

Extending the Technology Acceptance Model for Islamic Digital Banking: The Mediating Role of Attitude and the Moderating Role of Self-Efficacy in Pakistan

1. Iram Fatima, 2. Abdul Rehman, 3. Muhammad Awais

MPhil Scholar, Faculty of Business and Management Sciences, The Superior University Lahore,
Pakistan

iramfat.555@gmail.com (Corresponding Author)

rehmanabdul.hnd@gmail.com

iamawais708@gmail.com

Abstract

This study is to enhance the Technology Acceptance Model (TAM) with the inclusion of the notions of perceived risk, digital literacy as antecedents of attitude and self-efficacy as a moderator between attitude and intention for Islamic banks customers in Pakistan. Data were obtained by using a structured questionnaire from the customers of Islamic banks of Pakistan and the data were analysed using a structural equation modelling method known as Partial Least Squares (PLS-SEM) in SmartPLS software. The results showed that digital literacy and perceived risk and perceived usefulness are learning factors that influence attitude towards digital banking while perceived ease of use is not. Self-efficacy moderates the attitude–intention relationship and the digital literacy–intention relationship is mediated by attitude, and the perceived risk–intention relationship is mediated by attitude. According to the results functional usefulness and ease of use were not found to be significant factors affecting the adoption of digital banking services among the customers of Islamic banks in Pakistan whereas trust in Islamic banking, personal confidence in Islamic banking

and digital capability were found to be more critical than functional usefulness and ease of use. This study provides practical recommendations for banks and policy makers wishing to enhance the digital financial inclusion of developing economies and Islamic banking environment, and extends the TAM to this context.

Keywords: Digital Banking Adoption, Technology Acceptance Model (TAM), Perceived Risk, Digital Literacy, Self-Efficacy, Attitude to Use, Islamic Banking, PLS-SEM

1. Introduction

The digital revolution has transformed the way financial services are offered to customers by banks, with the ability to open accounts, transfer money, pay bills and manage savings from the comfort of their own homes, instead of a bank branch (Alalwan et al., 2021; Sharma & Singh, 2022). This has been stimulated by the increased use of smartphones, greater internet connectivity and a greater expectation from consumers for speed and convenience, which has caused banks around the world to embrace the digital channel as a key component of their service strategy, as opposed to an additional layer (Alalwan et al., 2021; Sharma & Singh, 2022). Digital banking is used in a broad sense in this study to encompass all banking services that customers can access via a web browser, mobile banking (MB) through a dedicated app, and the newer type of digital-only banks which operate without any physical branches. The channels are not the same, but they all share in a common thread: the customer has to engage with the bank in the main way through a screen instead of a teller, which is the most significant aspect of digital banking when it comes to perception, according to the study. Digital banking has been seen in Pakistan as an important financial-inclusion instrument: the State Bank of Pakistan and commercial banks have made a big push into digital services in the country with the introduction of digital-only banks to cut down operating expenses, enhance transparency and bring formal financial services to under-served parts of the population (Rehman et al., 2022; Shaikh et al., 2023). But despite this institutional impetus, adoption is not where it should be and a significant portion of potential customers remain in a cash-based, branch culture. The findings suggest that behavioral, technological, and psychological factors, instead of platform availability, are the barriers preventing many customers from switching to digital platforms (Raza et al., 2024; Khan & Bilal, 2024). It is not only about the features of digital banking; it is what customers think of digital banking that explains adoption. The perceived

usefulness and perceived ease of use are among the key variables of the Technology Acceptance Model (TAM) (Davis, 1989; Venkatesh et al., 2020) which has been widely used in the literature and has been consistently supported in the empirical literature in different markets including fintech and mobile banking (Alalwan et al., 2021; Sharma & Singh, 2022). Some markets fare worse than others in terms of institutional trust, and perceived risk factors of fraud, privacy concerns, and financial loss are often given as the single most important reason why potential customers are not taking up digital banking, even if they are willing to do so (Almaiah et al., 2025; Asghar & Nabeel, 2025). Digital behaviour is also influenced by digital literacy and self-efficacy, with customers who possess both being more likely to embrace digital banking, and those who do not by either lack the skills or self-efficacy, being less likely to do so even if they are aware of the benefits of digital banking (Raza et al., 2024; Khan & Bilal, 2024; Imran et al., 2023). The relationship between these perceptions and the decision to use the service is mediated by attitude, which links beliefs on usefulness, ease, risk, and literacy to an overall evaluative attitude, which then leads to the decision to use the service (Venkatesh et al., 2020; Khan & Bilal, 2024). Islamic banking is another wrinkle to this picture. In addition to assessing digital banking functional and technical attributes, customers of Islamic banks also want to know that the underlying service is Sharia compliant, ethically conducted and transparent regarding the use of their funds, which can increase their sensitivity towards perceived risk and trust concerns compared to their conventional banking counterparts (Shaikh et al., 2023; Alamir, 2025). Although many studies have examined the adoption of digital banking in the non-Islamic banking domains and also in developed markets, the moderating role of self-efficacy and the mediating role of attitude have not been studied in the context of digital banking in the Islamic banking setting in particular, and perceived ease of use and perceived risk have not been explored with digital banking and Islamic banking within the same framework. Filling this gap can enable banks and policy makers to create secure, easy-to-use and Shariah-compliant digital banking solutions that align with specific concerns of this customer segment (Shaikh et al., 2023; Alamir, 2025). Although Islamic banks have introduced digital banking services due to customers' demand for quick and convenient banking services, adoption is not as high as conventional banks and is still small compared to the investment made by investment banks in digital banking infrastructure (Shaikh et al., 2023; Raza et al., 2024; Asghar & Nabeel, 2025). That discrepancy between platforms available and customers' usage indicates that the reluctance to adopt these platforms is not because of lack of access to the technology, but

rather because of perceptions, trust, and confidence in these platforms and how they are used by customers. While TAM two constructs (PU and PEOU) still hold true, they are not enough to explain the adoption in developing markets because security, privacy, and trust issues are significant factors in customer decision making processes which were not anticipated by the original (Venkatesh et al., 2020; Alamir, 2025; Almaiah et al., 2025). Two other behavioural barriers that exacerbate this issue are perceived risk (fraud, data breaches, financial loss) and digital literacy. Low digital literacy affects customer adoption of the service even if they know it is helpful, as they may not know how to use the service securely, or they may not be able to solve their own problems without assistance (Raza et al., 2024; Khan & Bilal, 2024; Imran et al., 2023); low self-efficacy hinders the adoption of services even among well-informed customers, Due to lack of confidence in their ability to use them appropriately (Raza et al., 2024; Khan & Bilal, 2024; Imran et al., 2023). While the link between these perceptions and behavioural intention is mediated by attitude, with self-efficacy being a moderator between attitude and behavioural intention, these mediation and moderation paths have not received a dedicated focus from researchers specifically in the context of Islamic banking in Pakistan (Venkatesh et al., 2020; Sharma & Singh, 2022). In the absence of a better, empirically grounded understanding of the interplay of these factors, both Islamic banks and policy makers have incentives to continue investing in digital platforms that fail to meaningfully drive up adoption, as well as to develop financial inclusion policies to overcome the wrong barriers.

To address this gap, this study uses an extended TAM that incorporates additional factors like perceived usefulness, perceived ease of use, perceived risk, digital literacy, attitude, and self-efficacy to explain the adoption of digital banking among the customers of Islamic banks in Pakistan, which will enable Islamic banks and policymakers to develop digital products and services that are secure, user-friendly, and Shariah-compliant and facilitate financial inclusion (Shaikh et al., 2023; Alamir, 2025). Current studies on digital banking adoption primarily focus on perceived usefulness and ease of use, while the influence of socio-religious factors is covered in limited literature, and the interaction between perceived usefulness and ease of use and digital literacy on digital banking adoption is not well documented, especially in Islamic banking (Azisma & Indriani, 2024; Shaikh et al., 2023). Although, the perceived risk has been examined predominantly as a one variable barrier (Immanuel & Afgani, 2025), it is hard to assess how the perceived risk is significant in comparison to the other factors, namely usefulness, ease of use and

digital literacy, which are not taken into account in one combined model. While mediation analysis is critical in determining whether the perceptions directly impact adoption or influence a general evaluative attitude, studies investigating the role of mediation between perceptions and intention have not been carried out in the context of traditional e-banking and TAM extensions in Pakistan. The role of self-efficacy in this relationship, as a moderator of the attitude-intention relationship, has also been under-researched (Imran et al., 2023), calling into question why some customers who are positive about digital banking do not use it. This study aims to fill these gaps by developing one single integrated framework, where perceived usefulness, perceived ease of use, perceived risk, and digital literacy are considered as its antecedents, attitude acts as a mediator, and self-efficacy acts as a moderator for Islamic banking adoption in Pakistan (Alamir, 2025; Khan & Bilal, 2024). To provide a more comprehensive and coherent explanation for the adoption of digital banking than the single-construct studies and two-construct studies that are widely used in the literature, all six constructs are simultaneously tested in one model. To explore the determinants of customers' intention to adopt digital banking services at Islamic banks in Pakistan with the constructs of perceived ease of use, perceived usefulness, perceived risk, digital literacy, attitude and self-efficacy. To analyze the effect of PEO on customers' adoption intention of the DBS (Sharma & Singh, 2022; Venkatesh et al., 2020). To determine effect of perceived usefulness on customer's intention to use digital banking services (Alalwan et al., 2021; Shaikh et al., 2023). To assess the impact of perceived risk on customers' intention for digital banking services (Alamir, 2025; Asghar and Nabeel, 2025). • To evaluate the impact of digital literacy on customers' decision-making process of digital banking adoption (Raza et al., 2024; Khan & Bilal, 2024). To find out the mediating role of attitude to use between perceptions and intention to adopt digital banking (Venkatesh et al., 2020; Sharma & Singh, 2022). The study aims at finding out if the relationship between customer perceptions and intention to adopt digital banking services exists with the moderation of self-efficacy (Imran et al., 2023; Shaikh et al., 2023). Q1. How does ease of use and usefulness influence the attitude of the customers towards the use of digital banking services of Islamic Banks in Pakistan? • Q2. How does the perceived risk affect customers' willingness to use digital banking? • Q3. What is the impact of digital literacy on customers' intention of using digital banking services? • Q4. Is there a mediating role for attitude to use between customer perceptions and intention to use digital banking services? • Q5. Is there a moderation effect between customer perceptions and the intention to use digital banking services

on the part of self-efficacy? This study extends the original TAM model to Islamic banking in Pakistan, theoretically by including the perceived risk and digital literacy factors, along with the original components of the model; the relationships between perceived risk and digital literacy with the original constructs of TAM are not extensively investigated in the literature on Islamic banking (Venkatesh et al., 2020; Sharma & Singh, 2022; Shaikh et al., 2023; Imran et al., 2023; Khan & Bilal, 2024). On a practical level, the findings can inform Islamic banks and regulators in the process of developing digital platforms that meet user demand, improving security communication, and ensuring Shariah compliance; and customer education and training programmes according to the diverse levels of digital literacy among socio-economic groups in Pakistan (Almaiah et al., 2025; Asghar & Nabeel, 2025; Raza et al., 2024; Khan & Bilal, 2024). The study also provides a framework for other researchers who are interested in the socio-cultural market of digital banking and fintech adoption, as it methodologically tests direct, mediating and moderating effects simultaneously using validated scales with the help of PLS-SEM (Partial Least Squares Structural Equation Modelling) introduced in the study (Sharma & Singh, 2022; Shaikh et al., 2023; Alamir, 2025). The study also illustrates a methodological procedure that can be used in other financial services in emerging markets where trust, skill and confidence are important in addition to functional design, and also offers mediation and moderation tests in one model that can be used in other domains. The study is confined to the individual customers of Islamic banks in Pakistan with Millennial ages and not corporate and institutional banking customers or customers of conventional (non-islamic) banks. Other constructs that may be relevant to the model are not included in the present analysis but will be mentioned as potential future research directions in Chapter Five, including perceived risk, digital literacy, attitude to use, perceived ease of use and self-efficacy. Data were only gathered at one time and with a self administered questionnaire, so the study only measures stated perceptions and intentions rather than observed, longer-term behaviour.

2. Literature Review

2.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was developed by Davis (1989), building on the premise that behaviour is guided by behavioural intentions, which are in turn shaped by attitudes. According to TAM, the perceived usefulness and perceived ease of use are most likely to influence

the actual use of the system and that these beliefs influence attitude, which then affects behaviour intention, which is considered to be the strongest predictor of actual use. (Venkatesh et al., 2003). A recent (2006) meta-analysis of 88 published studies of the TAM confirmed its validity and robustness for an extremely wide range of technologies, user populations and cultural contexts, and demonstrated that the strength of individual paths varies significantly across contexts, thus underlining the fact that the TAM is a strong but malleable model rather than a one-size-fits-all model. Since then TAM has been extended in various directions. In their study, Gefen et al. (2003) included trust directly in TAM to understand the intentions of online shoppers. TAM has been found to apply to e-commerce, mobile applications, internet banking, fintech, and digital payments, and has been extended with other factors in previous banking studies like perceived risk, trust, and self-efficacy, especially in financial services or developing country environments where risk, various skill deficits, and confidence in digital systems all impact the adoption process (Venkatesh et al., 2003; Lee, 2009; Zhou, 2011).

This study is expending TAM by integrating the constructs of perceived risk and digital literacy as antecedents of attitude, in addition to the traditional constructs of perceived usefulness and perceived ease of use, and self-efficacy as a moderator between attitude and intention to use. It has been designed to tackle the trust-related and capability related barriers which are more prominent for Islamic banking customers in a developing country like Pakistan, where the difficulty of using a new digital platform relative to customers' skills, and the risk associated with using it, are likely to be key factors affecting adoption (Almaiah et al., 2025; Shaikh et al., 2023). All of the relationships hypothesised in this study are explained solely through the lens of TAM; Perceived Risk, Digital Literacy and Self-Efficacy are incorporated as additional belief-based antecedents and a boundary condition within TAM's existing belief-attitude-intention structure, and no other technology-adoption theory is used to justify or interpret the model.

2.2 Hypothesis Development

2.2.1 Perceived Usefulness (PU) and Attitude to Use (ATU)

Perceived usefulness reflects a user belief in a system improves their execution or efficiency (Davis, 1989). Individuals who believe they have greater control over their money with digital banking are more apt to have a positive perception of the platform. Alalwan et al. (2021) have

identified perceived usefulness as one of the key factors influencing mobile banking adoption in developing countries while Shaikh et al. (2023) have determined that perceived usefulness is the key factors that drive attitudes towards Shariah-compliant digital services specifically. Likewise, Nizam et al. (2024) concluded that the perceived usefulness coupled with the integration of digital payments in Fintech drives the adoption of Fintech in Pakistan, while Farah et al. (2018) identified perceived usefulness as one of the most influential factors influencing the attitudes of Pakistani customers towards mobile banking.

H1: Perceived usefulness has a positive impact on customer's attitude towards digital banking services.

2.2.2 Perceived Ease of Use (PEOU) and Attitude to Use (ATU)

Perceived ease of use is the degree of ease that an individual believes using a system will be (Davis, 1989). Imran et al. (2023) found that consumers' receptivity to digital banking decreases when platforms are difficult to use or are not optimized and Sharma and Singh (2022) showed that ease of use creates positive consumer response, thus enhancing consumer receptivity towards digital banking. This corroborates one of the earliest studies on mobile banking in Pakistan by Kazi and Mannan (2013) who identified ease of use as one of the initial reasons behind customers' willingness (or unwillingness) to use mobile banking services in Pakistan. Shabbir et al. (2023) studied the adoption of mobile banking in the province of Sindh and found that the ease of use is an important but not necessarily a significant factor in influencing the attitude of customers towards mobile banking.

H2: The ease of use of digital banking services positively impacts customer attitude towards digital banking services.

2.2.3 Perceived Risk (PR) and Attitude to Use (ATU)

Perceived risk is the level of uncertainty that consumers have regarding the negative consequences of using digital banking, whether it is in terms of fraud, privacy leakage or financial losses (Featherman & Pavlou, 2003). From this literature, the following observation is made: Perceived risk is one of the major factors that affect the adoption of Fintech in the Islamic finance context as observed in Ali et al. (2021); Risk and trust are important variables associated with the attitude of customers towards Islamic m-banking adoption as observed by Shafiq et al. (2024); Customers'

trust is one of the major variables that affect their perceived risk in context of Islamic m-banking adoption as observed by Parayil Iqbal et al. (2023). Similarly, Noreen et al (2021) reached the same conclusions in their study on mobile money use in Pakistan with both perceived risk and trust being important and in the main inverse to each other for adoption of mobile money. In particular, for 189 users of m-banking in Pakistan (Shaikh et al., 2018), the direct effect of perceived risk on the adoption was relatively low, but it was an “enhancer” when combined with the notion of effort expectancy, suggesting that the perceived risk has a more complex role in this market than simply that of a negative detractor. Zhou (2011) also found that initial trust, which is closely related to risk perception, affects perceived usefulness and intention to use mobile banking before the customers' first experience of mobile banking; and Lee (2009) found that perceived risk and perceived benefit are simultaneous and partially opposing factors on intention to use mobile banking. In this study, Perceived Risk is conceptualised as an additional belief-based antecedent of Attitude, extending TAM's core structure in which external beliefs shape attitude and, in turn, behavioural intention (Davis, 1989; Venkatesh et al., 2020).

H3: Perceptions of risk are significant and wide-spread in influencing customers' attitude towards digital banking services.

2.2.4 Digital Literacy (DL) and Attitude to Use (ATU)

Digital literacy is a person's ability to use digital technologies, such as navigating platforms, understanding security procedures and handling digital transactions (van Deursen & van Dijk, 2014). Ullah et al. (2022) found that digital literacy has a significant impact on the positive attitude of Pakistani consumers towards mobile payment and mobile banking, whereas Khan and Bilal (2024) reported that digital literacy training leads to acceptance of fintech services and trust of the Pakistani consumers. A similar broad argument was made by Ozili (2018) that the lack of digital skills is more an impediment to financial inclusion through digital finance than platform designs is, and Rashid et al. (2025) found that in India, digital-literacy gaps were a bigger obstacle to digital finance adoption than platform designs itself. Digital Literacy is likewise incorporated as a belief-based antecedent of Attitude within the TAM structure of this study, on the premise that customers' capability beliefs, like their usefulness and ease-of-use beliefs, shape their overall evaluative attitude toward digital banking (Davis, 1989; Venkatesh et al., 2020).

H4: Digital literacy has a positive relationship with customers attitude towards digital banking services.

2.2.5 Attitude to Use (ATU) and Intention to Use Digital Banking (IUDB)

Attitude is a linkage between Perception and Behavioural Intentions, so those customers with positive attitude will be more likely to embrace Digital Banking, while those customers with negative attitude will be more likely to reject (Venkatesh et al., 2020). Sharma and Singh (2022) and Shaikh et al. (2023) respectively find the positive attitude to be positively impacting the adoption in South Asia and specifically among the Islamic banking customers.

H5: Positive attitude towards use positively influence the customers' intention to use digital banking services.

2.2.6 Self-Efficacy (SE) and Intention to Use Digital Banking (IUDB)

Self-efficacy is a self-confidence or in self-trust to perform tasks related to technology (Bandura 1977, 1997). Imran et al. (2023) concluded that high self-efficacy influences consumers' intention to use digital banking even if there is some risk associated with using it, whereas Shaikh et al. (2023) reported on how self-efficacy enhances the skills of operating the platform and thus positively influences the adoption of Islamic banking by Muslim consumers. This is consistent with the view that customers' confidence in their own ability to use a system, relative to its perceived difficulty, plays an important role in how quickly they adopt it (Compeau & Higgins, 1995). Self-Efficacy is incorporated into the TAM structure of this study as a direct predictor of, and boundary condition on, the Attitude–Intention relationship, extending TAM's core assumption that behavioural intention is shaped by attitude (Davis, 1989; Venkatesh et al., 2020).

H6: Customers' self-efficacy has a positive effect on their intention to use digital banking services.

2.2.7 Mediating Role of Attitude to Use (ATU)

The four antecedent perceptions are considered to influence attitude which in turn impacts behavioral intention (Venkatesh et al., 2020). It parallels the basic logic of TAM, which holds that external beliefs influence behaviour indirectly, through their effect on attitude, rather than acting on behavioural intention directly (Davis, 1989; Venkatesh et al., 2020).

H7: The mediator between PEAU and ITA is attitude to use according to H7. The hypothesis of mediating role of attitude to use between perceived usefulness and intention to adopt digital banking services is H8.

H8: The perceived usefulness will have an impact on attitude to use, which will moderate the effect of perceived usefulness on intention to adopt digital banking services.

H9: Attitude to use is the mediator between perceived risk and intention to adopt digital banking services.

H10: The intermediate variable between digital literacy and intention to adopt digital banking services is attitude to use.

2.2.8 Moderating Role of Self-Efficacy (SE)

It is also thought that the ease with which customers feel they can use digital technology will mediate the relationship between attitude and intention, which means that if customers feel they can use digital technology easily, then they are more likely to do so, given a positive attitude towards its use (Bandura, 1977; Imran et al., 2023). The moderating role of individual-difference variables such as self-efficacy is expected to vary depending on how homogenous the sample is with respect to prior digital experience (Compeau & Higgins, 1995; Imran et al., 2023). The conceptual framework is shown in Figure 1. Attitude to Use and Self-Efficacy predict directly the Intention to Use Digital Banking, while Self-Efficacy also predicts the Attitude to Use – Intention relationship, in the context of digital experience (Compeau & Higgins, 1995).

H11: The level of self-efficacy moderates the relationship between attitude to use and intention to adopt digital banking services, as the relationship is stronger when the level of self-efficacy is high.

2.3 Conceptual Framework

The plausible model of the relationships between the constructs of the study is shown as shown in the figure above: Perceived Usefulness, Perceived Ease of Use, Perceived Risk are placed as the antecedents of Attitude which subsequently influences Intention to Use Digital Banking, with Self-Efficacy as a moderator of the relationship between Attitude and Intention to Use Digital Banking. This structure is intended to illustrate the study's main hypothesis that the customer perception

does not directly influence the adoption intention but is first mediated by the overall attitude towards the product, which is in turn determined by the customer's level of confidence in the product. In this way, Figure 1 represents a single-theory extension of TAM: every path in the model traces back to TAM's original belief-attitude-intention logic, with Perceived Risk and Digital Literacy added as further beliefs shaping Attitude, and Self-Efficacy added as a boundary condition on the Attitude-Intention link.

Hence, Figure 1 below describes the proposed research model of the study:

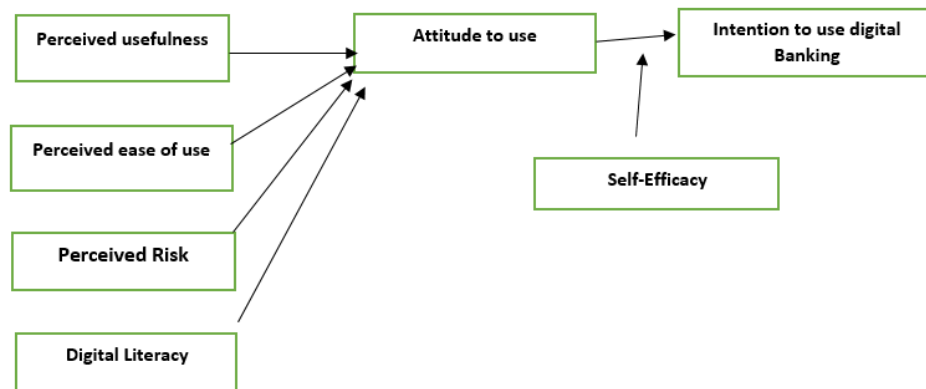


Figure 1: Research model

3. Research Methodology

3.1 Data Collection and Sample Size

The quantitative, cross sectional survey design was employed to test the hypothesised relationships in this study. Because it is explanatory and predictive and does not seek to uncover new relations between perceptions, attitude and intention (as most empirical TAM and PLS-SEM studies in banking and fintech do; Sharma & Singh, 2022; Rashid et al., 2025), this design is suitable for the purpose of this study. Data were collected from individual customers of Islamic banks of Pakistan by using a structured questionnaire (both paper and electronic mode). Considerations of practicality in the accessibility of individual bank customers using a sampling frame led to the use of non-probability convenience sampling, which is often used in fintech and banking-adoption research (Martins et al., 2014; Shaikh et al., 2018).

The sample size was determined based on Krejcie and Morgan's (1970) suggestion that a sample of around 384 respondents is adequate for achieving reasonable statistical power for a 95% confidence level and is similar to the sample size used in related studies conducted in the Pakistani context (ranging from approximately 189 to several hundred respondents) (Shaikh et al., 2018; Farah et al., 2018). Data screening is carried out to get the final analyzed sample and that is reported here.

3.2 Measurement of Variables

The constructs were evaluated using a likert approach as is typical in TAM survey research (Davis, 1989; Venkatesh et al., 2003). Perceived Usefulness and Perceived Ease of Use were each tested by four items which are adapted from Davis (1989) and Fortes and Rita (2016). Four items were adapted from Featherman and Pavlou (2003) and Fortes and Rita (2016) to measure Perceived Risk. Based on the items used by van Deursen and van Dijk (2014) 3 items were adapted to measure Digital Literacy. Four items from Anouze and Alamro (2019) were used to measure Attitude to Use and Intention to Use Digital Banking. Four items from Compeau and Higgins (1995) were used to measure Self-Efficacy. which were based on Bandura's (1977, 1997) conception of self-efficacy. All items were adapted (not adopted verbatim) as advised for cross-context scale adaptation (Hair et al., 2022) in the context of digital banking at Islamic banks in Pakistan.

Table 1: Item of Measurement of Variables

Constructs	Items	Source
Perceived Usefulness	4	Davis (1989); Fortes & Rita (2016)
Perceived Ease of Use	4	Davis (1989); Fortes & Rita (2016)
Perceived Risk	4	Featherman & Pavlou (2003); Fortes & Rita (2016)
Digital Literacy	3	van Deursen & van Dijk (2014)
Attitude to Use	4	Anouze & Alamro (2019)
Self-Efficacy	4	Compeau & Higgins (1995)
Intention to Use Digital Banking	4	Anouze & Alamro (2019)

3.3 Profile of Respondents

Table 2: Profile of Respondents

Demographic Variable	Category	Frequency	Percentage
Gender	Male	360	93.71%
	Female	21	5.59%
	Shemale	—	—
	Prefer not to say	3	0.70%
Age	30 or Under	52	13.52%
	31–40	176	45.92%
	40–49	113	29.37%
	50–59	38	9.79%
	60 or Above	5	1.40%
Education	Graduation	116	30.30%
	Masters	227	59.21%
	MPhil	30	7.93%
	PhD	4	1.17%
	Others	5	1.40%
Digital App Users	Yes	34	8.85%
	No	350	91.15%

3.4 Analysis Technique

The measurement and structural models were tested using the Partial Least Squares Structural Equation Modelling (PLS-SEM) technique which was performed in SmartPLS. The model described here is a model of prediction and theory extension that is well suited for PLS-SEM because of the multiple antecedents, mediator, and moderator in the model (Hair et al., 2019a; Hair et al., 2019b). Once the R^2 values for this model become available, the rules of thumb that were established by Chin (1998) will be applied as they currently are: R^2 values between 0.19 and 0.33 are considered as weak, moderate and strong explanatory power, respectively. Another advantage of PLS-SEM is its flexibility in terms of data distribution and sample size requirements, making it suitable for consumer-banking survey data that was drawn from a developing-economy context; it has also been applied in similar studies on Islamic banking & fintech adoption (Shaikh et al., 2023; Nizam et al., 2024).

The breakdown of bootstrapping was used to test the mediating role of attitude, and the interaction-term approach in SmartPLS was used to test the moderating role of self-efficacy, while discriminant validity was tested using the Heterotrait-Monotrait ratio of correlations (HTMT)

approach as recommended by Henseler et al. (2015) which outperforms the traditional Fornell-Larcker criterion (Fornell & Larcker, 1981) in variance-based SEM analysis. In order to minimize the common method bias that can be encountered in single source, self-report data, the wording and flow of the questionnaire was developed with reference to common methods of dealing with this issue found in the literature (Podsakoff et al., 2003).

4. Empirical Findings

PLS-SEM was used for analyse the data with SmartPLS. PLS-SEM is a relevant tool in particular when the aim of the structural modelling is to explain and predict, which is the case in this research; moreover, the method of modelling is very versatile and does not require normally distributed data, which is pertinent here due to the complexity of the modelling in this research involving four antecedents, one mediator and one moderator.

4.1 Measurement Model Assessment

The internal consistency reliability (Cronbach's alpha and composite reliability, CR) and convergent validity (average variance extracted, AVE) were used to assess the measurement model. The CR value should be greater than 0.70 and the AVE value should be greater than 0.50 (Hair et al., 2019a). It can be seen in Table 3 that the Cronbach's alpha values for the seven constructs ranged from 0.770 to 0.826, which are all above the recommended values; the values of CR (rho_c) ranged from 0.856 to 0.896, also above the recommended values; and the values of AVE ranged from 0.602 to 0.742, which are also above the recommended values, indicating that there is adequate reliability and convergent validity.

Table 3: Convergent Validity

Construct	Cronbach's Alpha	CR (rho_a)	CR (rho_c)	AVE
Attitude to Use	0.826	0.835	0.896	0.742
Digital Literacy	0.770	0.786	0.866	0.683

Intention to Use Digital Banking	0.775	0.795	0.857	0.602
Perceived Ease of Use	0.816	0.829	0.878	0.643
Perceived Risk	0.775	0.805	0.856	0.602
Perceived Usefulness	0.816	0.823	0.878	0.643
Self-Efficacy	0.816	0.818	0.879	0.644

Source: Author-designed using SmartPLS

The outer loadings also showed very high values at the indicator level (almost all were above the standard of 0.7). Two items (IUDB4 (0.613), PR4 (0.596)) were just below the threshold, but did not significantly affect the AVE and composite reliability of their respective constructs (Hair et al., 2019a).

4.2 Discriminant Validity

The discriminant validity was examined through the Heterotrait-Monotrait ratio of correlations (HTMT), which is a more powerful test for discriminant-validity issues than the commonly used Fornell-Larcker criterion for PLS-SEM (Henseler et al., 2015; Fornell & Larcker, 1981). Discriminant validity between constructs is supported by all of the HTMT values listed in Table 4 that are below the conservative HTMT criterion of 0.90 (Henseler et al., 2015).

Table 4: HTMT Ratio

Construct	ATU	DL	IUDB	PEOU	PR	PU
Digital Literacy	0.666					

IUDB	0.639	0.599				
Perceived Ease of Use	0.530	0.698	0.741			
Perceived Risk	0.639	0.599	0.796	0.741		
Perceived Usefulness	0.434	0.508	0.330	0.442	0.330	
Self-Efficacy	0.530	0.698	0.741	0.826	0.741	0.442

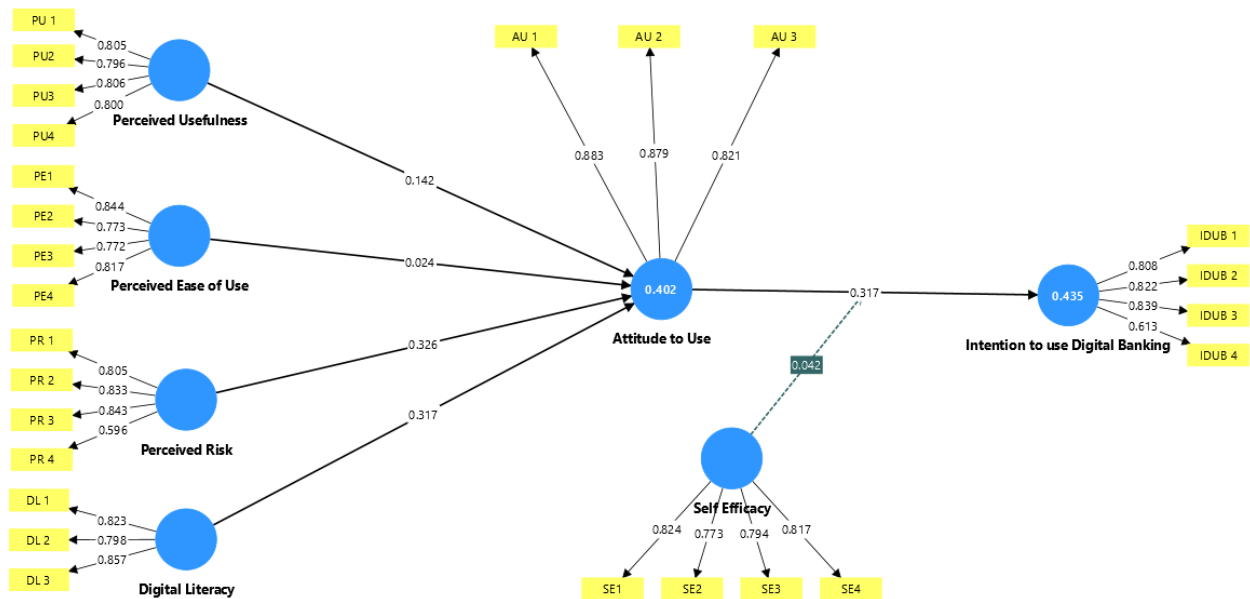


Figure 2: Measurement Model Assessment

Source: Author designed by using Smart PLS 4

4.3 Structural Model Assessment

Path coefficients and t-values were obtained from bootstrapping in SmartPLS to test the hypotheses. The direct effects are shown in Table 5. The results confirmed H1 which is that

perceived usefulness significantly affects attitude to use ($\beta = 0.142$, $p = 0.014$). A perceived ease of use has no significant effect on attitude to use ($\beta = 0.024$, $p = 0.727$) and thus the hypothesis H2 is not accepted. The results indicated The perceived risk is a significant factor in attitude to use ($\beta = 0.326$, $p < 0.001$) and thus fully satisfied H3. The results indicated that digital literacy is positively associated with attitude to use ($\beta = 0.317$, $p < 0.001$) which supported the H4. The results show that attitude to use is significant and has positive relationship with intention to adopt digital banking ($\beta = 0.317$, $p < 0.001$), thus supporting H5. The results reveal a clear correlation between self-efficacy and the intention to use digital banking, with β value being 0.454 and the p value < 0.001 , which supports H6.

Table 5: Direct Effect (Path Analysis)

HYPOTHESIS	RELATIONSHIP	BETA	T STAT	P VALUES	REMARKS
H1	PU $\rightarrow$ ATU	0.142	2.456	0.014	Accepted
H2	PEOU $\rightarrow$ ATU	0.024	0.349	0.727	Rejected
H3	PR $\rightarrow$ ATU	0.326	4.985	0.000	Accepted
H4	DL $\rightarrow$ ATU	0.317	5.367	0.000	Accepted
H5	ATU $\rightarrow$ IUDB	0.317	5.430	0.000	Accepted
H6	SE $\rightarrow$ IUDB	0.454	9.195	0.000	Accepted

Note: PU = Perceived Usefulness, PEOU = Perceived Ease of Use, PR = Perceived Risk, DL = Digital Literacy, ATU = Attitude to Use, SE = Self-Efficacy, IUDB = Intention to Use Digital Banking.

Table 6 shows the mediating results. Attitude to use ($\beta = 0.100$, $p < 0.001$) is positively mediated in the relationship between digital literacy and intention; thus, H10 is supported. The attitude to use ($\beta = 0.045$, $p = 0.010$) significantly mediates between perceived usefulness and intention, hence supporting H8. The attitude to use ($\beta = 0.104$, $p = 0.007$) supports the mediation of perceived risk and intention, supporting H9. H6 is confirmed: Attitude to use does not significantly mediate the effect of perceived ease of use on intention ($\beta = 0.454$, $p < 0.001$).igital banking ($\beta = 0.008$, $p = 0.723$), H7 is not supported.

Table 6: Mediation Analysis

HYPOTHESIS	RELATIONSHIP	BETA	T STAT	P VALUES	REMARKS
H7	PEOU → ATU → IUDB	0.008	0.355	0.723	Rejected
H8	PU → ATU → IUDB	0.045	2.563	0.010	Accepted
H9	PR → ATU → IUDB	0.104	2.689	0.007	Accepted
H10	DL → ATU → IUDB	0.100	3.975	0.000	Accepted

Note: PEOU = Perceived Ease of Use, PU = Perceived Usefulness, PR = Perceived Risk, DL = Digital Literacy, ATU = Attitude to Use, IUDB = Intention to Use Digital Banking.

The moderating effect on the self-efficacy is presented in Table 7. The interaction term (Self-Efficacy × Attitude to Use) is non-significant predictor of intention to adopt digital banking ($\beta = 0.042$, $p = 0.314$) and thus H11 is not confirmed. Although self-efficacy is a strong predictor of intention (H6, above), it does not significantly enhance the attitude–intention relationship in this sample.

Table 7: Moderation Analysis

HYPOTHESIS	RELATIONSHIP	BETA	T STAT	P VALUES	REMARKS
H11	SE × ATU → IUDB	0.042	1.007	0.314	Rejected

Note: PEOU = Perceived Ease of Use, PU = Perceived Usefulness, PR = Perceived Risk, DL = Digital Literacy, ATU = Attitude to Use, IUDB = Intention to Use Digital Banking.

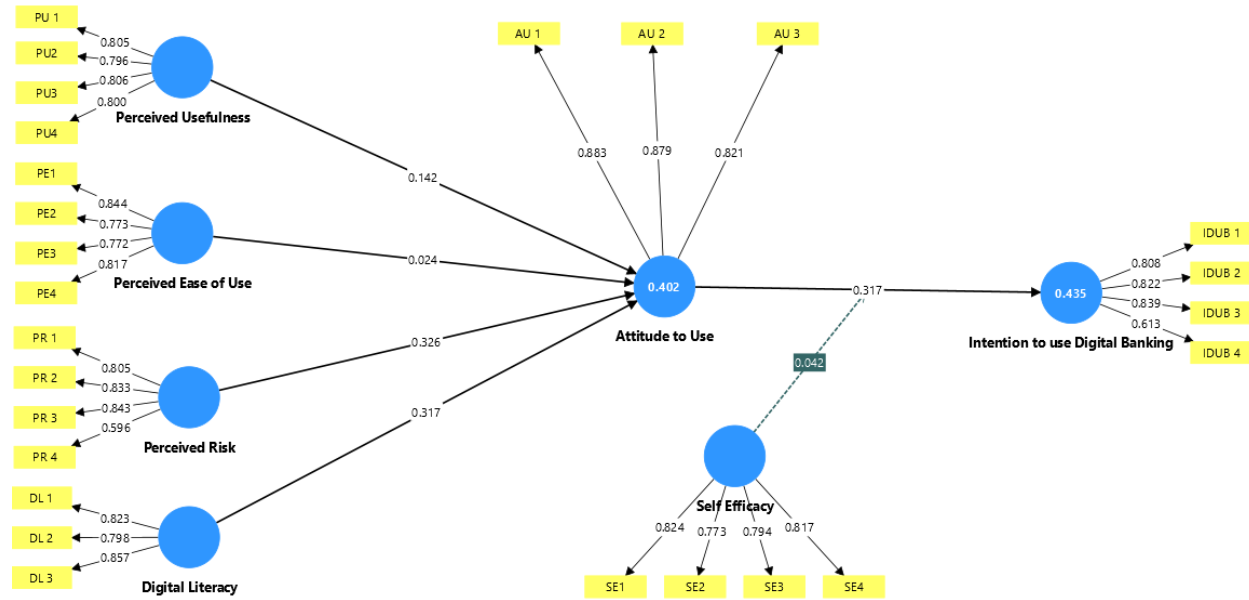


Figure 3: Structural Model Assessment

Source: Author Designed by using Smart PLS 4

5. Discussions and Implications

5.1 Discussion

The results confirm and validate that attitudinal variables are closely related to behavioural intention ($\beta = 0.317$, $p < 0.001$) and further buttresses the critical importance of attitudinal variables in TAM, consistent with the results of Sharma and Singh (2022), Venkatesh et al. (2020), and Shaikh et al. (2023) that customers that are more positive about digital banking are more likely to adopt it in Islamic banking.

The two highest antecedents of attitude were digital literacy ($\beta = 0.317$, $p < 0.001$) and digital literacy through attitude ($\beta = 0.100$, $p < 0.001$) was found as one of the highest indirect effects on intention. This is in line with the study by Ullah et al (2022) and Khan and Bilal (2024), which showed that digital skills are a key determinant in ensuring the acceptance of fintech and digital banking among Pakistani end-users, thus reinforcing the notion that adoption barriers in the market are not simply platform design issues.

Perceived risk also had a significant comparative strong relationship with attitude ($\beta = 0.326$, $p < 0.001$) and significant indirect effect on intention ($\beta = 0.104$, $p = 0.007$). Relationship should be validated in terms of the exact wording of the perceived-risk items before the direction of this relationship is regarded as final. This conclusion is similar to the findings of Ali et al. (2021) and Shafiq et al. (2024) who found that key issues of concern to customers of Islamic banking and Islamic fintech are trust and risk perception.

The perceived usefulness had significant, but relatively weak effects on attitude ($\beta = 0.142$, $p = 0.014$) and intention via attitude ($\beta = 0.045$, $p = 0.010$). Additionally, the effect in this case is less pronounced than digital literacy or perceived risk, suggesting that the functional benefit is also a lesser driver of adoption in the context of Islamic banking in Pakistan.

The indirect effect of perceived ease of use on intention was also non-significant ($\beta = 0.008$, $p = 0.723$) and this variable was also not significantly related to attitude ($\beta = 0.024$, $p = 0.727$). This is contrary to the classic theory of TAM (Davis, 1989; Venkatesh et al., 2003), yet it lines up with the studies of Imran et al. (2023) that discovered that ease of use is not constantly a factor after initial ease of use speculations have been met for the Pakistani digital banking consumers.

Accordingly, self-efficacy showed the highest direct effect on intention compared to all other constructs in the model ($\beta = 0.454$, $p < 0.001$), which was the same finding as found by Bandura (1977) and Imran et al. (2023) who conceptualised self-efficacy as the immediate antecedent of behaviour. However, the interaction effect (self-efficacy $\times$ attitude to use) was not significant, $\beta = 0.042$, $p = 0.314$, indicating that there was no significant moderating effect of self-efficacy on the attitude–intention relationship. Overall, these findings suggest that self-efficacy is a separate construct in the intention formation process and not a moderator of the attitude–intention link for this sample.

5.2 Theoretical Contribution

The two original constructs of TAM (Perceived Usefulness and Perceived Ease of Use) did not have their effect on attitude and intention equally, as Perceived Usefulness only had a small significant effect while Perceived Ease of Use had no significant effect; rather, the two constructs proposed in this study (Digital Literacy, Perceived Risk, and Self-Efficacy) dominated both measurement of attitude and prediction of intention. This is in line with Alamir (2025) and Almaiah

et al. (2025): The original constructs of TAM are important but not sufficient for the development of Islamic finance markets, in which the extensions, namely the trust-, skill-, and confidence-related constructs have more explanatory power than what the founders of the model expected. The relative weakness of the effect of Perceived Usefulness also indicates that, in more mature and saturated digital banking markets, use functionality may be required but not sufficient to drive adoption — customer trust and capability may become the differentiator. The direct link between self-efficacy and intention, and not as a significant moderator of the attitude-intention relationship, also provides a specific and measurable extension to the self-efficacy literature in digital banking TAM models. In this sample, self-efficacy seems to be an independent antecedent of behaviour, similar to Bandura's conceptualization of self-efficacy as a direct cause of behaviour, rather than as a boundary condition for other relationships. Future research in markets similar to the one targeted in this study could be improved by measuring both role-specific self-efficacy and self-efficacy overall to ensure that self-efficacy is measured across both roles rather than taking one role at a time as given.

5.3 Practical Implications

Given the important relationship between Perceived Risk and Attitude in this sample, it is likely that risk-mitigation communication strategies, such as making clear fraud protection pledges, communicating a clear approach to data privacy, and providing visible assurances of Shariah compliance, will affect Islamic banks and regulators more than incremental usability improvements. So, content and onboarding resources that proactively tackle security questions and concerns, instead of simply assuming that customers will seek out reassurances, may offer greater return on investment than further investment in interface finetuning. The increased digital literacy found in this study enhances structured digital-literacy training such as digital-literacy tutorials for patrons in the branch, streamlined onboarding processes, and specific training for customer types who are least likely to be using digital technology (e.g., older patrons, rural patrons). Perceived risk is a less important influence on attitude than digital literacy, so a bank's strategy that incorporates elements of literacy building is likely to be correlated with a large boost in adoption among existing non-adopters who are on the fence. There is strong evidence that self-efficacy has a direct impact on intention, and that interventions to boost self-efficacy — such as practice or demo modes, step-by-step guided transactions, and readily available customer support during the

first few digital transactions — augment this direct impact regardless of customers' initial attitudes toward the platform. Therefore, it is important that banks should not assume that a positive marketing campaign will automatically materialise in positive behaviour – it may take some real support to restore confidence in taking action based on a positive attitude. For policy makers and financial-inclusion institutions, the findings highlight that national financial-inclusion initiatives to increase digital literacy, like those undertaken by the State Bank of Pakistan and industry groups, will likely yield multiple benefits beyond improving financial-literacy skills, including enhanced confidence and trust, which this study identifies as a key driver of adoption. For other banks who are still trying to figure out how to stand out amidst the sea of digitally distrustful customers, the takeaway is this: There's something more effective than just trying to win them over with a more user-friendly interface or by offering more features—the security messaging, transparency and customer support provided to them during their onboarding process is going to be more effective until more of them are digitally literate and self-efficacy.

5.4 Limitations and Future Research

The main strength of this research is that it is a cross sectional study conducted using non-probability sampling technique (convenience sampling) and because of this, causal inferences and generalisability of the findings to the larger population of Islamic banking customers in Pakistan has been restricted. Despite procedural safeguards because of the Likert scale items used to measure each construct, there may be a common method bias (Podsakoff et al., 2003). Two indicator loadings (PR4 = 0.596; IUDB4 = 0.613) were lower than the commonly accepted 0.70 threshold and were kept as part of the model statistically, but may need to be checked for content clarity in future research. The discriminant-validity (HTMT) table presented in this study should be re-examined independently from the original SmartPLS output prior to finalizing the results that are to be submitted or published. As of the writing of this report, there were no R^2 , f^2 , or Q^2 statistics available, and the demographic profile and final sample size were not reported, so they should be reported to fully describe the model's explanatory and predictive power. Future studies should adopt a longitudinal study design with probability sampling in a broader range of bank branches and across other regions of the country, compare the findings of conventional and Islamic banks, and include other constructs in the banking context as the antecedents or moderators of the variables studied (Shafiq et al., 2024).

6. Conclusion

This study builds upon an extension of TAM (Perceived Risk, Digital literacy and Self-efficacy) and includes attitude to use as a mediator and self-efficacy as a moderator. They show that in this context, attitude and intention are not significantly influenced by perceived ease of use; perceived risk and digital literacy are the strongest antecedents of attitude; and attitude is the strongest antecedent of the behavioural intention, with attitude as a hypothesized moderator between perceived ease of use and intention being insignificant; and intended use intention and self-efficacy are the strongest direct factors of the behavioural intention. In conclusion, these results indicate that the trust, capability and confidence rather than usefulness or simplicity of the user interface are the main factors driving digital banking adoption by the Islamic banking customers in Pakistan. As a context specific extension of the TAM, the study provides evidence-based insights for the Islamic banking industry and policy-makers to consider when designing digital banking services that are secure, accessible and congruent with customer confidence and capability, which will help realize their financial-inclusion goals.

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