

A Study on Impact of AI-Based Virtual Assistants on Customer Experience and Satisfaction in Banking: A Moderated Mediation Model Integrating UTAUT2 and SERVQUAL

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Abstract

Artificial intelligence (AI)-based virtual assistants are gaining popularity to enhance the customers' experiences in the banking sector; yet their impacts and associated mechanisms and outcomes are not well understood. In this study, we examine these relationships by integrating the Unified Theory of Acceptance and Use of Technology (UTAUT2) with SERVQUAL in a moderated model. This study gathers primary data from 426 bank customers, and uses structural equation modeling (SEM) and hierarchical regression to test the model. It finds that performance expectancy ($\beta = 0.292$, $p < 0.001$), effort expectancy ($\beta = 0.254$, $p < 0.001$), social influence ($\beta = 0.146$, $p = 0.002$), and reliability ($\beta = 0.383$, $p < 0.001$) are significant predictors of customer experience, and reliability is the most significant. In addition, customer experience significantly positively affects customer satisfaction ($\beta = 0.958$, $p < 0.001$), indicating it is an important variable to explain customer satisfaction. The proposed model explains a large percentage of variance in customer satisfaction ($R^2 = 0.620$), with very good power. The moderating effects analysis also indicates that the moderating effects of digital literacy on the relationships between the antecedent factors and customer experience are large, with reliability having the largest moderating effect ($\beta = 0.168$, $p < 0.001$). The outcomes of further regression analyses also indicate that customer experience has a mediating effect, as the direct links between effort expectancy and social influence with customer satisfaction are no longer significant when it is considered. The study builds on the existing body of research in offering an experience-based approach that extends current theories on technology acceptance and service quality and the role of digital literacy as moderating factor. The research emphasises the importance of reliable AI systems and customer ability in enhancing customer experience and satisfaction in web banking.

Keywords: AI Based Virtual Assistants, Customer Satisfaction, Customer Experience, SERVQUAL.

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Introduction

The banking digital revolution has brought about a transformation in the way customers engage with banking services and virtual assistants based on artificial intelligence (AI) are at the forefront of this change. Banks are now commonly implementing AI-powered chatbots and virtual assistants to automate processes, provide real-time and relevant information, and personalise banking services (Dwivedi et al., 2020). This is part of a shift towards smart service systems, where customer interaction is co-produced through human-machine interactions instead of service interactions (Paluch & Wirtz, 2020).

While the use of AI-enabled virtual assistants continues to increase, the research literature is still unfolding on how these virtual services contribute to creating value for customers. Existing studies have tended to focus on technology adoption and use patterns, neglecting the user-experience aspect that underpins customer perceptions and responses to AI-based services. Recent research indicates that while adoption of digital technologies may not necessarily lead to improved customer satisfaction, customer experience plays a critical role in leveraging technological affordances for positive customer outcomes (McLean et al., 2020). In the context of AI-powered banking services, where transactions are increasingly automated, identifying the factors influencing customer experience is critical for maintaining customer satisfaction and loyalty.

Theoretically, the Unified Theory of Acceptance and Use of Technology (UTAUT2) provide a solid basis for understanding user engagement with digital technologies in terms of performance expectancy, effort expectancy and social influence (Venkatesh et al., 2012). These constructs are well-recognised as predictors of technology adoption, yet little is known about their influence in post-adoption behaviours, specifically customer experience in AI-driven services. Similarly, the SERVQUAL model, with its emphasis on reliability, offers essential insights into perceptions of service quality, highlighting the need for accuracy, reliability and dependability in service provision (Parasuraman et al., 1988). In the context of AI-driven banking, where services are automated, reliability is a key driver of customer experience and trust.

Moreover, customer experience is a key mediating factor in the relationship between technological and service quality factors and customer satisfaction. Taking an experience-based approach, customer experience includes customers' cognitive and emotional reactions to their interactions with services, and as such, serves as a mediator between the service and satisfaction (De Keyser et al., 2015). Yet, the role of customer experience in mediating the link between technology and service quality attributes, and satisfaction, in AI-based banking services has not been widely investigated.

Moreover, differences in users' abilities to engage with technology - commonly referred to as digital literacy - may play a crucial role in customers' experiences of AI-based banking (Blake, 2024). Digital literacy improves users' skills to search, comprehend and use digital technologies to make better informed decisions, which in turn impacts on perceptions and experiences (Neururer et al., 2018). In the realm of AI-based banking, it seems likely that customers with higher digital literacy gain more benefits from virtual assistants, implying a moderating role that enhances the effects of technology/service constructs on the customer (Paluch et al., 2020).

While previous research has explored technology acceptance, service quality and customer satisfaction separately, there is a need for more comprehensive models that holistically capture the simultaneous impact of UTAUT2 factors, service quality (reliability) and customer capability (digital literacy) on customer experience and customer satisfaction in the context of AI-based banking. In particular, little empirical research has focused on (i) joint effects of performance expectancy, effort expectancy, social influence and reliability on customer experience, (ii) the influence of customer experience as a dependent variable and mediator between the factors and satisfaction, and (iii) the moderating influence of digital literacy in strengthening these relationships.

The current study aims to address this research gap by investigating the impact of key constructs of technology acceptance - performance expectancy, effort expectancy, and social influence - and service quality (reliability) on customer experience with AI-enabled virtual assistants in banking (Adam et al., 2021). It also explores the role of customer experience in determining customer satisfaction, as well as assessing the role of digital literacy in strengthening these associations. Through the creation of a moderated mediation model that incorporates UTAUT2 and SERVQUAL viewpoints, this study seeks to offer a holistic view of customers' response to AI-based banking services.

2. Literature Review and Hypothesis Development

2.1 Banking Virtual Assistants Powered by AI

Virtual assistants powered by AI have revolutionised the banking industry by providing timely, personalised and efficient service to customers. Employing machine learning and natural language processing, they handle common customer inquiries, expedite service delivery, and improve efficiency. Beyond the operational, the AI-based interfaces are experiential platforms that influence customer perceptions, customer engagement and service assessment (Huang & Rust, 2018). But the success of these systems in delivering a superior service experience to customers hinges on perceptions of

technology capabilities and service quality during service encounters.

2.2 UTAUT2 Constructs and Customer Experience

The Unified Theory of Acceptance and Use of Technology (UTAUT2) offer a holistic model of examining user behaviours in relation to digital technologies through factors of performance expectancy, effort expectancy and social influence (Venkatesh et al., 2012). These factors have been well validated in predicting technology adoption, but emerging evidence suggests they play a role in post-adoption factors, such as customer experience in digital services (Patil et al., 2020).

Performance Expectancy and Customer Experience

Performance expectancy is the extent to which one believes that using a technology will help one to accomplish a task. In AI banking, virtual assistants that boost efficiency, speed up the response and help complete the task are likely to lead to a better customer experience. Research evidence indicates that usefulness plays a crucial role in engagement and experience in AI services (Alalwan et al., 2017a).

H1: Performance Expectancy has a positive impact on Customer Experience.

Effort Expectancy and Customer Experience

Effort expectancy is related to the simplicity of interacting with a technology. Banking systems powered by AI and designed to be user-friendly and intuitive diminish effort and ease interactions. Existing research emphasises the importance of ease of use for user satisfaction and positive service experience in digital services (McLean et al., 2020).

H2: Effort expectancy has a positive effect on Customer experience.

Social Influence and Customer Experience

Social influence is the degree to which people perceive others important to them have positive attitude towards using a technology (Becker & Jaakkola, 2020). In online banking, the adoption of AI services is influenced by the opinions of others, their usage and social influences. Studies show that social support increases trust and decreases uncertainty, which in turn has a positive impact on customer experience (Alalwan et al., 2017a; Patil et al., 2020).

H3: Social Influence has a positive impact on Customer Experience.

2.3 Service Quality (Reliability) and Customer Experience

Reliability (ability to deliver accurate, consistent and dependable service) is one of the dimensions of the SERVQUAL model (Parasuraman et al., 1988). The reliability aspect is crucial in AI-enabled banking, where customers interact with AI for financial transactions and information retrieval (Sheehan et al., 2020).

Recent research shows that reliability plays a key role in the perceptions of customers in online service contexts,

impacting trust and experience (Hollebeek et al., 2022). AI assistants delivering reliable and error-free service boosts trust and positively affect customer experience (Flavián et al., 2019).

H4: Reliability positively impacts Customer Experience.

2.4 Customer experience and customer satisfaction

Customer experience is an overall assessment of customer interactions with a service, including cognitive and emotional reactions. In line with Expectation–Confirmation Theory, satisfaction is a function of whether service performance is consistent with expectations (Brown et al., 2024).

Research supports the notion that favourable customer experience is a good predictor of satisfaction, especially in technology-mediated settings (Lemon & Verhoef, 2016; Roy et al., 2020). In digital banking, positive experiences with the AI-based virtual assistants are likely to increase satisfaction.

H5: Customer Experience has a positive impact on Customer Satisfaction.

2.5 Digital Literacy as a moderating factor

Digital literacy is a person's proficiency in using digital technologies. For digital banking systems with AI capabilities, digital literacy is a key factor in customer interaction with digital banking assistants.

Customers with greater digital skills are better able to navigate the digital environment, understand the features and troubleshoot minor problems, improving their user experience (Belanche et al., 2019). On the other hand, low digital competence might hinder interaction with the system and decrease the value perception. Existing research suggests digital skills positively affect the relationship between technology-related factors and user outcomes (Alalwan et al., 2017b).

Therefore, digital literacy is likely to be a moderating factor, enhancing the effects of technology and service quality factors on customer experience.

H6: Digital Literacy strengthens the relationships between Performance Expectancy, Effort Expectancy, Social Influence and Reliability with Customer Experience.

3. Research Model

3.1 Theoretical Framework

This study adopts a unified theoretical lens that integrates the technology adoption, service quality and customer evaluation theories to understand the customer's reaction to AI-based virtual assistants in banking. In particular, the research builds on the Unified Theory of Acceptance and Use of Technology (UTAUT2), the SERVQUAL model, the Expectation-Confirmation Theory (ECT) and the Digital Literacy framework to understand the interplay of technological and service

factors on customer experience and satisfaction with AI-based virtual assistants.

The UTAUT2 model (Venkatesh et al., 2012) offers a solid framework for understanding the use of digital technologies. Performance expectancy, effort expectancy, and social influence help to understand how users perceive the usefulness, ease of use and social acceptance of AI-based virtual assistants. UTAUT2 has been extensively used for predicting technology use, but its application to post-adoption outcomes (such as customer experience in the context of AI-based services) is still in its infancy. In the banking sector, these factors are likely to impact customers' perceptions and use of AI-based services, which in turn affect the customer experience.

To supplement this, the SERVQUAL model (Parasuraman et al., 1988), and its dimension of reliability, offers a service quality perspective by highlighting the value of accurate, dependable and consistent service. In the context of AI-based banking, where service delivery is automated, reliability is key to establishing trust and perceptions of service quality. By combining SERVQUAL and UTAUT2, we can better understand customer attitudes by including both technology and service quality components.

Moreover, the study extends Expectation-Confirmation Theory (ECT) to explain customer satisfaction as a result of evaluative experience. According to this theory, satisfaction is formed when customers' expectations are met. In banking using AI, customer experience plays a role as an evaluative process that translates the perceived technology and service quality into satisfaction. Hence, customer experience is considered a bridge between technology and service factors, and customer satisfaction.

Further, to account for variations among individuals in their use of digital technologies, the study draws on the Digital Literacy model. Digital literacy includes skills and abilities to use AI-based services. In this study, we propose digital literacy to be a moderating variable that increases the effect of technology/service factors on experience. The higher the digital literacy of customers, the better the use of the features and functionalities of

AI-based virtual assistants, which then results in a better experience.

Drawing on the above theories, the study suggests a multi-theory model of customer responses to AI-based banking services, which extends beyond adoption to include the value of customer experience and ability on customer satisfaction.

3.2 Research Model

The study adopts a moderated mediation model to explore the effect of AI-based virtual assistants on customer experience and satisfaction in the banking industry, building on the above integration of theories.

The model proposes Performance Expectancy, Effort Expectancy, Social Influence (UTAUT2 dimensions) and Reliability (SERVQUAL dimension) as independent variables that impact Customer Experience which, in turn, impacts Customer Satisfaction. Customer experience is conceptualised as a mediator, representing how the influence of technological and service factors affects customer satisfaction.

Additionally, Digital Literacy is also proposed as a moderating variable that affects the relationships between the independent variables and customer experience. In particular, the positive influence of performance expectancy, effort expectancy, social influence and reliability on customer experience is likely to be greater for customers with higher levels of digital literacy.

As such, there are both direct and indirect relationships in the proposed model, representing:

②The direct effect of factors associated with technological and service quality on customer experience

②The mediating role of customer experience in these factors' influence on customer satisfaction

②The moderating effect of digital literacy on these factors

Therefore, the model offers a holistic view of the impact of AI-powered virtual assistants on banking customers by bridging technology acceptance, quality of services, appraisal of customer experience and users' capability.

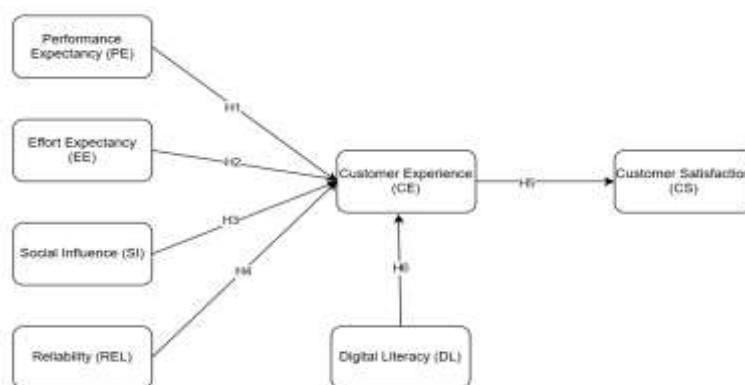


Figure 1: Conceptual Framework

4. Research Methodology

The study follows a quantitative research approach using a cross-sectional research design to explore the relationships between the key factors of technology acceptance, service quality, customer experience, and customer satisfaction in relation to the service of AI-powered digital banking. The cross-sectional survey approach was suitable because the purpose of the study is to examine the behavioural perceptions and test the interrelationships among the theoretical constructs at a particular time. Customers who have adopted AI-enabled banking features like virtual assistants and chatbots, or intelligent digital banking apps, are the sole focus of the study. To capture different user experience in the context of AI-based banking services, the study was conducted with 426 bank customers in urban and semi-urban areas of Tamil Nadu, India. The target population is customers with previous experience of using an AI-powered banking platform, with the sampling unit being individual banking service users. The fact that there is no official or formalized list of users of AI technologies in banking makes it difficult to establish a complete and accessible sampling frame for identifying eligible respondents. This sampling frame was created with the help of networks and connections, both professional and academic, as well as digital networks. Simple random sampling technique was employed in this study and it involved taking samples from the accessible population because the individuals had an equal chance of being selected. A structured questionnaire with validated measurement scales adapted from previous studies was used to collect the data from the study participants, consisting of 5-point Likert scale for measurement, which ensured content validity and consistency with the previous studies conducted within the field of technology acceptance and digital banking. Data collected was analysed using SEM, which can estimate multiple relationships at once, including direct, indirect, mediating and moderating relationships. In line with the recommendations of Joseph F. Hair Jr. and Hult (2021), the first stage involved the assessment of the measurement model using Confirmatory Factor Analysis (CFA), to test for reliability, convergent and discriminant validity; the second stage involved the evaluation of the structural model, to test for the hypothesised relationships, interaction effects of digital literacy, and indirect effects of customer experience in influencing satisfaction with AI banking service.

5. Analysis and Interpretation

5.1 Preliminary Analysis

The preliminary analysis lends empirical evidence to the conceptualised model. The sample is reasonably balanced in terms of gender: females (53.4%) slightly outnumber males (45.4%) (the remaining are others). The age ranges are fairly spread out with the greatest

share under 25 years (31.3%) followed by 35-44 years (29.8%) and 25-34 years (25.8%), suggesting the presence of young and tech-savvy users and older banking customers. Similarly, the respondents' educational profile and occupation are reasonably diverse with the majority of them being undergraduates (39.3%) and postgraduates (35.0%) and a equal split of students (35.3%) and professionals (36.2%). More importantly, the range in the usage of AI-based banking services from "never" (30.7%) to "often" (31.6%) implies the sample has a mix of respondents with different levels of exposure to AI services, which will help in the generalisability of the experiential knowledge to digital banking.

The descriptive statistics show that all of the variables have moderate to high mean scores, suggesting that respondents have a positive attitude towards AI-based virtual assistants. In particular, reliability has the highest mean ($M = 3.719$, $SD = 0.768$), followed by digital literacy ($M = 3.728$, $SD = 0.769$), implying that the respondents perceive AI-based banking systems as reliable and they have the necessary skills to use such technology. Perceived usefulness ($M = 3.611$, $SD = 0.729$) and perceived value ($M = 3.515$, $SD = 0.797$) also display positive assessments, suggesting that consumers perceive the utility of and benefits derived from using AI-based services. On the other hand, social influence has a relatively lower mean ($M = 3.200$, $SD = 0.803$), suggesting that AI banking services are not as influenced by social factors, but rather personal perceptions and experience. Moreover, the skewness ranging from -0.335 to 0.211 and kurtosis values within the recommended range suggest that the data is relatively normally distributed, thus meeting model assumptions of structural equation modeling.

The reliability test also shows high internal consistency of all items, with Cronbach's alpha ranging between 0.792 and 0.825, which is higher than the recommended value of 0.70. In particular, digital literacy ($\alpha = 0.825$) and customer experience ($\alpha = 0.820$) are more reliable, suggesting that the items used to measure the constructs are consistent and not redundant. The results of the correlation analysis also lend evidence to the consistency of the developed model, with all constructs showing a positive and significant relationship at the 0.01 level. The strong association between customer experience and customer satisfaction ($r = 0.767$) supports the position of customer experience as an important explanatory construct in the model. Likewise, reliability is positively and moderately correlated with customer experience ($r = 0.526$), suggesting that reliable and consistent service delivery plays a significant role in the customer experience. The correlation between performance expectancy ($r = 0.480$) and effort expectancy ($r = 0.405$) and customer experience also suggests that usefulness and ease of use play important roles in customer experience. Crucially, all correlation

values are below 0.80, ensuring that there is no multicollinearity and that the constructs are empirically distinguishable, yet theoretically consistent. Overall, the

results confirm the suitability of the sample data, and the use of confirmatory factor analysis and structural equation modeling to test the remaining hypotheses.

Table 1: Descriptive Statistics, Reliability, and Correlation Matrix

Constructs	Mean	SD	α	PE	EE	SI	REL	CE	DL	CS
PE	3.515	0.797	0.812	1						
EE	3.344	0.805	0.808	.175**	1					
SI	3.200	0.803	0.817	.233**	.207**	1				
REL	3.719	0.768	0.808	.249**	.234**	.270**	1			
CE	3.461	0.747	0.820	.480**	.405**	.361**	.526**	1		
DL	3.728	0.769	0.825	.229**	.236**	.164**	.193**	.354**	1	
CS	3.611	0.729	0.792	.447**	.374**	.346**	.510**	.767**	.371**	1

Note: $p < 0.01$

5.2 Measurement Model

The measurement model was examined to measure the reliability and validity of the constructs using composite reliability (CR), average variance extracted (AVE) and discriminant validity through the HTMT criterion. Table 2 shows that all the constructs are internally consistent, with CR values ranging from 0.785 to 0.826, above the recommended cut-off of 0.70. Digital literacy (CR = 0.826), social influence (CR = 0.818) and performance expectancy (CR = 0.812) have the highest reliability among the constructs, demonstrating a high degree of consistency in measuring these variables. Although the lowest CR value for customer satisfaction (CR = 0.785) is still above the minimum recommended value of 0.70, it confirms that the measurement items for the constructs are consistent in explaining the latent constructs.

AVE values were used to test convergent validity, which refers to the amount of variance that a construct explains in its indicators. As revealed in Table 2, the AVE values of most constructs are above the suggested cut-off value of 0.50 (from 0.519 to 0.612) and thus demonstrate adequate convergent validity. Digital literacy, with an AVE of 0.612, is the highest, followed by social influence (0.599) and performance expectancy (0.591), with their indicators having high explanatory

power. While customer satisfaction demonstrates a slightly lower AVE (0.477), it is acceptable as its composite reliability is higher than 0.70, in line with methodological recommendations that allow such cases when reliability is sufficient.

To test discriminant validity, the Heterotrait-Monotrait ratio (HTMT) was used as it is a conservative measure of construct uniqueness. As Table 2 shows, all the HTMT values are below the conservative cut-off value of 0.85, suggesting satisfactory discriminant validity. The largest HTMT value is found between customer experience and customer satisfaction (HTMT = 0.821), which is expected due to the direct connection in the proposed model. Other HTMT values are relatively smaller but still significant (e.g., reliability-customer experience = 0.645 and performance expectancy-customer experience = 0.586) and reflect important but separate relationships. Moreover, the lower HTMT values associated with digital literacy (htmt = 0.198-0.459) confirm its distinctiveness, confirming its role as a moderator. In summary, the findings confirm that the measurement model meets the requirements for reliability, convergent and discriminant validity, thus ensuring a solid basis for the analysis of the structural model.

Table 2: Measurement Model Assessment (Construct Level)

Constructs	CR	AVE	PE	EE	SI	REL	CE	DL	CS
PE	0.812	0.591	—						
EE	0.809	0.586	0.218	—					
SI	0.818	0.599	0.285	0.255	—				
REL	0.809	0.586	0.308	0.288	0.332	—			
CE	0.812	0.519	0.586	0.495	0.441	0.645	—		
DL	0.826	0.612	0.281	0.288	0.198	0.237	0.431	—	
CS	0.785	0.477	0.556	0.466	0.429	0.637	0.821	0.459	—

5.3 Structural Model and Hypothesis Testing

To test the model, we examined the relationship between the constructs, and the findings offer comprehensive empirical evidence in support of our model. All the direct relationships between antecedents

and customer experience are positive and significant, as shown in Table 3, suggesting that both technology and service quality dimensions play an important role in the user experience of AI-based banking. In particular,

performance expectancy ($\beta = 0.292, p < 0.001$) and effort expectancy ($\beta = 0.254, p < 0.001$) show strong impacts, implying that customers experience a higher level of customer experience when the AI-based virtual assistants are perceived as being useful and easy to use. This is consistent with the enduring importance of these key UTAUT2 constructs, even in post-adoption experiences. While social influence ($\beta = 0.146, p = 0.002$) is significant, it shows a relatively lesser effect, suggesting that customers' experience with AI-based banking is not as socially influenced and is more individualistic with regard to the effectiveness of interaction. On the other hand, reliability ($\beta = 0.383, p < 0.001$) has the most significant impact on customer experience, suggesting that the stability, accuracy and trustworthiness of AI-powered services are the most important factors for predicting positive customer experience. This suggests that in critical service settings like banking, service quality is more important than social and perceptual factors. Finally, customer experience has a very positive effect on customer satisfaction ($\beta = 0.958, p < 0.001$), which suggests that satisfaction is almost fully determined by the customer experience of interacting with AI. This very high coefficient implies that customer experience acts as a near-deterministic mechanism to translate service interactions into customer satisfaction, thus confirming the pivotal role of customer experience in the model. Overall, these results confirm hypotheses H1 to H5.

In addition, the moderating effect of digital literacy adds to the understanding of how customer capabilities impact the success of AI-based services. Table 3 shows that the interaction effects between digital literacy and antecedent variables are all positive and significant, revealing that digital literacy enhances positive effects of the technology/service factors on customer experience. Specifically, the interaction effect is observed for performance expectancy ($\beta = 0.113, p = 0.003$), effort expectancy ($\beta = 0.122, p = 0.001$), social influence ($\beta = 0.091, p = 0.016$), and reliability ($\beta = 0.168, p < 0.001$). These findings indicate that customers with higher levels of digital literacy can better comprehend, operate, and leverage AI-based banking services, leading to an enhanced experience from the use of these digital technologies. Interestingly, the moderating relationship is the largest for reliability ($\beta = 0.168$) suggesting that digital literacy enhances the importance of system accuracy and consistency in experiential assessment processes. On the other hand, the weak moderating effect for social influence ($\beta = 0.091$) indicates that digital literacy is more likely to enhance cognitive and functional use, rather than social use. In general, digital literacy is a key enabler, translating the potential of technology into experiential value through its role in enabling users to better interact with AI. This suggests that, for AI-based banking to be successful, it is not only important for the systems to be well designed, but also for customers to take full advantage of their features. Thus, H6 is fully supported.

Table 3: Structural Model Results and Hypothesis Testing

Hypothesis	Relationship	β (Std.)	C.R.	P-value
H1	PE $\rightarrow$ CE	0.292	5.588	***
H2	EE $\rightarrow$ CE	0.254	5.096	***
H3	SI $\rightarrow$ CE	0.146	3.039	0.002
H4	REL $\rightarrow$ CE	0.383	6.878	***
H5	CE $\rightarrow$ CS	0.958	10.981	***
H6	DL moderates (PE, EE, SI, REL $\rightarrow$ CE)	Significant	—	<0.05

Note: *** means $p < 0.01$

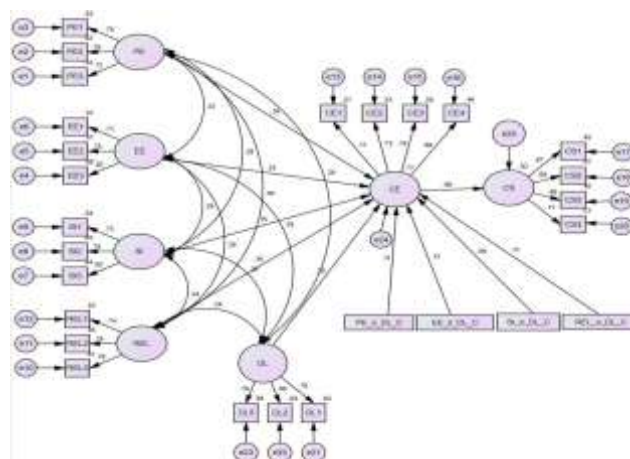


Figure 2: Standardized Estimates of SEM Analysis

5.4 Robustness Analysis Using Hierarchical Regression

The structural model was evaluated to understand the effects and directions of the relationships between the variables, and the findings empirically support our proposed model. As summarised in Table 3, all the direct effects from the constructs to customer experience are positive and significant, suggesting that both technological and service quality factors significantly influence the customer experience in AI-based banking. In particular, performance expectancies ($\beta = 0.292$, $p < 0.001$) and effort expectancies ($\beta = 0.254$, $p < 0.001$) have significant effects, implying that customers have a better experience with AI banking when the AI-based virtual assistants are perceived as useful and easy to use. This finding supports the importance of key UTAUT2 constructs in the post-adoption customer experience context. The effect of social influence ($\beta = 0.146$, $p = 0.002$) is relatively weak, suggesting customers' experience with AI-based banking services is less socially influenced and more related to personal experiences with the service. On the other hand, reliability ($\beta = 0.383$, $p < 0.001$) has a highly significant, positive effect on customer experience, suggesting that service dependability, accuracy and stability are the key drivers of positive customer experience with AI-based services. This suggests that in the context of high-risk service sectors like banking, service quality has a greater impact on customer experience compared to social and perceptual factors. Moreover, customer experience has a very strong positive effect on customer satisfaction ($\beta = 0.958$, $p < 0.001$), suggesting that the satisfaction is virtually determined by the quality of experience obtained from interactions with AI. This very large coefficient implies that customer experience acts as a

virtual "black or white" mechanism in converting service experiences into customer satisfaction, and, therefore, confirms its pivotal role in the model. These results provide ample evidence in support of hypotheses H1 to H5.

The results of the hierarchical regression analysis also shed further light on the role of customer experience as a mediator of the effects between the antecedents and customer satisfaction. Table 4 reveals that, in Model 1, performance expectancy ($\beta = 0.290$, $p < 0.001$) effort expectancy ($\beta = 0.212$, $p < 0.001$) and social influence ($\beta = 0.140$, $p = 0.002$) have significant effects on customer satisfaction. But when customer experience is entered into the model in Model 2, these effects are no longer significant (effort expectancy: $\beta = 0.070$, $p = 0.064$; social influence: $\beta = 0.055$, $p = 0.142$), while the influence of performance expectancy ($\beta = 0.101$, $p < 0.05$) customer experience is significant ($\beta = 0.597$, $p < 0.001$). This finding suggests the effect of effort expectancy and social influence on customer satisfaction is completely mediated by customer experience. That is, customers do not perceive satisfaction directly from their perceptions of ease of use and social influence; these perceptions increase satisfaction only when they are part of a positive customer experience. This evidence suggests a key explanatory factor in translating technological and social perceptions into customer satisfaction through customer experience. The findings are in line with expectation-confirmation theories, where customer experience is the precursor to satisfaction. As such, the findings support the strong mediating role of customer experience, thereby highlighting its important role in the proposed model.

Table 4: Hierarchical Regression Results

Variables	Model 1 (β)	Model 2 (β)
Performance Expectancy	0.290***	0.101*
Effort Expectancy	0.212***	0.070 (ns)
Social Influence	0.140**	0.055 (ns)
Reliability	0.351***	0.140***
Customer Experience	—	0.597***
Model Fit	Model 1	Model 2
R ²	0.436	0.620
ΔR^2	—	0.184***
F-value	62.107***	104.403***

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; ns = not significant

5.5 Group Differences Analysis

The results of group differences indicate significant differences among demographic segments, demonstrating the impact of user diversity on the perceptions of AI-based banking services. The independent sample t-test indicates that female respondents report significantly higher mean scores than male respondents across key constructs, including performance expectancy ($t = -4.040$, $p < 0.001$), effort expectancy ($t = -3.799$, $p < 0.001$), reliability ($t = -4.526$, $p < 0.001$), customer experience ($t = -6.807$, $p < 0.001$), digital literacy ($t = -4.521$, $p < 0.001$), and customer satisfaction ($t = -5.935$, $p < 0.001$). This suggests that female users are more engaged cognitively and experientially with the use of AI-based banking services. But there is no statistically significant difference in social influence ($t = -1.555$, $p = 0.121$), which indicates that the influence of social factors is the same for both male and female respondents.

The one-way ANOVA results confirm that there are differences across demographic groups. For age groups, all constructs show statistically significant variation, including performance expectancy ($F = 11.623$, $p < 0.001$), effort expectancy ($F = 6.347$, $p < 0.001$), social influence ($F = 6.520$, $p < 0.001$), reliability ($F = 14.431$, $p < 0.001$), customer experience ($F = 34.122$, $p < 0.001$), digital literacy ($F = 22.368$, $p < 0.001$), and customer satisfaction ($F = 28.711$, $p < 0.001$). The highest F-values are seen for customer experience and customer satisfaction, which means that these outcome variables are most affected by age variations. Similar results are found for education (e.g., customer satisfaction: $F = 32.282$, $p < 0.001$), occupation (customer experience: $F = 23.501$, $p < 0.001$), income (customer satisfaction: $F = 47.778$, $p < 0.001$) and usage frequency (customer

experience: $F = 77.225$, $p < 0.001$; customer satisfaction: $F = 82.524$, $p < 0.001$), showing robust and consistent group variations. Here, usage frequency has the greatest explanatory power, implying that frequent engagement with AI-based technologies plays an important role in increasing usage familiarity, trust and value. Further post hoc comparisons show that the differences are greatest between the lowest and highest groups, suggesting that the perceptions have consistently increased rather than fluctuated randomly. In summary, these results show that demographic and usage-related attributes, especially usage frequency and socio-economic background, are significant in determining customer experience and satisfaction, thus confirming that digital skills and engagement are important in AI-based banking.

6. Discussion

The current research aimed to explore the impact of using AI-based virtual assistants on customer experience and satisfaction in the banking domain by blending UTAUT2 and SERVQUAL perspectives into a moderated model. The study provides robust empirical evidence of the hypothesised relationships, drawing a number of theoretical and contextual conclusions. First, the positive influence of performance expectancy ($\beta = 0.292$), effort expectancy ($\beta = 0.254$), social influence ($\beta = 0.146$) and reliability ($\beta = 0.383$) on customer experience confirms the relevance of UTAUT2 elements in AI-based service contexts. But the relative importance of these relationships signals a shift: reliability is now the dominant factor, overtaking traditional technology acceptance factors. This suggests that in the banking industry, where trust, risk, and accuracy are of concern, the role of service quality factors is more prominent

than that of technology acceptance. That is, although customers expect AI systems to be useful and easy to use, customer experience is primarily driven by the reliability of these systems in delivering the right results consistently and free of errors.

The findings also reveal the role of customer experience as the intermediary variable between the antecedent factors and customer satisfaction. The very strong impact of customer experience on satisfaction ($\beta = 0.958$) implies that satisfaction with AI in banking is mostly experiential rather than cognitive. This is consistent with the expectation-confirmation theory of satisfaction, which suggests satisfaction is derived by comparing actual service experiences with expectations. The complementary regression analysis supports this view because the direct effects of effort expectancy and social influence become non-significant after the addition of customer experience, suggesting that the effects of these constructs are entirely mediated through customer experience. This shows that the impact of ease of use and social influence is not direct: customers do not experience satisfaction from ease of use and social influence, but only when these attributes improve the service experience. Consequently, customer experience plays a pivotal role in translating service and technology features into customer satisfaction.

The moderating effect of digital literacy is a new finding of this study. This research demonstrates that digital literacy strengthens the relationships between performance expectancy, effort expectancy, social influence and reliability with customer experience (the strongest moderating effect is associated with reliability, $\beta = 0.168$). This suggests that users with greater digital literacy have a better ability to comprehend system performance, use the system and reap the benefits of AI-based services, which in turn leads to a better user experience. Crucially, the moderating effect implies that the efficacy of AI-based banking systems is not solely dependent on the system itself, but also human skills. For example, in cases where users have low levels of digital literacy, highly complex systems may not necessarily lead to optimal user experience. However, when the user is highly digitally literate, the system features can be used more effectively and this increases user experience and satisfaction. The finding adds to the UTAUT2 literature by revealing user competence is not only an antecedent but also a moderator of the relationship between technology and user experience.

The group analysis further contributes to these insights by revealing differences in customers' perceptions. The significantly higher mean scores of female customers and the incremental increase in user experience and satisfaction with increase in income, education and usage frequency highlights that exposure, experience and socio-economic status are important factors in shaping perceptions of AI-powered banking services. Interestingly, the difference across the usage frequency

groups shows that the experience with AI technologies over time increases trust, confidence and perceived utility, showcasing the importance of experience for satisfaction. This extends the moderating influence of digital literacy through recognition of the important role of both ability and experience in determining perceptions of AI-driven services.

Overall, the study extends previous work by integrating technology acceptance and service quality with the experience-based view and in consideration of the moderating role of digital literacy. The findings show that in the context of AI banking, customer experience is the primary link between technology and service attributes and satisfaction and is enhanced by the customer's digital literacy. This integrated perspective offers a more holistic perspective of customer behaviour in digital services, shifting from models of technology acceptance to an experiential view.

7. Implications

7.1 Theoretical Implications

The current research adds to the existing research by providing a holistic view that integrates the UTAUT2 and SERVQUAL models from an experiential perspective. While previous studies have largely focused on technology adoption from cognitive factors such as perceived usefulness and ease of use, the present study builds upon this knowledge base by showing that these variables have an indirect effect on customer satisfaction via customer experience. The robust link between customer experience and customer satisfaction suggests the need for a re-conceptualization of existing technology adoption models by including constructs that represent customer experience. By doing so, the study integrates the technology acceptance and customer evaluation streams to provide a more comprehensive model of customer behavior in AI-powered services.

Moreover, the study adds to the literature by demonstrating that reliability is the most significant predictor of customer experience, thus highlighting the role of service quality attributes in the digital environment. This insight counters the traditional emphasis on technology-related factors in UTAUT models and highlights the fact that in riskier and trust-based industries like banking, service quality factors play a more important role in influencing user perceptions. Moreover, the inclusion of digital literacy as a moderating factor broadens the theoretical framework of current models by incorporating individual user capability as a moderating factor. The findings show that digital literacy not only affects adoption, but also enhances the link between system attributes and experiential variables. This insight enhances our theoretical insights into individual differences in technology-enabled service contexts and sets the stage for future studies to develop capability-based models in digital service ecosystems.

7.2 Managerial Implications

The study offers critical insights for managers on how banks can enhance the customer experience with AI-based virtual assistants. The strong influence of reliability on customer experience suggests that organisations should emphasise on accuracy, predictability and error-free performance when designing and deploying their AI solutions. For banks, this is likely to mean that the investments in core processing, fast response times, and secure transaction processing will have a greater impact on customer experience than investing in the look and feel of the system or marketing efforts. While expectations of performance and expectations of effort are important, they are moderated by reliability and are indicative of a service model for AI.

The significant moderating role of digital literacy also suggests a need to enable users to fully benefit from AI services. Banks must be actively involved in digital literacy initiatives, training and designing simple and intuitive user interfaces that consider users' proficiency. Such increased digital literacy not only helps direct use but also amplifies the effects of technology and service features, leading to a greater impact on user experience and satisfaction. And, the variations in user segments indicate that a "one size fits all" approach may not be suitable. Instead, financial institutions should adopt a segmented approach providing AI services and marketing messages in a segmented way, considering user segments based on age, income and usage. By promoting frequent use through personalised engagement, user-adaptive design and technical support, additional awareness and trust can be fostered to lead to long-term satisfaction and loyalty.

8. Conclusion

The effect of virtual assistants based on artificial intelligence (AI) on customer experience and satisfaction in banking services has been investigated in this study through a moderated approach, integrating UTAUT2 and SERVQUAL. Our study provides strong empirical evidence of the influence of technology attributes (performance expectancy, effort expectancy, social influence) and service quality (particularly reliability) on customer experience. Reliability emerges as the strongest predictor, suggesting the critical role of system reliability in service delivery involving high-stakes situations, such as banking services. Further, it confirms the role of customer experience as important for predicting customer satisfaction, and acts as a vital link between predisposing factors and customer outcomes. The research offers a new contribution by demonstrating the moderating role of digital literacy that strengthens the relationship between service/technology attributes and customer experience. It highlights that the effectiveness of AI technologies is

not only determined by the design of the technology but also by the users' ability to engage with the technologies. In addition, the differences between groups highlight the importance of taking into account the diversity of customers and how experience and satisfaction are both influenced by digital literacy and digital technology experience. Overall, the study adds to the understanding of AI-based service interactions, by bringing customer experience to the forefront of system attributes and customer experiences, and recognising the role of digital literacy. These insights provide a comprehensive view to inform future research and practice in the emerging area of AI-based banking.

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