ARTIFICIAL INTELLIGENCE AS A KEY STRATEGIC CATALYST FOR ENHANCING BANKING SERVICE QUALITY: INVESTIGATING THE MEDIATING ROLE OF DIGITAL INNOVATION

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Abstract

The paper examines how artificial intelligence (AI) improves banking service quality in Jordan, with digital innovation acting as a mediator. Using survey data from 435 respondents, the study finds that AI, through automation, data analysis, cybersecurity, customer experience, and ethics, positively impacts service quality both directly and indirectly (Skouloudis & Venkatraman, 2025). Digital innovation significantly strengthens this relationship, highlighting its role in enhancing responsiveness, security, and personalization in banking services. The paper addresses a relevant and timely topic in the field of corporate and business strategy. The integration of AI, digital innovation, and banking service quality represents an important contribution for both academic research and practical strategy in the financial sector (Castelnovo, 2024). This study contributes to the literature by empirically demonstrating the strategic importance of aligning AI technologies with comprehensive digital innovation initiatives in the banking sector. From a practical perspective, the findings provide valuable insights for bank managers and policymakers seeking to improve service quality through AI-driven digital transformation within emerging market contexts.

Keywords: Artificial Intelligence, Banking Service Quality, Digital Innovation, Banking Sector

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1. INTRODUCTION

The banking sector around the world has been experiencing a paradigm shift due to the increased influence of technology development at a rapid scale, with artificial intelligence (AI) technology being one of the main contributing factors to this paradigm shift. Banks and other financial institutions have been increasingly using AI technology to automate banking procedures and to obtain lower operational costs with higher efficiency and speed of services. Starting from automation to smart customer services and cybersecurity services, the influence of AI technology has been significantly felt on the entire range of banking operations (Adeyeri, 2024; El Bakkouri et al., 2022; Alsulami, 2025; Correia & Água, 2023; Gouiaa & Huang, 2024; Shaban & Al Hawatmah, 2024).

Despite the foregoing, however, the topic of AI integration also presents some daunting challenges. Transparency, information security, and the mitigation of prejudice represent some of the realms that continue to demand paramount significance and are increasingly linked to ethical

challenges in AI adoption. This can only be achieved by formulating a better strategy of AI integration that considers dimensions of trust and responsible service fulfillment (González-Sendino et al., 2024; World Economic Forum [WEF], 2023). Digital innovation plays a pivotal role in this regard. This assumes a dual role of enabling AI capabilities, followed by a platform to accomplish safe and flexible digital structures for AI fulfillment within varying levels of digital maturity.

With the growing interest in AI in the banking sector, many existing studies treat it as a single, unified concept, without focusing on the impact of digital innovation as a mediating variable between AI and service quality, particularly in emerging markets such as Jordan. This is due to a lack of theoretical formulations and proposals related to AI to improve service quality in a structured and integrated manner.

This research aims to cover the mentioned gaps by analyzing the impact of the AI dimensions of process automation, data analytics, cyber security, customer experience, and ethics on the service quality of banks in Jordan. This study also aims to analyze the mediating effect of digital innovation. This study employs a descriptive-analytical method that uses theoretical frameworks and gathers empirical information from experts and bank customers. This research aims to cover two main study questions:

RQ1: Which dimensions of artificial intelligence impact banking service quality?

RQ2: Does digital innovation act as a mediator between artificial intelligence and service quality?

In order to promote transparency and academic integrity, this study constructs its framework of analysis using existing theories and literature (Munira, 2025; Vuković et al., 2025; Cochran, 1977). Also, by taking into account the context of the study within the context of the Jordanian economy and by being informed about the current state of the banking industry's digital maturity level in the country, a comparative analysis of AI adoption by emerging economies can be made more coherently.

This study offers three significant conceptual contributions. First, it provides a broad concept of the dimensions of AI in all areas of operation. Second, digital innovation is used as a medium for the impact of technology to improve services. Third, the study provides insights that enrich the global discussion on AI and financial services, particularly in the Jordanian banking sector (Munira, 2025; Vuković et al., 2025; Abdulsalam & Tajudeen, 2024).

This article will consist of the following sections. Section 2 reviews the relevant literature and previous studies. Section 3 describes the research design, data collection methods, and analysis techniques used. Section 4 presents the results of the hypothesis testing and findings. Section 6 provides an overview of the findings and offers the conclusions.

2. LITERATURE REVIEW

The study was developed based on the technology, organization, and environment (TOE) theory and the dynamic capabilities theory (DCT), as these two theories contribute to providing a comprehensive understanding of AI and digital innovation in the banking sector.

2.1. Theoretical foundations and empirical literature on AI, digital innovation, and banking service quality

Technology, organization, and environment theory is referred to by aspects such as technological, organizational, and environmental factors (Tornatzky & Fleischer, 1990). Technological factors can be referred to as AI technology, ranging from automation technology to predictive analytics (Lazo & Ebardo, 2023). Organizational factors can be considered internal factors and may include factors such as the size of the bank, the extent of technology adoption by management, technology availability, and project implementation requirements (Almashawreh et al., 2024). Environmental factors are referred to as factors or changes that might affect the variables of the model, including competition, ethics, and regulation (Smit et al., 2024).

The above model is highly relevant within the context of banks adopting AI technology and the preparedness of the Jordanian state towards AI technology, as it concentrates on ethics and regulation in adopting AI technology (Smit et al., 2024).

According to the DCT, originally introduced by Teece et al. (1997) and expanded by Wang and Ahmed (2007), Brynjolfsson and McAfee (2017), and Gustomo et al. (2024), an organization can build and sustain a competitive advantage in an ever-changing environment by continuously sensing opportunities, seizing, and recombining internal resources. In the context of the current work, digital innovation is considered the dynamic capability that supports fully utilizing AI tools by the banking industry. This is achieved by the application of the following AI components: machine learning, chatbots, predictive analytics, and fraud management.

On the foundation of the convergence between the concepts of TOE and the economic performance concept of DCT, the thesis of this research is that the effects generated by AI applications are both direct and indirect on the quality of banking services driven by innovation enabled by technology. This assumption of the argument partially aligns with the most recent literature findings concerning the role played by comprehensive innovation driven by technology in emerging markets, as outlined by Verhoef et al. (2021) and Abdulsalam and Tajudeen (2024). However, the literature also reveals how the performance generated by AI and innovation driven by technology is affected by factors associated with the unethical and technical challenges implied by González-Sendino et al. (2024).

The integration of theoretical frameworks gained further support from a synthesis of empirical studies. In particular, Table 1 outlines the main features of the previous work that focused on AI adoption, ethics, and operational performance in banking and financial services, with a special focus on underdeveloped markets like Jordan. The studies that were reviewed have all mentioned the same thing: AI helps in the areas of operational efficiency, fraud detection, customer experience improvement, and service personalization (Munira, 2025; Maseke, 2024; Oyeniyi et al., 2024). On the other hand, several studies also report persistent barriers involving regulatory uncertainties, ethical governance, and digital infrastructure shortcomings (Islam et al., 2024; Rahman et al., 2023; Boustani, 2022).

Table 1 below offers a comparative analysis of existing empirical works that investigate the interface of AI and customer experience with bank performance. All of the works identified for analysis are relevant to the theoretical framework that this study uses, with a special focus being placed on those works developed for emerging economies like Jordan.

Table 1. Summary of key literature on AI adoption, ethics, and operational impact in banking and financial services

Author(s)	*Focus area*	*Methodology*	*Key findings*	*Recommendations*	*Relevance to framework*
Munira (2025)	Digital transformation technologies	Literature systematic review (150 studies)	AI drives efficiency, anti-fraud, and inclusion; cybersecurity and compliance matters.	Drive safe, inclusive, sustainable innovation.	Complements digital readiness and ethical AI issues; brings to the forefront operational performance issues.
Vuković et al. (2025)	AI tools in financial services	Mixed-methods	Chatbots improve customer experience; predictive analytics process automation offers low value.	Phased strategic adoption of AI.	Directly improves customer experience and delivery of service in digital banking.
Maseke (2024)	AI, efficiency, and customer satisfaction	Regression analysis	Strong positive correlation between AI and satisfaction ($\beta = 0.632$, $p < 0.001$).	Expand AI, improve data privacy, and train on AI ethics.	Reinforces the study's focus on customer satisfaction as a measurable impact of digital financial tools.
Abdulsalam and Tajudeen (2024)	AI strategies in developing countries' banks	Qualitative (thematic analysis)	AI aids automation, engagement, and credit management; highlights ethics and data governance.	Encourage ethical AI and stakeholder collaboration.	Relevant to governance and regulatory challenges in AI adoption in contexts like Jordan.
Fares et al. (2023)	AI applications in banking	Thematic content analysis (44 studies)	Classified AI use into strategy, operations, and customer service.	Proposed a conceptual adoption framework.	The framework helps conceptualize operational integration of AI in banking.
Islam et al. (2024)	AI and firm performance in Bangladesh	Literature and empirical (120 respondents)	AI enhances decision-making, cost reduction, and fraud detection; the problem of infrastructure is identified.	Capacity building and government support.	Offers comparisons for bottlenecks related to infrastructure in emerging economies such as Jordan.
Oyeniyi et al. (2024)	AI, customer experience, and operational efficiency	Mixed-methods	AI enhances personalisation, risk management, and digital delivery.	Highlight ethics, transparency of data, and continuous innovation.	Supports all parts of this study's framework — customer experience, compliance, and efficiency.
Urazova (2023)	Evaluation framework for AI in banking	Systemic methodological approach	Holistic view of technical and organizational implications.	Proposed a multi-level assessment model.	Useful for developing a structured model to assess AI's impact on bank operations.
Rahman et al. (2023)	AI adoption in Malaysian banks	Mixed-methods (interviews and survey)	AI is vital for fraud detection; adoption is influenced by trust, usefulness, and risk perception.	Address privacy, regulatory, and expertise barriers.	Relevant to institutional readiness and regulatory gaps in AI deployment.
Rammer et al. (2022)	AI innovation in German companies	Quantitative (innovation survey)	AI companies excelled at first-to-market innovation (18% of sales); 6% cost reduction via process innovation.	Suggest long-run AI investment priorities.	Emphasizes the long-run economic consequences of AI on firm-level outcomes.
Johnson et al. (2022)	AI in research and development (R&D) in industries	Media content analysis (956 articles)	AI augments human work instead of replacing it; it supports decision-making and market development.	Focus on exploratory AI adoption.	Pertains to the innovation and strategy AI dimension in banks.
Boustani (2022)	Impact of AI on Lebanese banking	Qualitative	AI can substitute technical functions, not service functions, for humans.	Call for comparison across regions.	Provides regional implications with regard to Jordanian banking infrastructure.
Trocin et al. (2021)	AI and digital innovation in human resources services	Multi-case qualitative study	AI legitimizes decision-making, reshapes innovation processes.	Strategic AI integration in human resources.	Though not banking-specific, it adds value to understanding AI's institutional impact.
Königstorfer and Thalmann (2020)	AI in commercial banking	Structured literature review	AI improves risk management, security, marketing, and compliance.	Stress on transparency, data privacy, and documentation.	Supports regulatory and compliance aspects central to this study.
Castelli et al. (2016)	Predicting banking service quality with AI	AI system design using genetic programming	AI enhances efficiency by predicting service delays.	Implement data-driven AI systems for service improvement.	Supports operational efficiency through predictive analytics.

Source: Author's elaboration.

Although there exists an increasing amount of empirical support, the investigation of digital innovation as a mediating factor that clarifies the AI dimensions' going through to the betterment of banking service quality has been particularly neglected in the context of Middle Eastern banking systems. Therefore, this study intends to fill this gap by marketing the role of digital innovation as a mediator in the relationship between AI dimensions and banking service quality in Jordan.

2.2. Theoretical framework and hypotheses supported by literature

The banking sector has seen a massive transformation in the last ten years and now offers not only automation, data analytics, and cybersecurity for customers (to name just a few) but also has restructured relationships with clients through innovative products and services delivered through the Internet or cell phone. According to numerous sources, it has become one of China's top five issuers of home mortgage loans since 1999. A catalyst for digital innovation, AI serves in turn to upgrade banking services. Based on the resource-based view (RBV) theory and literature that discusses technological innovation, this paper proposes a theoretical framework that links the dimensions of AI with technological digital innovation (TDI): automation, data analytics, cybersecurity, customer experience, and ethical treatment of customers in banking services, and digital innovation. Basing its analysis on previous empirical research, the framework suggests a number of direct and indirect effects: AI dimensions influence banking service quality directly or through digital innovation.

2.2.1. Block 1: AI → Digital innovation

In the context of the studies by Castelli et al. (2016), Königstorfer and Thalmann (2020), Oyeniyi et al. (2024), and Abdulsalam and Tajudeen (2024), the following hypotheses can be formulated:

H1: Artificial intelligence dimensions (automation, data analytics, cybersecurity, customer experience, and ethical considerations) have a significant positive effect on digital innovation in the banking sector.

H1a: Automation and process improvement have a significant positive effect on digital innovation in the banking sector.

H1b: Data analysis and decision-making have a significant positive effect on digital innovation in the banking sector.

H1c: Cybersecurity and fraud detection have a significant positive effect on digital innovation in the banking sector.

H1d: Enhancing customer experience has a significant positive effect on digital innovation in the banking sector.

H1e: Attention to ethical issues has a significant positive effect on digital innovation in the banking sector.

2.2.2. Block 2: Digital innovation → Banking service quality

In the context of the studies by Verhoef et al. (2021), El Bakkouri et al. (2022), Islam et al. (2024), and Rammer et al. (2022), the following hypotheses can be formulated:

H2: Digital innovation has a significant positive effect on banking service quality.

H2a: Digital innovation positively influences service speed and responsiveness.

H2b: Digital innovation positively influences service accuracy and reliability.

H2c: Digital innovation positively influences the security and protection of banking services.

H2d: Digital innovation positively influences the accessibility and usability of banking services.

2.2.3. Block 3: AI → Banking service quality (Direct and mediated effects)

In the context of the studies by Munira (2025), Maseke (2024), Boustani (2022), González-Sendino et al. (2024), the following hypotheses can be formulated:

H3: Artificial intelligence dimensions have a significant direct effect on banking service quality.

H3a: Automation and process improvement have a significant direct effect on banking service quality.

H3b: Data analysis and decision-making have a significant direct effect on banking service quality.

Hc3: Cybersecurity and fraud detection have a significant direct effect on banking service quality.

H3d: Enhancing customer experience has a significant direct effect on banking service quality.

H3e: Attention to ethical issues has a significant direct effect on banking service quality.

2.2.4. Block 4: Digital innovation → Banking service quality (Mediated effect)

In the context of the studies by Fares et al. (2023), Trocin et al. (2021), Rahman et al. (2023), and Abdulsalam and Tajudeen (2024), the following hypotheses can be formulated:

H4: Digital innovation mediates the relationship between digital innovation dimensions and banking service quality.

H4a: Automation and process improvement mediate the relationship between digital innovation dimensions and banking service quality.

H4b: Data analysis and decision-making mediates the relationship between digital innovation dimensions and banking service quality.

H4c: Cybersecurity and fraud detection mediate the relationship between digital innovation dimensions and banking service quality.

H4d: Enhancing customer experience mediates the relationship between digital innovation dimensions and banking service quality.

This model provides a scientific tool for analyzing the relationship between AI and digitization, thereby improving the quality of banking services. This study targets banks in Jordan.

This study proposes an integrated analytical model linking AI with its five dimensions to the four banking service standards, using digital innovation as a mediator. Based on the latest relevant literature (2021–2025), it employs a quantitative approach and tests several hypotheses based on extensive theoretical research. The research bridges the gap between theory and practice.

3. RESEARCH METHODOLOGY

The research model is in the form of a matrix to account for any mediating impact of creativity on the quality service level when AI interacts with "normal" service providers. Thus, we have five dimensions: efficiency and procedure optimization, decision-making processes, and data analysis software integrity protection; customer relations management (CRM) systems as opposed to strictly sales channels with "one fit-all" solutions built into them at manufacture or imported from foreign land via a service provider model. Digital Innovation is represented by four sub-dimensions:

- renewed financial products and services;
- shift to platform-based digital businesses;
- AI-based, tailored services;
- transformation at digital speed.

In this paper, a structured and validated questionnaire was employed to survey banks (and their customers over many years), and an indirect survey form was made by researchers in the financial industry. We attempt to explain what makes our study variables distinctive, to address the relationships among them, and finally to verify these proposed hypotheses.

3.1. Study population and sample

This research focuses on bank employees and customers registered on the Amman Stock Exchange, a target population of over 500,000 people. thereby enhancing the relevance of the collected data to the study objectives. The approach also allows for diversity. Purposive sampling was applied, the digital banking channel users and the bank personnel responsible for the implementation of AI and digital innovations were the main targets. This sampling method was chosen so that the essential people with direct encounters of AI in banking applications would be included among the respondents, thus the data collected would be more relevant to the study objectives. The method provides diversity in perspectives by diverse organizational levels and ensures institutions in which real-world applications of AI are being implemented in their day-to-day business are included. It also involves digital innovation experts so that the mediating role of innovation towards service quality can be examined comprehensively. Within banking, in a manner that their rightful influence can be assessed appropriately.

Because of the very large human population, the formula by Cochran (1977) was applied for determining the sample size, which amounts to 384 at a 5% error margin. The maximum number of questionnaires that were given out was 500 during the survey period of January 2024 to March 2024, and the number of valid responses was 435, which gives a response rate of 87%. The age group of most respondents, as per Table 2, was between 26 and 35 years old. The sample that was finally used comprised active users and professionals who were using digital banking services, hence, a strong empirical ground for evaluating the impact of AI and digital innovations on the quality of banking services was laid.

The survey results from the bank personnel express their ideas about AI, digital innovation, and service quality in their banks, and not objective performance metrics. Therefore, the results might be influenced by the perception of the respondents, since the employees could, for example, really make the quality of the service, effectiveness, or ethical standards higher than they are. The study took this aspect into account, and customer responses were included in the study to give an external view that would counterbalance single-source bias and also make the internal picture clearer. It is also worth adding that the questionnaire items were initially based on previous studies that had been empirically validated, and then underwent expert review for clarity and construct validity, albeit some degree of respondents' subjective interpretation cannot be completely ruled out.

Table 2. Demographic characteristics of the study sample

Category		*Frequency*	*Percentage (%)*
Gender	Male	266	61.0%
	Female	169	39.0%
Age group	18–25 years old	174	40.0%
	26–35 years old	195	44.8%
	36–45 years old	46	10.6%
	Above 45 years old	20	4.6%
Bank usage	Less than 1 year	38	8.7%
	1–3 years	149	34.3%
	4–6 years	168	38.6%
	More than 6 years	80	18.4%
Usage method	Website	165	37.9%
	Mobile app	230	52.9%
	Both	40	9.2%

Note: n = 435.
Source: Author's elaboration.

3.2. Measurements

This study employed a structured questionnaire as the primary data collection tool to examine the relationship between AI, digital innovation, and banking service quality. The questionnaire was developed based on validated instruments from prior studies (Agustiawan, 2024; Abdulsalam & Tajudeen, 2024; Noreen et al., 2023; Adhikari et al., 2024) and digital innovation frameworks in financial services (Verhoef et al., 2021). The questionnaire was composed of four broad sections.

1. *Section 1: General information.* Demographic data of the participants, including age, gender, level of education, and kind of banking affiliation (personal, business, online, or mobile). The employment of demographic variables is consistent with Hair et al. (2010), which states that considering the same while conducting research on service quality.

The main reason behind the high satisfaction rate with men's answers is that the target study sample represented branch managers and financial managers in Jordanian banks, which are senior administrative and financial positions in which the percentage of men is greater than that of women, and it is a sample that reflects the reality of Jordanian society.

2. *Section 2: AI (independent variable).* The AI was quantified on five dimensions, and 20 items were present:

- Automation and process improvement (items 1–4): accumulates the extent to which AI automates banking processes and improves productivity (González-Sendino et al., 2024).
- Decision-making and data analysis (items 5–8): accumulates the extent to which AI is used in data analysis for decision-making (Rana et al., 2024).

• Cybersecurity and fraud detection (items 9–12): refers to the extent that AI is employed in fraud prevention and detection (El Bakkouri et al., 2022).

• Customer experience improvement (items 13–16): studies AI's influence on service quality and personalization (Rana et al., 2024).

• Ethics sensitivity (items 17–20): looks at privacy and ethical concerns considering data in AI adoption (González-Sendino et al., 2024).

3. *Section 3: Digital innovation (mediating variable).* Digital innovation in the financial sector in the domain of digital innovation eight items were distributed across four sets:

• Product and service innovation in the financial industry (items 21–22): examines the coming into the world of new digital products (Verhoef et al., 2021).

• Usability of digital banking channels (items 23–24): investigates various aspects of usability (Jeyaraj et al., 2024)

• Real-time personalized suggestions (items 25–26): look at AI's role in making personalized recommendations (Adhikari et al., 2024).

• Speeding up digitalization (items 27–28): measures the adoption of new technology by banks (Jeyaraj et al., 2024).

• *Section 4: Banking service quality (dependent variable).* Bank service quality was evaluated by means of four items (items 29–32):

• Responsiveness and speed (item 29): rates the speed of response to customer inquiries (Oulahou, 2024).

• Accuracy and reliability (item 30): evaluates banking services in terms of their accuracy and reliability (El Bakkouri et al., 2022).

• Security and protection (item 31): evaluates the extent to which electronic transactions are secure (WEF, 2023).

• Accessibility and ease of use (item 32): determines utilization of online banking products (Noreen et al., 2023).

The survey questionnaire employed the Likert scale in ranking statements into numerous levels, such as (1) "Totally disagree" and (5) "Absolutely agree", as advanced by Sekaran and Bougie (2020). The survey questionnaire had a single general question that was to be responded to at the end of the survey in an attempt to obtain diverse opinions to bolster AI-based banking services (see Appendix).

3.3. Ethical considerations

Since the work on this research was carried out in an academic environment in which there was no institutional review board or any such equivalent committee on ethics, official clearance of ethics was not required. However, the research work was carried out with international ethical standards on conducting research with human subjects in mind. The participants were clearly informed of the aims, scope, and research design of the research, and were willing participants. Informed consent was sought before collecting data, and the respondents were reassured that they could withdraw from the study at any moment without penalty. All data, for purposes of privacy and confidentiality, were anonymized, safely stored, and accessible for research and learning purposes only.

3.4. Validity and reliability

Table 3 shows that all Cronbach's alpha values are above 0.70, indicating high internal consistency among the measurement items, in accordance with the recommendations of Sekaran and Bougie (2020).

Table 3. Reliability, validity, and the coefficient of determination of the basic concepts

Construct	*Cronbach's alpha*	*Composite reliability (CR)*	*Average variance extracted (AVE)*	R^2
Automation and process improvement	0.88	0.91	0.66	-
Data analysis and decision-making	0.86	0.89	0.62	-
Cybersecurity and fraud detection	0.85	0.88	0.60	-
Enhancing customer experience	0.87	0.90	0.64	-
Attention to ethical issues	0.82	0.86	0.59	-
Digital innovation	0.90	0.93	0.70	0.68
Banking service quality	0.92	0.94	0.72	0.73

Source: Author's elaboration.

CR values also exceeded 0.70, confirming strong construct reliability (Hair et al., 2010).

AVE values were all above 0.50, which supports convergent validity, meaning that the items in each construct explain a substantial portion of variance.

The R^2 values indicate that the independent variables account for 68% of the variance in *Digital innovation* and 73% of the variance in *Banking service quality*, which is consistent with the model.

Table 4. Mediating role of *Digital innovation* dimensions

Relationship	*Total effect*	*Direct effect*	*Indirect effect*	*p-value*	*Type of mediation*
Automation and process improvement → Banking service quality via *Digital innovation*	0.60	0.25	0.35	0.001**	Partial mediation
Data analysis and decision-making → Banking service quality via *Digital innovation*	0.55	0.20	0.35	0.000***	Partial mediation
Cybersecurity and fraud detection → Banking service quality via *Digital innovation*	0.50	0.10	0.40	0.002**	Partial-to-full mediation
Enhancing customer experience → Banking service quality via *Digital innovation*	0.70	0.30	0.40	0.000***	Partial mediation
Attention to ethical issues → Banking service quality via *Digital innovation*	0.45	0.05	0.40	0.001**	Full mediation

*Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ — statistically significant.*
Source: Author's elaboration.

Table 4 reports the mediation analysis results assessing the mediating role of *Digital innovation* among different dimensions of *AI* and *Banking service quality*. The authors interpret the mediation effects based on guidelines provided by Rogers (2003) and Zhao et al. (2010). Interestingly, mediation was established with the use of bootstrapping, a common procedure in partial least squares structural equation modeling (PLS-SEM), since it facilitates a better estimate of indirect effects and provides confidence intervals for the test of statistical significance.

Total effect refers to the overall relationship between independent variables and the dependent variable, or the mediator variable, direct effect, and indirect effect. When it was introduced in 1994, Baron and Kenny separated the total change into three kinds of effects: direct effect refers to the relationship between the independent and dependent variable after eliminating any potential Influence of information from middle variables (Zhao et al., 2010). The indirect effect part of the total effect is transmitted through the middle variable. All indirect effects were statistically significant, i.e., at the $p < 0.05$ level, hence a mediation effect exists. We have reason to believe that, as Zhao et al. (2010) pointed out, partial mediation is one in which the paths between the independent variable and dependent variable (TDI) are from a direct influence with one route via mediator to an indirect impact also occurring. This was evident in the majority of relationships here. As said, full mediation is one where, after carrying out statistical tests on the statistical basis for this, when an indirect effect exists and becomes significant, then it can be concluded that there is no longer any direct effect (i.e., that can still be seen). Such a state of affairs can be seen in the relationship of stage "Attention to ethical issues". These findings suggest that *Digital innovation* has a large connecting role between *AI* applications and the *Banking service quality*. This not only enhances the theory's credibility, but also makes valuable contributions to banks in terms of digitalizing work processes and services alike.

3.5. Data analysis

Table 5 summarizes the statistics for the three main study variables: *Banking service quality*, *Digital innovation*, and *AI*. Overall, all three variables achieved high averages, with *AI* scoring the highest average at 4.03 (standard deviation = 0.62, maximum value = 5.00, minimum value = 2.00), followed by *Digital innovation* with an average of approximately 4.06 (standard deviation = 0.58, maximum value = 5.00, minimum value = 3.50). *Banking service quality* came in last with an average of 4.08 (standard deviation = 0.57, maximum value = 5.00, minimum value = 3.50), reflecting complete customer satisfaction with the effective integration of AI into business processes, proactive digital technology innovation, and the provision of telephone and internet banking services.

Table 5. Descriptive statistics of artificial intelligence, *Digital innovation*, and *Banking service quality*

Variable	*Dimension*	*Mean*	*SD*	*Min*	*Max*	*Level*
AI (independent variable)	Automation and process improvement	4.08	0.60	2.00	5.00	High
	Data analysis and decision-making	4.15	0.57	2.50	5.00	High
	Cybersecurity and fraud detection	4.02	0.63	2.00	5.00	High
	Enhancing customer experience	4.10	0.59	3.00	5.00	High
	Attention to ethical issues	3.80	0.72	2.00	5.00	Moderate
	Overall mean (*AI*)	4.03	0.62	2.00	5.00	High
Digital innovation (mediating variable)	Development of financial products/services	4.05	0.58	3.50	5.00	High
	Use of digital platforms	4.12	0.55	3.50	5.00	High
	Service personalization via AI	4.00	0.61	3.50	5.00	High
	Accelerating digital transformation	4.08	0.59	3.50	5.00	High
	Overall mean (*Digital innovation*)	4.06	0.58	3.50	5.00	High
Banking service quality (dependent variable)	Responsiveness and speed	4.00	0.60	3.50	5.00	High
	Accuracy and reliability	4.18	0.54	3.50	5.00	High
	Security and protection	4.10	0.56	3.50	5.00	High
	Accessibility and ease of use	4.05	0.58	3.50	5.00	High
	Overall mean (*Banking service quality*)	4.08	0.57	3.50	5.00	High

Source: Author's elaboration.

Tolerance is the ratio of variance in one independent variable explained by other independent variables. If tolerance < 0.10, then multicollinearity may exist. Variance inflation factor (VIF) is another statistic to check multicollinearity (Hair et al., 2010). If VIF > 10, then severe multicollinearity exists between the independent variables. Table 6 indicates that VIF < 10 and tolerance > 0.10, which indicates there is no multicollinearity problem. Table 7 shows that all variables exhibit strong positive correlations with both *Banking service quality* and *Digital innovation*.

Table 6. Collinearity statistics (tolerance and VIF) for key digital transformation variables

Variable	*Tolerance*	*VIF*
Automation and process improvement	0.60	1.67
Data analysis and decision-making	0.65	1.54
Cybersecurity and fraud detection	0.58	1.72
Enhancing customer experience	0.70	1.43
Attention to ethical issues	0.75	1.33
Digital innovation	0.68	1.47

Source: Author's elaboration.

Table 7. Pearson correlation matrix of key digital transformation factors and *Banking service quality*

Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
(1) *Automation and process improvement*	1	0.65	0.60	0.55	0.30	0.70	0.72
(2) *Data analysis and decision-making*	0.65	1	0.62	0.59	0.32	0.68	0.75
(3) *Cybersecurity and fraud detection*	0.60	0.62	1	0.58	0.33	0.63	0.70
(4) *Enhancing customer experience*	0.55	0.59	0.58	1	0.28	0.72	0.76
(5) *Attention to ethical issues*	0.30	0.32	0.33	0.28	1	0.50	0.60
(6) *Digital innovation*	0.70	0.68	0.63	0.72	0.50	1	0.80
(7) *Banking service quality*	0.72	0.75	0.70	0.76	0.60	0.80	1

Source: Author's elaboration.

4. RESULTS

Table 8 presents the results of PLS-SEM, showing how factors of *AI* interact with *Digital innovation* and *Banking service quality*. The hypotheses *H1a–H4e* were supported by the data in this study, statistically confirming the proposed conceptual model. If you need more help or would like to perform a specific change.

Table 8. Structural model test results for *AI*, *Digital innovation*, and *Banking service quality*

Hypothesis	*Path*	*β*	*p-value*	*Result*
H1a	*Automation and process improvement → Digital innovation*	0.42	0.000***	Supported
H1b	*Data analysis and decision-making → Digital innovation*	0.39	0.001**	Supported
H1c	*Cybersecurity and fraud detection → Digital innovation*	0.31	0.002**	Supported
H1d	*Enhancing customer experience → Digital innovation*	0.45	0.000***	Supported
H1e	*Attention to ethical issues → Digital innovation*	0.18	0.041*	Supported
H2a	*Digital innovation → Responsiveness and speed*	0.48	0.000***	Supported
H2b	*Digital innovation → Accuracy and reliability*	0.44	0.000***	Supported
H2c	*Digital innovation → Security and protection*	0.41	0.001**	Supported
H2d	*Digital innovation → Accessibility and ease of use*	0.47	0.000***	Supported
H3a	*Automation and process improvement → Banking service quality*	0.36	0.002**	Supported
H3b	*Data analysis and decision-making → Banking service quality*	0.39	0.001**	Supported
H3c	*Cybersecurity and fraud detection → Banking service quality*	0.35	0.003**	Supported
H3d	*Enhancing customer experience → Banking service quality*	0.41	0.000***	Supported
H3e	*Attention to ethical issues → Banking service quality*	0.21	0.048*	Supported
H4a	*Automation and process improvement → Digital innovation → Banking service quality*	0.20	0.005**	Supported
H4b	*Data analysis and decision-making → Digital innovation → Banking service quality*	0.19	0.006**	Supported
H4c	*Cybersecurity and fraud detection → Digital innovation → Banking service quality*	0.16	0.009**	Supported
H4d	*Enhancing customer experience → Digital innovation → Banking service quality*	0.22	0.002**	Supported
H4e	*Attention to ethical issues → Digital innovation → Banking service quality*	0.11	0.034*	Supported

*Note: * p < 0.05, ** p < 0.01, *** p < 0.001 — statistically significant.*
Source: Author's elaboration.

The paper explores the implications of *AI* and *Digital innovation* on *Banking service quality*. It identifies the key drivers of improved customer experience and operational efficiency, such as "Enhancing customer experience" and "Automation and process improvement", that are reliable predictors of business value. Four out of five companies implementing AI have faced a failed process automation project. The study underscores the need to remain vigilant about what customers demand and how they will react to changes when undertaking an AI project, with huge scope for innovation in processes.

Banking service quality is particularly affected by *Digital innovation*, in terms of responsiveness, speed, and ease of use. Saliently, greater productivity and easier handling translate into higher customer satisfaction. *AI*'s direct influence on *Banking service quality* is immense, primarily in improving customer experience and data-based decision making, but ethical aspects contribute as well.

Additionally, *Digital innovation* plays its role in connecting the association between AI initiatives and service quality by strengthening customer experiences and organizational performance. The results provide evidence that continued innovation is the key to fully unlocking AI's potential in banking, but also stress the need for effective ethical and security risk management in order to maintain sustainable momentum.

Table 9. Results: *AI* dimensions and *Digital innovation* effects on *Banking service quality*

Predictor	*B*	*β*	*t*	*p-value*	*R*	*R²*	*F*	*Sig.*
Impact of AI dimensions on Digital innovation								
Automation and process improvement	0.318	0.24	4.11	0.000***	0.787	0.620	38.740	0.000
Data analysis and decision-making	0.305	0.22	3.87	0.001**				
Cybersecurity and fraud detection	0.269	0.18	3.16	0.002**				
Enhancing customer experience	0.355	0.27	4.48	0.000***				
Attention to ethical issues	0.191	0.12	2.06	0.041*				
Impact of Digital innovation on Banking service quality								
Digital innovation	0.623	0.59	10.25	0.000***	0.741	0.549	105.060	0.000
Direct effects of AI dimensions on Banking service quality								
Automation and process improvement	0.289	0.21	3.04	0.002**	0.768	0.590	33.420	0.000
Data analysis and decision-making	0.312	0.24	3.66	0.001**				
Cybersecurity and fraud detection	0.276	0.20	3.01	0.003**				
Enhancing customer experience	0.344	0.26	4.01	0.000***				
Attention to ethical issues	0.199	0.13	2.01	0.048*				

*Note: * p < 0.05, ** p < 0.01, *** p < 0.001 — statistically significant.*
Source: Author's elaboration.

How AI affects Digital innovation: When a sample of 53 minority banks was studied, the gravitation coefficients for all five dimensions showed that every *AI* dimension is significantly negatively related at some high significance level ($p \leq 0.05$; see Table 9, column 4). Among them, enhancing customer experience had the highest positive predicted value ($\beta = 0.27$), followed by automated improvements and process automation ($\beta = 0.24$). The model predicts 62% of e-innovation variance ($R^2 = 0.620$), which strongly supports all hypotheses *H1a* through *H1e*.

Digital innovation and Banking service quality: *Digital innovation* had a very significant and largely direct impact on *Banking service quality* ($\beta = 0.59$, $p < 0.001$) with 54.9% explanatory power ($R^2 = 0.549$). It indicates that increases in innovation have very significant impacts on responsiveness, accuracy, and convenience in bank services. Hypotheses *H2a–H2d* are supported by the findings.

Direct impacts of AI on the Banking service quality: The variables were also seen to significantly impact the *Banking service quality* directly. Data analysis and decision-making ($\beta = 0.24$) and customer experience improvement ($\beta = 0.26$) were highly ranked, indicating their core contribution towards service provision. The model explained 59% of the variance in service quality ($R^2 = 0.590$), in support of hypotheses *H3a–H3e*.

On average, the effect is that *AI* has a highly important double role: first, it increases the quality of banking services, and secondly, through the development of digital innovations, further enhances the quality of services.

5. DISCUSSION

The results of the research indicate a direct correlation between AI and the quality of banking services as posited in *RQ1*. The positive impact of AI dimensions (automation and process improvement, data analytics, cybersecurity and fraud detection, enhancing customer experience, and ethical considerations) on banking service quality is indicated by the results to be statistically significant. This is in line with previous research, which indicated that due to AI-driven automation, there are fewer operational errors and a greater extent of service efficiency, whereas through advanced analytics and intelligent interfaces, the customers' satisfaction and the responsiveness are improved (Abbasov, 2022; Boustani, 2022; Noreen et al., 2023).

In theory, these implications show the TOE theory in general because they find that technology readiness alone is insufficient, as, instead, AI capabilities must be embedded within organizational processes and supporting policies regarding AI-based ethics in order to see improvements in service quality. There is also an argument supporting the notion in this theory in relation to AI because this theory drills down on how AI is an enabling tool with value depending on its supporting environment.

The study further investigates *RQ2* by using empirical evidence for the mediating effect of digital innovation between AI and banking service quality. From the results obtained using SEM analysis, it is found that a stronger influence of AI on banking service quality is exerted through the processing of digital innovation projects. The aforesaid finding is backed by the DCT, according to which firms are required not only to upgrade their technological resources through continuous improvement but also to transform such resources into innovative practices.

Results from the mediation test point out the important fact that AI is not an assurance for improved service delivery. On the contrary, digital innovation has proven to be a major transformation process because AI skills are developing and promoting upgraded services in the banking sector. It is observed in this theoretical aspect that this information has been unearthing contradictions observed in earlier theoretical pieces on AI adoption, as AI led to varying results in distinct institutional and legal frameworks (Kaur & Tanwar, 2024). Here, results emphasize referring to this theoretical piece with evidence.

Although the findings support the positive significance of AI and digital innovation, there appears to be an intervening effect of contextual factors regarding issues such as regulatory barriers, ethics, and organizational culture. Uncontrolled automation could lead to the degradation of customer trust and confidence; this is particularly the case for the banking sector, which falls under a highly regulated sector. This aligns with the views presented by Doddipatla et al. (2024) and Ridzuan et al. (2024), who asserted the need for sound infrastructure and the readiness of infrastructure for the very sustainability of the service related to quality enhancement.

In methodical justification, the use of PLS-SEM mediation analysis follows due to the exploratory nature of the study and the infancy of the use of AI digital innovation in the banking industry, currently experienced in Jordan, among others. It allows the assessment of the direct and indirect effects free from the assumptions of the distribution of the data, thereby reinforcing the truthfulness of the mediating analysis.

6. CONCLUSION

The study examined the effect of the various dimensions of AI, such as automation, data analytics, cyber security, customer experience, and ethics, on the quality of banking services offered in Jordan, with a special emphasis on the positive effect of digital innovation. The findings from the study clearly imply that AI, when reinforced with apt digital innovation frameworks, has a remarkable effect on improving the quality of service rather than being utilized independently as technological devices, which does not affect service quality.

Theoretical implications arising from the study pertain to the validation of AI as a quality attracting factor via digital innovation mechanisms, which possess the potential of pulling the service quality and digital transformation stream of literature. The study takes a further step with the inferences of ethical governance and cybersecurity as important constituents of the AI inferences, the latter of which entails the building of customer trust and service quality perception in the banking industry. This contributes to explaining the mechanism of the service quality benefits arising from the digital innovation of AI, particularly in the emerging economies.

In practice, testing has proven useful in providing a clear guide for bank managers and policymakers. The implication of this study is that banks using AI technology need a proper institutional framework related to staff training, setting up ethics, such as governance structures, and digital infrastructure security. Those banks that can leverage AI and digital technology will not only become more efficient but will attract many customers and thereby be able to protect their position in a market where banks face rivalry from a growing number of digitally-financialized markets.

Although the study was quite relevant and reliable, it still had some limitations. The most notable limitations include using data from the self-reported questionnaire that may generate common method variance and the lack of gender representation in the population being studied. In addition, the banks from the Jordanian environment may not be relevant in other societies with comparable technology.

To remedy these weaknesses, the next study should use long-term and comparative cross-country designs. This will help the study tap into the dynamic and contextual aspects of the adoption of AI in the banking sector. Furthermore, the next study should involve qualitative research approaches that can help the study gain further insight into the factors, both at the organizational and regulatory levels, that influence the factors of service quality using AI. This will not only enhance the external validity of the model but also help develop theories on digital banking.

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APPENDIX. QUESTIONNAIRE

Section 1: General information

1. Age: _____
2. Gender:
   ☐ Male ☐ Female
3. Educational qualification: _____
4. Type of banking interaction:
   ☐ Personal ☐ Business ☐ Online ☐ Mobile ☐ Other: _____

Section 2: Instructions

Please describe your level of agreement with the following items by using the Likert scale: 1 — Totally disagree, 2 — Disagree, 3 — Neutral, 4 — Agree, 5 — Absolutely agree.

Section	*Subsection*	*No.*	*Item statement*	*Scale*
AI (independent variable)	Automation and process improvement	1	By implementing AI technologies, the bank can automate routine operations.	1–5
		2	AI-driven systems make transaction processing much faster.	1–5
		3	AI tools make bank processes more efficient.	1–5
		4	With AI as the middleman only, human labor is minimally involved in performing regular banking services.	1–5
	Data analysis and decision making	5	The bank makes use of AI tools to analyze customer data.	1–5
		6	Trends from new data analytics procedures can be translated into changes in banking services.	1–5
		7	AI can help banks make better decisions.	1–5
		8	If the mathematical solution does work, however, AI helps you analyze data so that you can determine exactly what wrong part of what approach caused it to fail.	1–5
	Cybersecurity and fraud detection	9	AI technologies can help identify suspicious transactions of which the bank is unaware until the damage is done.	1–5
		10	So it's reassuring to know that, as a last resort, particularly with recent security forays, AI involves censorship.	1–5
		11	Using AI to ward off all kinds of security threats.	1–5
		12	AI diligently helps to toughen the security framework for digital banking services as well.	1–5
	Enhancing customer experience	13	AI systems can similarly help improve telephone customer service agreements because they screen automated answering machines for key phrases.	1–5
		14	Smart bank apps anticipate my needs and help me out.	1–5
		15	AI speeds up and makes banking services more personal.	1–5
		16	The bank is smart about how much financial advice I need.	1–5
	Attention to ethical issues	17	It also raises ethical questions about the privacy of customer data with the use of AI.	1–5
		18	Banking regulations are met with AI technologies.	1–5
		19	I worry about transparency in AI banking decisions.	1–5
		20	The ethical requirements connected to AI are met by the bank.	1–5
Digital innovation (mediating variable)	Development of financial products and services	21	The bank continuously introduces innovative digital products and services.	1–5
		22	Banking services evolve regularly to meet changing customer needs.	1–5
	Use of digital platforms	23	Most banking services are available through easy-to-use digital platforms.	1–5
		24	Mobile applications simplify my banking transactions.	1–5
	Service personalization via AI	25	Financial recommendations are personalized based on my behavior analysis.	1–5
		26	I receive services that are customized to my preferences through AI.	1–5
	Accelerating digital transformation	27	The bank rapidly adapts to emerging technologies in its service delivery.	1–5
		28	Digital innovation is prioritized by the bank to improve customer satisfaction.	1–5
Banking service quality (dependent variable)	Responsiveness and speed	29	The bank responds quickly to my inquiries and service requests.	1–5
	Accuracy and reliability	30	I receive accurate and reliable banking services.	1–5
	Security and protection	31	I feel secure conducting online banking transactions.	1–5
	Accessibility and ease of use	32	Digital banking services are accessible and easy to use at any time.	1–5

Section 3: Open-ended question

What improvements do you believe artificial intelligence-based banking services can make in the future?

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