H10: Perceived risk has a positive influence on behavioral intention.

H11: Perceived risk has a positive influence on system use.

Interface design quality

Everard and Galletta (2005) examined features such as screen appearance, format, and processing quality. Several studies have measured similar factors such as display colours, display formats, graphical design and how these elements affect adoption and satisfaction (Everard and Galletta, 2005; Lohse and Spiller, 1998). Based on the above, it is hypothesized that:

H12: Interface design quality has a positive influence on behavioral intention.

H13: Interface design quality has a positive influence on system use.

The study is proposing a refined model that is partly based on the UTAUT 2 model. The seven determining factors of the UTAUT 2 model were “performance expectancy”, “effort expectancy”, “social influence”, “facilitating conditions”, “hedonic motivation”, “price value”, and “habit”; the proposed model includes two additional dependent variables: intention to use mobile banking and actual use of mobile banking. Two additional determinants, perceived risk and interface design quality were added to the model. The perceived risk dimension was added with the support of the perceived risk model proposed by Featherman and Pavlou (2003). The proposed model in this study is shown in Figure 1.

Methods

The study's sampling design aimed to be representative of all Malaysian Generation Y citizens, to assess their use of mobile banking services from commercial, public banks in the Klang Valley, Malaysia. The banks were AmBank (M) Berhad, CIMB Bank Berhad, Malayan Banking Berhad, OCBC Bank (Malaysia) Berhad, Public Bank Berhad, RHB Bank Berhad, and Alliance Bank Malaysia Berhad.

Based on the statistics from the World Population Review (2017), the Klang Valley population was estimated to be 7.3 million. According to the statistics from AseanUp (2016), 33.6% of Malaysian citizens belonged to Generation Y. Therefore, the estimated population for this study was 2.5 million. According to Morgan's formula (1970) the optimal sample size required to represent a 2.5 million population was 384. The study adopted a purposive sampling technique and employed a self-administered survey, to collect empirical data from a sample of 384 Malaysians born between 1981 and 1996.

The questionnaire was constructed based on well-designed ones used by Venkatesh *et al.* (2003); Featherman and Pavlou (2003); and Lee and Chong (2009). The questionnaire data were collected in August, September, and October 2018 directly, by distributing the questionnaire in a variety of Universities, banks and shopping malls within the Klang Valley area. The questionnaire consisted of two parts: (1) socio-demographic characteristics and consumers' perception towards

Figure 1. Proposed model and hypotheses.

Table 1. Cleaning process.

Count	Number of answers
Distributed surveys	655
Collected cases	583
Non-fitted cases	–16
Uncompleted cases	–34
Initial cases for analysis	536
Unengaged screening	–1
Univariate screening	–31
Cleaned cases for analysis	504

the use of mobile banking; (2) questions on the studied variables regarding the participants' perception of the mobile banking system.

Data obtained from the survey were transformed and coded in an Excel spreadsheet and analyzed by the researcher himself using Statistical Package for the Social Sciences (SPSS v.22) software and SmartPLS v.3.0. Partial least square (PLS) is a structural equation modelling (SEM) technique that can simultaneously test the measurement model and structure model (relationships between constructs).

A total of 655 surveys were distributed, of which 583 were collected; the final cleaned data set comprised 536 responses. The survey collection rate was 89 %, and the valid surveys rate was 91.94%.

Information filtering was performed both manually and using analytical procedures. We manually filtered the 16 unfitted cases due to the participants of the study stating that their age was outside the Generation Y group (18-38 years), or that they were not Malaysian residents, as well as 31 unfinished cases where participants did not respond to all items (see Table 1). The analytical procedures filtered the unengaged cases, which corresponded to one case in which the participant's responses presented a repetitive norm, and the univariate outlier cases, which corresponded to 31 cases where the participant's explanation for a solitary variable was uncommon (see Table 1).

For the respondents' profile, 52.2% of the respondents were female, 53.6% of the respondents were male. All respondents were aged between 18-27 years, among which 57.1% were Malay, 50.8 % had a Bachelor's degree education, 39.3% were working in the private sector, 59.9% had an income lower than 3000 RM, and 64.1% were using mobile banking for at least one year. By asking the respondents about their experience of using mobile banking, more than 87.9% of respondents answered that they had good experience with mobile banking use.

Ethical considerations

This study was approved by the Ethical Review Board of the Multimedia University, Cyberjaya, Malaysia, with reference number TTO/REC/EA/124/2021.

All respondents were informed about the objectives of the survey and that participation was voluntary, and therefore consent was assumed from participation.

Results

The selected sample satisfied standards of data validity and reliability, indicator reliability, internal consistency reliability, convergent validity, discriminant validity, and collinearity assessment. The model was fit for path coefficient estimations. The outer loading test carried out to ensure that the absolute contribution of each indicator to the construct was at least 0.708 was passed successfully after excluding the overall risk (see Table 2). For discriminant validity, cross-loadings of each item in the construct were examined. The cross-loading test showed that all indicators had higher loadings with their respective construct than the cross-loadings with the other constructs in the model (see Table 3).

The primary endogenous latent variable is mobile banking use; the findings in Table 3 demonstrates that the associated predictive power (coefficient of determination) R-square was 0.553, and the associated predictive relevance Q-square was 0.473. For the proposed model, the exogenous variables habit, facilitating conditions, interface design quality,

Table 2. Internal consistency and convergent validity results. AVE: average variance extracted.

Variable	Abbreviation	Cronbach's alpha	AVE
Mobile banking use	MBU	0.800	0.833
Intention to use mobile banking	IU	0.843	0.762
Performance expectancy	PE	0.837	0.670
Effort expectancy	EE	0.875	0.728
Social influence	SI	0.821	0.740
Hedonic motivation	HM	0.871	0.795
Price value	PV	0.868	0.714
Habit	Ha	0.836	0.668
Facilitating conditions	FC	0.819	0.651
Interface design quality	IDQ	0.868	0.716
Financial risk	FR	0.880	0.807
Performance risk	PR	0.899	0.712
Time risk	TR	0.894	0.759
Social risk	SR	0.826	0.743
Psychological risk	PsR	0.866	0.789
Privacy risk	PvR	0.874	0.799

perceived risk and intention to use mobile banking had a sizeable predictive relevance and moderate predictive power. The second endogenous latent variable was intention to use; results show that the associated predictive power (coefficient of determination) R-square was 0.603, and the associated predictive relevance Q-square was 0.58.5. For the study model, the exogenous variables effort expectancy, facilitating conditions, performance expectancy, social influence, hedonic motivation, price value, habit, interface design quality and perceived risk had a sizeable predictive relevance and a moderate predictive power. The detailed results are given in [Table 4](#).

[Table 5](#) shows the path coefficient assessment with t-statistic values and Beta values. For the main dependent variable, mobile banking use, all five variables were significantly correlated to mobile banking use. The precedence for the correlations based on the path coefficient value (Beta) were interface design quality (0.298), habit (0.187), facilitating conditions (0.272), intention to use mobile banking (0.161), and perceived risk (−0.076). Eight variables were significantly correlated to the second dependent variable, intention to use Mobile Banking. The precedence for the correlations based on the path coefficient value (Beta) were effort expectancy (0.289), facilitating conditions (0.116), habit (0.109), interface design quality (0.239), hedonic motivation (0.158), perceived risk (−0.079), social influence (−0.079) and performance expectancy (0.115). Price value was not significantly related to intention to use mobile banking; the precedence for the correlations based on the path coefficient value (Beta) for price value was (0.044). As shown in [Figure 2](#), one correlation was rejected, and thirteen hypotheses were accepted at the common significance level of 5%.

The effective size of the performance expectancy, effort expectancy, habit, facilitating conditions and interface design quality on intention to use mobile banking variables was satisfactory, with a level range between 0.016 and 0.032. The variables social influence, hedonic motivation, price value, and perceived risk had an effective size with less than 0.007. In addition, the variables habit, facilitating conditions, interface design quality, perceived risk, and intention to use mobile banking had a satisfactory level of effective size on mobile banking use, with a level range between 0.018 and 0.060.

Discussion

The final dataset was examined for reliability and validity, as well as loading, convergence, and discriminate measures. Regarding the first outcome variable mobile banking use, the R-square value was 0.553, and the Q-square value was 0.473. The explanatory variables habit, facilitating conditions, interface design quality, perceived risk, and intention to use mobile banking could predict 55.3% and rebuild 47.3% of the mobile banking use variance. Regarding the second outcome variable, intention to use mobile banking, the R-square value was 0.603, and the Q-square value was 0.585. The explanatory variables performance expectancy, effort expectancy, social influence, hedonic motivation,

Table 3. Discriminate validity assessment of research variables. EE: effort expectancy; FC: Facilitating conditions; MBU: mobile banking use; IU: intention to use mobile banking; PE: performance expectancy; SI: social influence; HM: hedonic motivation; PV: price value; HA: habit; IDQ: interface design quality; FR: financial risk; PR: performance risk; TR: time risk; SR: social risk; PsR: psychological risk; PvR: privacy risk.

	EE	FC	FR	HM	Ha	IDQ	IU	MBU	PE	PR	PV	PsR	PvR	SI	SR	TR
EE	0.85															
FC	0.50	0.81														
FR	-0.20	-0.20	0.90													
HM	0.39	0.23	0.04	0.89												
Ha	0.51	0.37	0.02	0.54	0.82											
IDQ	0.57	0.45	-0.14	0.42	0.43	0.85										
IU	0.67	0.49	-0.15	0.49	0.53	0.61	0.87									
MBU	0.80	0.58	-0.20	0.30	0.51	0.62	0.60	0.91								
PE	0.53	0.40	-0.08	0.35	0.49	0.42	0.52	0.43	0.82							
PR	-0.28	-0.35	0.66	-0.08	-0.08	-0.20	-0.26	-0.28	-0.19	0.84						
PV	0.39	0.24	-0.05	0.43	0.42	0.42	0.42	0.34	0.27	-0.09	0.85					
PsR	-0.31	-0.18	0.55	-0.05	-0.09	-0.21	-0.36	-0.21	-0.24	0.57	-0.15	0.89				
PvR	-0.24	-0.27	0.63	-0.04	-0.05	-0.11	-0.14	-0.23	-0.10	0.75	-0.18	0.49	0.89			
SI	0.41	0.43	-0.02	0.45	0.49	0.46	0.40	0.44	0.47	-0.14	0.33	-0.04	-0.08	0.86		
SR	-0.28	-0.15	0.60	-0.12	-0.01	-0.09	-0.20	-0.19	-0.15	0.62	-0.14	0.59	0.67	-0.04	0.86	
TR	-0.30	-0.20	0.59	0.00	-0.02	-0.20	-0.27	-0.21	-0.20	0.60	-0.07	0.65	0.48	0.01	0.53	0.87

Table 4. Predictive power and predictive relevance assessment of the proposed model.

	Predictive power		Predictive relevance	
	R-square	Status	Q-square	Status
Intention to use	0.603	Moderate	0.585	Large
Mobile banking use	0.553	Moderate	0.473	Large

Table 5. Path coefficient assessment of research variables.

Independent variable	→	Dependent variable	Path coefficient	T statistic	P value (1- tailed)	Status
Performance expectancy	→	Intention to use	0.115	3.122	0.001	Significant
Effort expectancy	→	Intention to use	0.289	6.647	0.000	Significant
Social influence	→	Intention to use	−0.079	2.029	0.021	Significant
Hedonic motivation	→	Intention to use	0.158	4.145	0.000	Significant
Price value	→	Intention to use	0.044	1.336	0.091	Non-significant
Habit	→	Intention to use	0.109	2.553	0.005	Significant
Facilitating condition	→	Intention to use	0.116	3.143	0.001	Significant
Perceived risk	→	Intention to use	−0.079	2.706	0.004	Significant
Interface design quality	→	Intention to use	0.239	6.243	0.000	Significant
Intention to use	→	Mobile banking use	0.161	3.819	0.000	Significant
Habit	→	Mobile banking use	0.187	4.907	0.000	Significant
Facilitating condition	→	Mobile banking use	0.272	6.350	0.000	Significant
Perceived risk	→	Mobile banking use	−0.076	2.485	0.007	Significant
Interface design quality	→	Mobile banking use	0.298	6.956	0.000	Significant

price value, habit, facilitating conditions, interface design quality and perceived risk, could predict 60.3% and rebuild 58.5% of the variance in intention to use mobile banking.

In general, we can conclude that the model presented in this study is a successful tool for predicting young people's (generation Y) actual use and intention to use mobile banking services in Malaysia. However, the complementary percentages (approximately 44.7% for actual use and 39.7% for intentional use) show that another determinant, not covered in this study, explains this significant percentage. For mobile banking use, all variables were significantly related to mobile banking use: the habit variable showed correlation results consistent with prior studies (Venkatesh *et al.*, 2012; Kit *et al.*, 2014; Baabdullah *et al.*, 2019); the facilitating conditions variable also showed a similar effect on the response variable compared to prior studies (Venkatesh *et al.*, 2003; Raman and Don, 2013; Slade *et al.*, 2013; Alalwan *et al.*, 2015; Baabdullah *et al.*, 2019). Interface design quality yielded correlation results consistent with prior studies (Fung and Lee, 1999; Everard and Galletta, 2005; Lin, 2013; Al-Otaibi *et al.*, 2018). The perceived risk variable yielded consistent results with prior studies (Venkatesh *et al.*, 2003; Raman and Don, 2013; Slade *et al.*, 2013; Alalwan *et al.*, 2015; Zhou *et al.*, 2010).

For intention to use mobile banking, all variables were significantly related to intention to use mobile banking, except for price value: the performance expectancy variable showed results consistent with prior studies (Venkatesh *et al.*, 2003; Davis, 1989; Baabdullah *et al.*, 2014; AbuShanab and Pearson, 2007; Tan and Leby Lau, 2016; Alalwan *et al.*, 2015, 2017), the relationship between effort expectancy and intention to use mobile banking was consistent with findings from prior studies (Venkatesh *et al.*, 2003; Davis, 1989; Baabdullah *et al.*, 2014; AbuShanab and Pearson, 2007; Tan and Leby Lau, 2016; Alalwan *et al.*, 2015, 2017). The effect of social influence was also consistent with findings from prior studies

Figure 2. Path coefficient values for the proposed correlation model.

Figure 3. T-statistic values for the proposed model.

(Venkatesh *et al.*, 2003; AbuShanab and Pearson, 2007; Tan and Leby Lau, 2016; Abbas *et al.*, 2018; Farah *et al.*, 2018). Similarly, hedonic motivation showed consistent results with prior studies (Venkatesh *et al.*, 2003; Alalwan *et al.*, 2015, 2017; KIT *et al.*, 2014; Gharaibeh & Arshad, 2018; Farah *et al.*, 2018). The habit variable showed similar results as reported in prior studies (Venkatesh *et al.*, 2012; KIT *et al.*, 2014; Farah *et al.*, 2018; Baabdullah *et al.*, 2019). The facilitating conditions (Venkatesh *et al.*, 2003; Raman and Don, 2013; Alalwan *et al.*, 2015; Farah *et al.*, 2018; Baabdullah *et al.*, 2019), perceived risk (Featherman and Pavlou, 2003; Al Khasawneh *et al.*, 2018; Kavita *et al.*, 2018; Moorthy M. *et al.*, 2018), and interface design quality variables also showed correlation results consistent with findings from prior research (Fung and Lee, 1999; Everard and Galletta, 2006; Lin, 2013; Al-Otaibi *et al.*, 2018).

Results show that interface design quality is the highest predictor of mobile banking use and the second predictor of the intentional use of mobile banking in Malaysia. Interface design quality supports the importance of the application's appearance and design in appealing to users and directing them towards mobile banking use. Effort expectancy was the best predictor of intentional use; the ease of use of mobile banking applications, represented by the effort expectancy, is related to interface design quality as well. Therefore, effort expectancy and interface design quality are important for making mobile banking appealing to users.

In addition, perceived risk was found to impact intention to use and actual use of mobile banking in Malaysia. While this variable showed the weakest influence on intention and use, it is supposed that people become familiar with advanced technologies and do not feel threatened by mobile applications use. Therefore, specific efforts should be made by mobile application designers to make the mobile banking applications easier and effortless.

The study findings suggest that price value is not a determining factor, and social influence has a weak, negative impact on intention to use mobile banking in Malaysia. While the effect of price value can be explained logically, because banks do not add any extra charges for using the offered mobile services and some even provide promotions to motivate users, social influence is a questionable matter because financial transactions are more personal than using online shopping, or joining social media. Young people's social circles (family, friends) have a slight influence on the decision to use mobile banking.

Therefore, further studies may conduct qualitative research by using interviews to explain why social influence and price value do not predicting intention in mobile banking. Moreover, the empirical findings show that perceived risk is the variable affecting intention to use or actual use of mobile banking the least. Further interview-based research may also be conducted to explain why perceived risk has a minor effect on mobile banking. Additionally, this study was restricted to people living in Malaysia as well as designed specifically for Generation Y citizens. So, other groups in various countries could have different circumstances which may affect the results. Further studies may also need to focus on exploring additional, undiscovered variables of real use of mobile phone banking.

Data availability

Underlying data

Figshare: Mobile Banking Adoption and Usage among Malaysians of Generation Y, <https://doi.org/10.6084/m9.figshare.14882307> (Al Tarawneh *et al.*, 2021).

This project contains the following underlying data:

- Dataset_Mobile Banking Adoption and Usage among Malaysians of Generation Y.xlsx (final data set summarising the answers from 504 questionnaire respondents).

Acknowledgement

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This paper analyzes the determinants of mobile banking use and intention to use of the 1981-1996 generation in Malaysia. Using survey data and the PLS-SEM method, results indicate that the main determinants of use and intention to use are habit, facilitating condition, and interface design quality. In contrast, perceived risk and intention to use were found to only have significant impacts on the use of mobile banking, while effort expectancy was found to only have a significant impact on the intention to use.

The article analyses an important and current issue and we would like to make some comments to improve the quality of the article

Abstract

- Authors can give the main policy implication of these results.

Introduction

- Gives the references of this statistics « The growth of fintech start-ups shows that in 2006 alone, their numbers had doubled by more than 2,000. »
- In paragraph 3 of the introduction, you should insist on the advantages of mobile banking. In addition to flexibility and ease of use, you can add "reduced transaction costs, secure operations, traceability and trust (the fact that you can follow your banking movements creates trust between customers and the bank).
- The statistics in the following paragraph need to be updated (at least 2020 statistics)
« According to the 2018 report issued by the Bank Negara of Malaysia, among the amounts of money transferred through various payment channels such as Internet banking, mobile banking, ATM payment transaction, credit card, charge card and debit card between 2005 to 2018, the Internet banking channel had the highest-value transaction channel in 2018, i.e., RM607.5 billion (equivalent to USD146.24 million). In comparison, mobile banking had the

third-ranking overpayment channel value, with RM 78.36 billion in the same year.»

- The issue needs to be strengthened. The author discusses the quality of the interface and the trust problem associated with mobile banking. It would be interesting if the author could show some stylized facts about these problems in Malaysia. For example, do the banking structures point out fraud, do consumers complain? For example, in the case of my region, the problem that is often cited is the difficulty related to the internet connection.
- Review the following paragraph « Currently, there is a lack of research on the framework for evaluating the quality of interface design for mobile banking. The evaluation of information quality on mobile interface design for banking services is unclear (Zamzami *et al.*, 2012). The interface design quality of mobile banking services is examined in this research. »

Be more specific. The research was never conducted or the work is unclear. (There are some studies. See ^{1,2}).

- The following sentence « This work investigated the phenomenon of the inefficient use of mobile banking service among Malaysian citizens; this study will emphasize the roles of perceived risk and interface design quality, among other technical and human factors. Hence, this study aims to bridge the gaps in previous literature and provide valuable guidelines to determine the factors that influence the intention to use mobile banking among banking users in Malaysia » - Do you analyze the inefficiency? Or the risk or the determinants of the use of mobile banking?

But in the introduction you develop as if it is the problem of quality that is your objective because you say that the literature gap is at this level, and your research is interested in this question. See next sentence « Currently, there is a lack of research on the framework for evaluating the quality of interface design for mobile banking. The evaluation of information quality on mobile interface design for banking services is unclear (Zamzami *et al.*, 2012). The interface design quality of mobile banking services is examined in this research. »

In your results you discuss the determinants. If your concern is the quality of the interface the discussions should be focused on this outcome. Review your objectives in accordance with the title of the article « Mobile banking adoption and usage among Generation Y Malaysians » or change the title of the article.

Conceptual framework

- **H10:** Perceived risk has a positive influence on behavioral intention.

Better express this hypothesis. The perception of low or high risk?

- Figure 1 should be improved. You need to show how the different factors influence adoption. Does it facilitate the use or not. Moreover, when we talk about use, it implies that we already have access to the technology. The authors would benefit from integrating this aspect in their analysis.

Methods

- Why the choice of generation Y? The justification given is insufficient. And the 2000

generation? Today this generation is part of the fintech star up. More justification is needed. For me, I would opt for a comparative analysis in terms of adoption between two generations before drawing conclusions.

- Review your descriptive statistics « For the respondents' profile, 52.2% of the respondents were female, 53.6% of the respondents were male ». For me, the total must be 100%. Check
- After the presentation of the conceptual framework, it is important in the methods section to present the empirical model with the definition and measurement of the different variables.
- It is also important that you highlight the econometric problems, and justify the choice of the PLS-SEM method.

Discussion

- Your discussion needs improvement. You should explain why such a result in Malaysia. The result may be similar to other countries but the explanation of this result is not the same, depending on the context.
- The following result « In addition, perceived risk was found to impact intention to use and actual use of mobile banking in Malaysia. » is not accurate. Perceived risk increases or decreases intent to use?
- The authors should include a concluding section showing the economic policy implications of their results.

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Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: banking, digital financial, gender,

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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