



# The Impact of Artificial Intelligence Applications on Financial Services quality and Financial Performance: Evidence from the Egyptian Bank Sector

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## Abstract:

The present study aimed to examine the impact of Artificial Intelligence (AI) applications (Expert Systems, Genetic Algorithms, Artificial Neural Networks, Intelligent Agents) on Financial Services quality dimensions (Tangibility, Reliability, Responsiveness, Assurance, Empathy) and Financial Performance in the Egyptian bank sector. The researchers designed a questionnaire to collect data from the research sample which represented in (384) managers from the Egyptian bank sector. The researchers used an online survey through a snowball sample. Data was analyzed by SEM (structural equation modeling) using Smart PLS 4.0 and IBM SPSS 26 software.

The results found that AI applications affect financial services quality except there is no significant effect of Artificial Neural Networks on Tangibility and Reliability. Besides, there wasn't any significant effect of Intelligent Agents on Responsiveness, Thus, H1 was partially supported. Moreover, the results illustrated that AI applications affect the financial performance of the Egyptian bank sector. Therefore, H2 was supported.

**Keywords:** Artificial Intelligence, Financial Services quality, Financial Performance

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## I. Introduction

The world is witnessing a tremendous development in technology, artificial intelligence (AI) is at the forefront of this development thanks to its ability to promote innovation and efficiency in various fields (Murugan et al.,2025). Artificial intelligence is smart and useful technology that helps business organizations accomplish their work efficiently and quickly by providing a large amount of high-quality data, as artificial intelligence is a process of developing computer systems as a simulation of human intelligence (Bankar & Shukla, 2023).

The advent of Artificial Intelligence (AI) has transformed various sectors, with financial services being no exception. The banking sector, especially in emerging markets like Egypt, is experiencing a paradigm shift in operational and strategic frameworks due to AI technologies. The integration of AI in financial services can optimize processes such as risk assessment, customer relationship management, and fraud detection (Feng et al., 2021).

Artificial intelligence (AI) has emerged as a disruptive technology with significant potential to revolutionize banking and financial services. AI-powered chatbots and virtual assistants are rapidly transforming the banking and financial services industry, offering a cost-effective and efficient way to handle customer queries, complaints, and inquiries. These chatbots and virtual assistants use natural language processing (NLP) and machine learning algorithms to understand customer requests, offer personalized solutions, and perform tasks like money transfers, balance inquiries, and account opening. These applications not only reduce wait times but also improve the overall customer experience by offering personalized and targeted solutions. Second, AI-based chatbots can handle a high volume of customer requests simultaneously, providing a seamless and frictionless customer experience. In addition, they are available 24/7, eliminating the need for customers to wait for business hours to get their queries resolved. Third, they can reduce operational costs for banks, as they require less staff to handle customer inquiries. This chapter aims to explore, analyze, understand, and compare

the existing machine learning and NLP techniques that enhance the operational capability of the AI-based chatbots in the banking and financial services (Polireddi, 2024).

Recent literature highlights the growing importance of AI in the financial services sector. AI-enabled tools, such as machine learning algorithms and natural language processing, have demonstrated significant potential in improving decision-making processes and operational efficiency (Brynjolfsson & McAfee, 2017). In the context of the Egyptian banking sector, previous studies have suggested that AI could enhance risk management practices by allowing for more accurate credit assessments and fraud detection. However, there remains a scarcity of empirical research specifically examining the impact of AI on financial performance metrics in this region (Sardar, 2024).

The financial services industry is a cornerstone of the global economy, encompassing a broad range of sectors including banking, insurance, investment management, and financial markets (Criado & Gil-Garcia, 2019). Its primary functions involve managing financial transactions, investments, and risk, and providing services such as loans, savings, and investment products to individuals and businesses (Javaid, 2024).

Financial performance is a paramount aspect of any organization, serving as a key indicator of its operational success and financial stability. It reflects how effectively a company utilizes its resources to generate revenue, manage costs, and ultimately, create profit. An assessment of financial performance is often conducted through the analysis of various financial statements, including the income statement, balance sheet, and cash flow statement. These documents provide vital information that stakeholders—such as investors, management, and creditors—use to evaluate a company's profitability, liquidity, and overall financial health (Gordon & Nallareddy, 2018). As the Egyptian banking sector continues to evolve, understanding the impact of AI on financial performance becomes increasingly important. This study investigates this relationship, aiming to contribute valuable insights into how AI can enhance banking outcomes in Egypt.

Based on the above, the current paper will present the following sections: Literature Review, hypotheses development, research objectives, methodology, results, discussion, conclusion, implications, limitations and future research.

## **II. Literature Review**

### **Artificial Intelligence (AI):**

Babina et al., (2024) defined artificial intelligence (AI) as the development of computer systems that can perform tasks that normally require human intelligence. These tasks include learning, reasoning, problem solving, understanding natural language, and perceiving and interacting with the environment. AI systems are designed to simulate cognitive functions such as learning from data, adapting to new information.

Parekh & Olivia, (2024) defined it as a system created with advanced technology or a computer system that can understand and simulate human intellectual abilities in different ways. It is a computer system that can simplify and complete many human work professions. Developing computer systems capable of performing tasks usually requires human intelligence, such as speech recognition, language translation, visual perception, and decision-making, which constitutes artificial intelligence.

Previous studies used several dimensions for AI. In this study, the researchers used the most appropriate dimensions for bank sector, these dimensions can be mentioned as follows:

1. **Expert Systems:** They are complex computer systems that collect specialized information in only one field of human knowledge and prepare it in a form that allows the computer to apply that information to similar cases. They are the mainstay of learning systems based on artificial intelligence, as they simulate the procedures of experts in dealing with and solving complex problems. The main purpose of the expert system is to assist and support the learner's thinking process rather than providing information to the learner, as it allows learners to practice their skills in an interactive educational environment by answering questions, providing guidance and advice, and finding solutions to educational problems (Beta & Astuti, 2024).
2. **Genetic Algorithms:** One of the artificial intelligence applications that helps solve complex problems, so, it's a method for solving both constrained and unconstrained optimization problems that is based on natural selection, the process that drives biological evolution (Li et al., 2023).
3. **Artificial Neural Networks:** It is a data processing system based on mathematical models that can perform certain tasks in a manner similar to biological neural networks in humans (Yang et al., 2023).
4. **Intelligent Agents:** It is based on the knowledge contained within reliable, computer-based information systems that are intelligent and effective (Rahman et al., 2023).

### **Banking financial services quality:**

The financial services sector is changing as a result of artificial intelligence (AI), especially in the field of digital banking. AI is helping banks to provide customized experiences, reorganize processes, and cut costs because of its capacity to analyze enormous volumes of data and make precise predictions (Varma, 2021).

Scholars define e-banking in various ways. According to Salehi et al. (2008), e-Banking is an electronic connection between banks and clients to prepare, manage, and control financial transactions. For Timothy (2012), e-Banking refers to using a remote conveyance used by customers to access a bank account, transfer funds and make payments. As a generic term, Abid and Noreen (2006) and Awara and Anyadighibe (2014), describe e-Banking as the provision of retail banking services via electronic channels as well as a large value electronic payment and other wholesale banking services delivered electronically.

E-banking, according to Mohamud (2017), is a type of distance banking that handles not only the flow of information between customers' "living spaces" and the bank's physical facilities, but also solicitation, sales, distribution, and service access, all without requiring the customer and the financial institution representative to be in the same physical location at the same time. Most electronic business experts agree that E-banking provides access to all types of financial transactions 24 h a day, 7 days a week, through any advanced information system (Automated Teller Machines, Personal Computers, Internet, mobile phones, etc.) and for all types of financial transactions (Mohamud,2017).

Mukhtar et al., (2014) and Ayinaddis et al., (2023) stated that banking service quality has five dimensions can be mentioned as follows:

1. **Tangibility:** Tangibles in the services sector are meant by physical facilities facilitating the process of service provision. Branch related issues like safety, convenience, access to facility are tangibles. Appearance of personals, physical facilities and equipment are knowing as tangibles (Ayinaddis et al., 2023). Tangibles comprises of employees, materials, facilities and equipment that have direct relationship with the customer services (Mukhtar et al., 2014).
2. **Reliability:** It can be defined as the firms perform their service at the right time when they promised to give services to their customers. It is included in accuracy of all the functions which are performed by any firm or banks like check records properly, billing and provide services at the exact time when it is recorded. Reliability includes many factors, maintain error-free records of the bank and finally solve the problems of customers related to services provided. It is very important dimension of service in conventional sectors (Tetteh, 2022). Reliability includes security, privacy and assurance. Security is actually a freedom from the doubts, risks and dangers like financial security and physical safety etc. It is a very important dimension of services of banks. Online banking is more concerned about the security of customers. Banks introduce different methods to secure the data of customers. In online banking, customers are more careful for their transactions. Financial transactions of customers are very important for the online banking services. If security is not involved, then customer satisfaction increases towards online banking services. No one can ignore the importance of security in online banking. Every customer is cautious about the security of monetary transactions (Ayinaddis et al., 2023).
3. **Responsiveness:** Responsiveness apprehensions the willingness of employees to make available a service in such a way as; sending a transaction slip instantly, speedy mortgage conformation, updating accounts on time (Adeoye & Lawanson, 2012). Responsiveness has been considered as an important factor. Determinations to enhance speed of processing information and a customer is assuming to have a positive influence on customer satisfaction in banking. (Mukhtar et al., 2014), stresses that when a customer has a demand, meet it, be easily offered and available to customer. Customers in general suppose early responds to their demands immediately, because they do not want to wait for long time. If a bank fails to provide service to a customer at certain time, it can recover this failure by providing prompt services in professional way (Adeoye & Lawanson, 2012)
4. **Assurance:** Assurance means building confidence and trust in customers towards financial services of banks. Banks assure their customers that their employees are trustworthy, knowledgeable and loyal with their institute. Employees are very friendly and cooperative towards customer's complaints and try to resolve them. There are some ways by which customers can agree on the services of banks like; by providing each and everything clear in the annual reports of banks included background, mission, vision, mission statements, private data handling and revenues of banks (Gounaris et al., 2010).
5. **Empathy:** Empathy is about the personal attention extra care and better understanding toward customers. And show them they are special and important by showing kindness, affection and looking them as close friends. So that customers feel special. It is the functional dimension of service quality. However, Empathy is all about entertain the customers in term of place, better communication and time. It also focuses on what type of services are providing to customers. In empathy employee's gives attention and extra care to their customers that can increase the quality of services and customer feel special. This thing increases customer loyalty and customer satisfaction. To satisfy the customer's need management should improve service

quality like through empathy. Organization must pay attention to the customer objections (Mukhtar et al., 2014).

**Financial performance:**

Financial performance is a comprehensive evaluation of a company's overall financial health and how well it is achieving its financial goals. It encompasses various aspects of a company's financial standing, including its ability to generate revenue, manage expenses, utilize assets efficiently, and maintain a healthy financial structure (Alatawi et al., 2023). (Ross et al., 2019) reported that strong financial performance is crucial for several reasons:

- Investor Confidence: Positive financial performance attracts investors and increases shareholder value.
- Creditworthiness: Good financial health improves a company's creditworthiness and access to financing.
- Decision-Making: Financial analysis helps management make informed decisions about resource allocation, strategic planning, and risk management.
- Operational Efficiency: Identifying areas of inefficiency and implementing improvements.

### **III. Hypotheses Development**

**AI applications and financial services quality:**

A growing body of research has explored the potential of AI to transform the financial services industry. Studies have demonstrated that AI can significantly improve the efficiency and accuracy of various financial processes. For instance, AI-powered chatbots and virtual assistants can provide round-the-clock customer support, reducing response times and enhancing customer satisfaction (Huang et al., 2019). Furthermore, AI algorithms can analyze vast amounts of data to detect fraudulent activities more effectively, mitigating financial losses (Bashir et al., 2020). (Herrmann & Masawi, 2022) stated that AI applications can enhance the quality of financial services of banks which are provided to customers.

(Rahman et al., 2023) found that adopting AI applications in banking services is an essential tool for bank services such as fraud detection and risk prevention. Banks can use AI in their financial services to enhance its quality (Cintamür, 2024). (Umamaheswari & Valarmathi, 2023) found that AI usage in banks can increase the financial services quality. Also, (Miglionico, 2019) stated that banking services can be more efficient through using AI applications. (Elegunde & Oladimeji, 2020) concluded that AI effect positively on service quality. Based on that the following hypothesis can be formulated:

**H1: There is a significant effect of AI applications on financial services quality.**

**AI applications and financial performance:**

One of the most significant areas where AI has impacted financial performance is in banking. Traditional banking processes have been slow, manual, and error-prone, leading to inefficiencies. AI-powered solutions such as chatbots, automated loan underwriting, and fraud detection systems have streamlined these operations (Agarwal & Sriram, 2017). Chatbots, for example, are capable of providing round-the-clock customer service, significantly improving customer satisfaction and reducing labor costs. AI algorithms are also employed for credit risk assessment, enabling banks to offer personalized lending options, improve loan approval rates, and reduce defaults (Gyau et al., 2024). (Baker et al., 2023) mentioned that financial technology can improve the financial performance, so, the study recommended that banks should be encouraged to adopt inclusive strategies to attain sustainable development.

Moreover, AI has been utilized for fraud detection and prevention. Machine learning algorithms can analyze vast amounts of transactional data in real time, detecting anomalies and preventing fraudulent activities before they occur. This reduces losses and improves overall financial performance. AI's predictive analytics capabilities also allow financial institutions to better understand consumer behavior, enabling them to create more targeted marketing strategies, increase customer acquisition rates, and boost revenue generation (Chakraborty, 2021).

(Gyau et al., 2024) found that AI influence positively on financial performance, moreover AI can enhance the financial performance. (Shiyyab et al., 2023) determined to what extent Jordanian banks refer to and use artificial intelligence (AI) technologies in their operation process and examines the impact of AI-related terms disclosure on financial performance. The results showed that AI affect positively financial performance

Based on that the following hypothesis can be formulated:

**H2: There is a significant effect of AI applications on financial performance.**

Based on the above theoretical discussions, the researchers developed a research model depicted in Figure1 as follows:

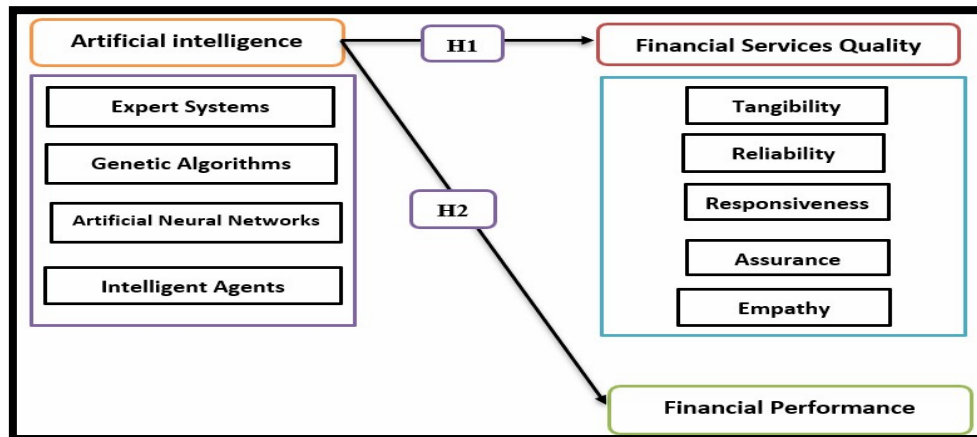


Figure 1: Research model

#### IV. Research Objectives

The researchers seek to achieve the following objectives:

1. Measuring the effect of AI Applications (Expert Systems, Genetic Algorithms, Artificial Neural Networks, Intelligent Agents) on financial services quality dimensions (Tangibility, Reliability, Responsiveness, Assurance, Empathy).
2. Exploring the effect of AI Applications (Expert Systems, Genetic Algorithms, Neural Networks, intelligent Agents) on Financial Performance.

#### V. Methodology

##### Survey measures

An online survey using questionnaires via google drive was adopted to collect data for research hypotheses testing. For measuring the research variables, the questionnaire included measures for every variable. The scale of (Beta & Astuti., 2024; Armutcu et al., 2024) was adopted to measure Artificial intelligence (AI) which included 20 items. As for measuring financial services quality, (Mukhtar et al., 2014; Ayinaddis et al., 2023) scales were used including 33 items. Finally, (Hernaus et al., 2012) scale was adopted to measure financial performance including 3 items ([Appendix 1](#)). Five-point Likert scale was used for measuring all variables' items ranging from 1 (strongly disagree) to 5 (strongly agree).

Convenience sampling was employed to determine the participants to receive the questionnaire, which was distributed through various communication channels, including email, social media platforms and other messaging applications. In the current study, a pilot test was conducted before starting the main questionnaire application. A pilot test plays an important role in questionnaire research processes as it improves the quality and effectiveness of the questionnaire (Armutcu et al., 2023). Teijlingen and Hundley (2002) point to the importance of pilot testing in ensuring/increasing the reliability and validity of the development of survey instruments and the data collection process. In this context, a pilot study was conducted on 50 participants to evaluate how valid and reliable the questionnaire is. The final form of the questionnaire was given based on the feedback received from the participants during the pilot study. A total of 341 questionnaires were collected from the participant, sufficient for structural equation modeling (Cohen, 1988; Westland, 2010; Tabachnick and Fidell, 2007; Kline, 2011). The questionnaire form used in the study was first translated into Arabic, then into English and again into Arabic by experts who are proficient in both languages. The participants were instructed to provide responses using a five-point Likert scale, with options ranging from 1 for "strongly disagree" to 5 for "strongly agree". The data collected were subsequently analyzed using Smart PLS4 and SPSS 26 statistical software.

##### Sampling technique

The research sample consisted of the employees of the Egyptian bank sector. A snowball sample approach was selected. 384 questionnaires were distributed to the managers of the Egyptian bank sector to collect data. 341 questionnaires were valid for statistical analysis and free of lost data were retrieved with a response rate of 88.8%.

## VI. Results

### 1. Descriptive Statistics:

Table 1: Summary of demographic profile of respondents

Demographic variables		Frequency	Valid Percent (%)
Gender	Male	209	61.3%
	Female	132	38.7%
Age	from 30 to less than 40 years	96	28.2%
	from 40 to less than 50 years	142	41.6%
	50 years and more	103	30.2%
Education level	Graduated	221	64.8%
	postgraduate	120	35.2%
Job level	Head of department	119	34.9%
	Department manager	131	38.4%
	Branch manager	91	26.7%
Experience Years	less than 10 years	89	26%
	from 10 to less than 15 years	143	42%
	15 years and more	109	32%

Source: From the results of statistical analysis

Table 1 indicates that 61.3% (209) of employees are male, while 38.7% (132 respondents) are female. Regarding employees' age, the highest percentage of them are 41.6% (142 respondents) in the age category (from 40 to less than 50 years), while the lowest percentage are 28.2% (96 respondents) in the age category (from 30 to less than 40).

In terms of education Level, about 35.2% (120 respondents) are postgraduate which represents the lowest percentage, the highest percentage of employees are 64.8% (221 respondents) located in the education level graduated. Regarding job level, the highest percentage of employees are 38.4% (131 respondents) which represents the category (Department manager), while the category (Branch manager) located in the lowest percentage by 26.7% (91 respondents).

Finally, according to experience years, the highest percentage of the sample is 42% (143 respondents) in the income category (from 10 to less than 15 years), while the lowest percentage of experience years category located in (less than 10 years) with a percentage 26% (89 respondents).

### 2. Measurement Model Assessment:

The structural equation model was relied upon to ensure the structural validity of the scale, in addition to ensuring the validity of the model before conducting the hypothesis test, by determining the reliability of the loading factors, calculating composite reliability (CR), Alpha Cronbach coefficient ( $\alpha$ ), measuring the convergent Validity and Discriminant Validity, moreover, calculating model fit indices.

Table 2: Mean, standard deviation, loading Factors, cronbach's Alpha, CR and AVE for all variables

Variables	Dimensions	Items	Loading Factor	Mean	S. D	$\alpha$	CR	AVE
Artificial Intelligence (AI)	Expert Systems	ES.1	0.703	3.93	0.642	0.841	0.849	0.724
		ES.2	0.632					
		ES.3	0.552					
		ES.4	0.662					
		ES.5	0.711					
	Genetic Algorithms	GA.1	0.556	4.08	0.533	0.826	0.831	0.716
		GA.2	0.574					
		GA.3	0.621					
		GA.4	0.608					
		GA.5	0.585					
	Artificial Neural Networks	AN.1	<b>0.341</b>	3.88	0.446	0.818	0.822	0.641
		AN.2	0.641					
		AN.3	0.529					
		AN.4	0.708					
		AN.5	0.686					
	Intelligent Agents	IA.1	0.677	4.02	0.722	0.804	0.811	0.687
		IA.2	<b>0.402</b>					
		IA.3	0.594					
		IA.4	0.642					
IA.5		0.714						
IA.6		0.707						
		TG.1	0.660	3.83	0.332	0.788	0.793	0.631
		TG.2	0.549					
		TG.3	<b>0.382</b>					

Financial Services Quality	Tangibility	TG.4	0.532	4.01	0.841	0.802	0.807	0.562
		TG.5	<b>0.411</b>					
		TG.6	0.588					
		TG.7	0.636					
	Reliability	RB.1	<b>0.291</b>	3.90	0.460	0.772	0.778	0.581
		RB.2	0.588					
		RB.3	0.646					
		RB.4	0.577					
		RB.5	0.599					
		RB.6	<b>0.242</b>					
		RB.7	0.525					
	Responsiveness	RS.1	0.712	3.80	0.649	0.751	0.758	0.608
		RS.2	0.706					
		RS.3	0.694					
		RS.4	0.680					
		RS.5	0.707					
	Assurance	AR.1	0.642	3.78	0.942	0.766	0.771	0.555
		AR.2	0.814					
		AR.3	0.726					
		AR.4	<b>0.362</b>					
		AR.5	0.584					
		AR.6	<b>0.406</b>					
		AR.7	0.546					
AR.8		0.550						
Empathy	EP.1	0.656	3.96	0.516	0.791	0.798	0.651	
	EP.2	0.548						
	EP.3	0.661						
	EP.4	<b>0.286</b>						
	EP.5	0.529						
	EP.6	0.514						
Financial Performance	FP.1	0.606	3.96	0.516	0.791	0.798	0.651	
	FP.2	0.718						
	FP.3	0.734						

Source: From the results of statistical analysis

As indicated in table 2, loading factors for all items were accepted due to their scores were higher than 0.50 except 9 items (AN.1, IA.2, TG.3, TG.5, RB.1, RB.6, AR.4, AR.6, EP.4) which were under 0.50, so, these items were deleted as shown by (Hair et al., 2014). CR and  $\alpha$  were estimated to identify the reliability of the internal consistency of the scale, by reading the results in this table, CR and  $\alpha$  values were reached the criteria of (Hair et al., 2014), the values were higher than 0.70, so all values were accepted for all research variables. Convergent validity was estimated by AVE which its value should be higher than 0.50 for all variables (Hair et al., 2014), as shown in the table, all values of AVE exceeded 0.50, so, all values were accepted. Moreover, the researchers estimated the correlations between variables ([Appendix 2](#)).

Table 3: Results of discriminant validity by Fornell-Larcker criterion

Variables	ES	GA	AN	IA	TG	RB	RS	AR	EP	FP
ES	<b>0.773</b>									
GA	0.621	<b>0.791</b>								
AN	0.324	0.601	<b>0.801</b>							
IA	0.511	0.587	0.622	<b>0.822</b>						
TG	0.621	0.622	0.697	0.639	<b>0.817</b>					
RB	0.552	0.545	0.702	0.647	0.703	<b>0.782</b>				
RS	0.432	0.614	0.603	0.589	0.623	0.614	<b>0.811</b>			
AR	0.660	0.503	0.612	0.456	0.584	0.523	0.642	<b>0.809</b>		
EP	0.523	0.432	0.635	0.656	0.454	0.442	0.601	0.644	<b>0.742</b>	
FP	0.501	0.401	0.587	0.588	0.497	0.404	0.580	0.637	0.551	<b>0.726</b>

Note: ES (Expert Systems), GA (Genetic Algorithms), AN (Artificial Neural Networks), IA (Intelligent Agents), TG (Tangibility), RB (Reliability), RS (Responsiveness), AR (Assurance), EP (Empathy), FP (Financial Performance)

Source: From the results of statistical analysis

Discriminant validity refers to the extent to which each variable differs from other variables. It is measured by the square root of AVE. Its value for each variable must be greater than its association with other

variables (Hair et al., 2016). As shown in table 3, the square rote of AVE for each variable is greater than the associations of other variables, which indicates a high consistency of the scale as a whole.

Table 4: Model Fit Indices

Indices	Symbol	Acceptance Index	Saturated Model	Estimated Model
Standardized Root Mean Square Residual	SRMR	SRMR < 0.08	0.043	0.051
Unweighted Least Square Discrepancy	d_ ULS	d_ ULS > 0.05	12.532	12.874
Geodesic Discrepancy	d_ G	d_ G > 0.05	6.771	6.932
Normed Fit Index	NFI	NFI > 0.90	0.93	0.92

Source: From the results of statistical analysis

As shown in Table 4, all indices fall in the acceptance area. Thus, all indices were accepted, therefore the model is fit.

### 3. Hypotheses Testing:

Table 5: Hypotheses testing results

No	Hypotheses	Path Coff	f <sup>2</sup>	P-Value	Result
<b>H1</b>					<b>Partially Supported</b>
H1a	Expert Systems → Tangibility	0.346**	0.29	0.00	Supported
	Expert Systems → Reliability	0.311**	0.24	0.00	
	Expert Systems → Responsiveness	0.283*	0.19	0.033	
	Expert Systems → Assurance	0.186*	0.17	0.028	
	Expert Systems → Empathy	0.241**	0.31	0.00	
H1b	Genetic Algorithms → Tangibility	0.358**	0.36	0.00	Supported
	Genetic Algorithms → Reliability	0.306**	0.26	0.00	
	Genetic Algorithms → Responsiveness	0.291**	0.30	0.00	
	Genetic Algorithms → Assurance	0.273**	0.38	0.00	
	Genetic Algorithms → Empathy	0.162*	0.28	0.041	
H1c	Artificial Neural Networks → Tangibility	0.041	0.01	0.116	Rejected
	Artificial Neural Networks → Reliability	0.052	0.01	0.104	
	Artificial Neural Networks → Responsiveness	0.181*	0.16	0.040	Supported
	Artificial Neural Networks → Assurance	0.137*	0.12	0.044	
	Artificial Neural Networks → Empathy	0.209**	0.22	0.00	
H1d	Intelligent Agents → Tangibility	0.332**	0.39	0.00	Supported
	Intelligent Agents → Reliability	0.381**	0.18	0.00	Supported
	Intelligent Agents → Responsiveness	0.030	0.01	0.108	Rejected
	Intelligent Agents → Assurance	0.188*	0.17	0.031	Supported
	Intelligent Agents → Empathy	0.157*	0.22	0.024	Supported
<b>H2</b>					<b>Supported</b>
H2a	Expert Systems → Financial Performance	0.314**	0.37	0.00	Supported
H2b	Genetic Algorithms → Financial Performance	0.246*	0.29	0.027	
H2c	Artificial Neural Networks → Financial Performance	0.297**	0.21	0.00	
H2d	Intelligent Agents → Financial Performance	0.184**	0.19	0.00	

Source: From the results of statistical analysis



Table 5 shows the direct effects. As for H1 testing, AI applications have a direct, positive, and significant effect on financial services quality dimensions except Artificial Neural Networks has no significant effect on Tangibility and Reliability, also Intelligent Agents has no significant effect on Responsiveness. Genetic Algorithms is the most AI applications affections on financial services quality specially on Tangibility with a large effect ( $\beta = 0.358$ ,  $p = 0.00$ ,  $f^2 = 0.36$ ). Artificial Neural Networks is the lowest AI applications affections on financial services quality specially on Assurance with a small effect ( $\beta = 0.137$ ,  $p = 0.044$ ,  $f^2 = 0.12$ ). Therefore, H1 is partially supported.

As for H2 testing, AI applications have a direct, positive, and significant effect on financial performance. Expert Systems is the most AI applications affection on financial performance with a large effect ( $R = 0.314$ ,  $n = 0.00$ ,  $f^2 = 0.37$ ). Thus, H2 is supported as shown in figure 2.

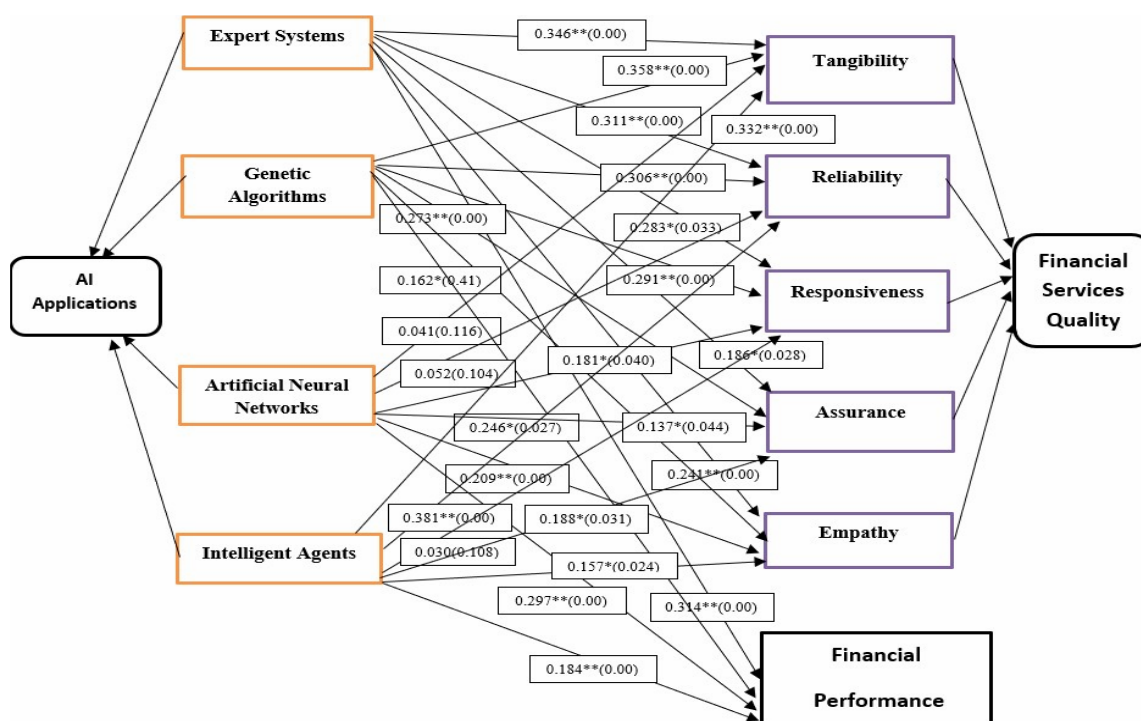


Figure 2: Path diagram with path coefficients estimates and their significance levels

### VII. Discussion

The main objective of the current research is to examine the direct effect of AI applications on financial services quality and financial performance of the Egyptian bank sector. The results found that AI applications affect significantly financial services quality and financial performance. The results relevant to previous studies follows:

As for H1, it was partially supported. This result is in an agreement with some previous studies such as (Elegunde & Oladimeji, 2020; Herrmann & Masawi, 2022; Rahman et al., 2023; Umamaheswari & Valarmathi, 2023; Cintamür, 2024) as these studies stated that using AI applications in bank sector can improve financial services quality, and so some positive consequences such as customer satisfaction can be achieved. As for H2, the results found that its supported. This result is compatible with some previous studies like (Shiyyab et al., 2023; Gyue et al., 2024). These studies reported that using AI applications leverage organizations financial performance. The current study results showed that using AI applications in the field of bank sector is vital and necessary for improving the performance and service quality.

### VIII. Conclusion

The current study aimed to measure the impact of artificial intelligence applications on the quality of banking services in relation to the Egyptian banking sector. The results concluded that there is a significant positive impact of artificial intelligence applications on improving the quality of banking services, which indicates that bank managements should introduce and use artificial intelligence applications in the banking sector.

On the other hand, the current study addressed exploring the role of artificial intelligence applications in improving the financial performance of Egyptian banks. The results found that artificial intelligence

applications have a significant positive impact on the financial performance of Egyptian banks, which leads bank managers to pay increasing attention to artificial intelligence applications and their updates in order to enhance financial performance and the resulting many benefits for the Egyptian banking sector, such as sustainable development.

## **IX. Implications**

### **Theoretical Implications**

The current study contributes to the body of knowledge of the existing literature on Artificial Intelligence, financial services quality, and financial performance. It is considered as the first study which examined these variables in the same research model. Therefore, the current study has some theoretical implications, which can be summarized in the following points:

1. The current study contributes to a deeper understanding of the relationship between AI applications and financial services quality which is necessary for bank customers in order to be satisfied.
2. Using AI applications as a predictor for the financial performance.
3. The results enriched the current literature on AI applications, especially in Egypt. Also, the results of the current study confirmed that using AI applications enhance the financial services quality and financial performance.

### **Practical Implications**

The current study's findings provide significant practical implications for using artificial intelligence applications in the banking industry. First, the current study has confirmed that AI applications positively affect financial services quality. Besides, the most influential factor was Genetic Algorithms. In fact, this result means that Genetic Algorithms is essential application in banks nowadays, so, bank managers should have attention to improve and update Genetic Algorithms in order to be more effective. Moreover, managers should implement incentive programs to enable bank customers who are actively using banks artificial intelligence applications to share their positive experiences about the performance of these applications on their social media platforms and to spread these experiences within their social groups. However, managers should be careful about increasing using AI applications without awareness in order to prevent its harmful effect.

As for the second object of the current study, the results showed that AI applications affect significantly and positively the financial performance. Besides, the most influential factor was Expert Systems. In fact, this result means that Expert Systems have a very important role in improving the financial performance of banks.

## **X. Limitations and Future Research**

The current study has several limitations, although it has significant theoretical contributions to the literature and practical contributions to banking industry practitioners. Therefore, the limitations of the study should be mentioned, and suggestions should be made for future studies based on these limitations.

Firstly, the current study focused on some artificial intelligence applications without addressing some other applications. Therefore, the results of the current study are limited to the impact of the applications that were used only, without other applications. Therefore, the researchers suggest that future research can use other applications of artificial intelligence such as chatbots, automatic learning, and machine learning.

Secondly, the current study tended to examine the role of artificial intelligence applications on financial services quality and financial performance in the banking sector without adding any mediating or moderating variables. Therefore, the researchers suggest that future research can add mediating or moderating variables to the current study model, such as the use of financial technology and risk aversion as moderating variables.

Lastly, the current study was applied to the banking sector and not to other sectors. Therefore, the researchers suggest that future research apply the study variables to other sectors, such as the industrial companies sector.

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Appendix 1:

Construct	Code	Items	Source
<b>AI Applications</b>			
Expert Systems	ES.1	The bank relies on expert computer systems to acquire knowledge in special fields that support the employees' capabilities.	(Beta & Astuti., 2024; Armutcu et al., 2024)
	ES.2	The bank uses expert computer systems as an expert consultant to employees to improve the decision-making process.	
	ES.3	Expert systems contribute to the development of human expertise in solving problems.	
	ES.4	The bank relies on expert systems in thinking process and is not limited to providing information only.	
	ES.5	The bank relies on expert systems for their ability to derive information from complex and inaccurate data.	
Genetic Algorithms	GA.1	The bank uses genetic algorithms to find rapid solutions in a changing environment.	
	GA.2	The bank uses genetic algorithms to reach options in non-numerical matters.	
	GA.3	Genetic algorithms are an excellent way to get fast results when there are many complex inputs in the bank.	
	GA.4	Genetic algorithms work to find the best solutions.	
	GA.5	The bank develops genetic algorithms to keep pace with developments in financial transactions and administrative work.	
Artificial Neural Networks	AN.1	The bank uses neural networks to create workflows through which it processes information. *	
	AN.2	Neural networks help to load large amounts of information.	
	AN.3	Neural networks provide the bank with multiple options.	
	AN.4	The bank uses neural network systems to distinguish them from human learning.	
	AN.5	The bank relies on neural networks for their ability to derive information from complex and inaccurate data.	
Intelligent Agents	IA.1	The intelligent agent assists the employee in making decisions based on its stored knowledge base.	
	IA.2	The intelligent agent helps reduce the time it takes for employees to achieve their goals. *	
	IA.3	The intelligent agent represents the bank and helps in making decisions on its behalf in certain pre-defined situations.	
	IA.4	The intelligent agent can be operated as an alternative to human agents for reducing the operations cost.	
	IA.5	The intelligent agent helps provide the employee with information that helps them perform their work efficiently and effectively.	
	IA.6	The intelligent agent allows the user to view reports and financial statements.	
<b>Financial services quality</b>			
Tangibility	TG.1	The bank has modern equipment and machinery.	(Mukhtar et al., 2014; Ayinaddis et al., 2023)
	TG.2	The bank furniture features a convenient design.	
	TG.3	Bank staff have a decent look like. *	
	TG.4	The bank has convenient waiting spaces.	
	TG.5	The bank has parking spaces for customers. *	
	TG.6	The overall appearance of the bank reflects a decent image of it.	
	TG.7	The bank's website is easy to access.	
Reliability	RB.1	Bank employees provide highly professional banking services. *	
	RB.2	Bank employees are committed to provide banking services to customers on time.	
	RB.3	Bank employees are committed to make the service procedures easy for customers.	
	RB.4	The bank management is keen to ensure that customer records are free of errors.	
	RB.5	The bank's management is keen to continuously improve its performance level.	
	RB.6	The banking service provided to customers is in accordance with the written policies of the bank. *	
	RB.7	Customers trust the bank's management.	
Responsiveness	RS.1	Bank employees respond to customers' requests no matter how busy they are.	
	RS.2	Bank employees show great interest in handling customer problems.	
	RS.3	Bank employees inform customers specifically about the time required to complete a particular service.	
	RS.4	Bank employees provide clear answers to all customer questions and inquiries.	

	RS.5	The bank has a specialized department to deal with customers and answer their inquiries.	
Assurance	AR.1	The bank has a good reputation among customers.	
	AR.2	Customers feel safe when dealing with the bank.	
	AR.3	The bank guarantees the confidentiality of customer information.	
	AR.4	The behavior of bank employees leads to psychological comfort when dealing with customers *	
	AR.5	The bank uses an effective security system to ensure its protection.	
	AR.6	The bank keeps customer documents in a computerized system. *	
	AR.7	The bank keeps customer documents in a paper system.	
	AR.8	The bank contributes to reassuring customers by investing their money with high efficiency.	
Empathy	EP.1	Bank employees are polite when dealing with customers.	
	EP.2	Bank employees provide individual and personal attention to each customer.	
	EP.3	The bank provides working hours that suit the customers' conditions.	
	EP.4	Bank employees understand the special needs of customers. *	
	EP.5	The bank places the interests of its customers at the forefront of its priorities.	
	EP.6	The bank provides the necessary support to customers in special conditions.	
Financial Performance	FP.1	Bank profitability increases faster compared to industry average	(Hernaus et al., 2012)
	FP.2	Return on assets (ROA) of the bank is significantly higher than industry average	
	FP.3	Value added per employee is significantly higher than industry average	

Note(s): \*Items deleted according to measurement model test results

Appendix 2:

Correlation matrix between research variables

Variables	ES	GA	AN	IA	TG	RB	RS	AR	EP	FP
ES	<b>1</b>									
GA	0.607**	<b>1</b>								
AN	0.614**	0.587*	<b>1</b>							
IA	0.596**	0.516**	0.622**	<b>1</b>						
TG	0.532**	0.474**	0.214	0.552**	<b>1</b>					
RB	0.491*	0.561*	0.118	0.518*	0.622**	<b>1</b>				
RS	0.488**	0.590**	0.661*	0.331	0.684*	0.686**	<b>1</b>			
AR	0.519*	0.611*	0.624**	0.328*	0.712**	0.595**	0.708**	<b>1</b>		
EP	0.601*	0.431*	0.432*	0.686**	0.704**	0.731**	0.684**	0.553**	<b>1</b>	
FP	0.581**	0.503*	0.711**	0.642**						<b>1</b>

Note: ES (Expert Systems), GA (Genetic Algorithms), AN (Artificial Neural Networks), IA (Intelligent Agents), TG (Tangibility), RB (Reliability), RS (Responsiveness), AR (Assurance), EP (Empathy), FP (Financial Performance)

\*Significant at 0.05, \*\*Significant at 0.01

Source: From the results of statistical analysis