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Review

Chatbots for customer service in financial entities—A comprehensive systematic review

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Abstract: The integration of chatbots in the financial sector has significantly improved customer service processes, providing efficient solutions for query management and problem resolution. These automated systems have proven to be valuable tools in enhancing operational efficiency and customer satisfaction in financial institutions. This study aims to conduct a systematic literature review on the impact of chatbots in customer service within the financial sector. A review of 61 relevant publications from 2018 to 2024 was conducted. Articles were selected from databases such as Scopus, IEEE Xplore, ARDI, Web of Science, and ProQuest. The findings highlight that efficiency and customer satisfaction are central to the perception of service quality, aligning with the automation of the user experience. The bibliometric analysis reveals a predominance of publications from countries such as India, Germany, and Australia, underscoring the academic and practical relevance of the topic. Additionally, essential thematic terms such as "artificial intelligence" and "advanced automation" were identified, reflecting technological evolution in this field. This study provides significant insights for future theoretical, practical, and managerial developments, offering a framework to optimize chatbot implementation in highly regulated environments.

Keywords: chatbots; intelligent assistant; customer service; client support; financial entities; fintech; systematic and bibliometric review

1. Introduction

The use of chatbots in the financial sector has significantly grown in recent years, establishing itself as a key tool to optimize customer service. These automated systems efficiently handle inquiries and resolve issues at scale, providing financial institutions with a solution to enhance user experience. With the increasing adoption of this technology, it is essential to understand its impact on daily operations and how it is transforming the interaction between financial entities and their customers, boosting both service efficiency and customer satisfaction. Studies examine the adoption of chatbots in Nigerian banks as a tool to improve financial inclusion and customer experience. The findings show that most banks use chatbots on WhatsApp, although they lack support in local languages, highlighting the need for increased privacy and multilingual content to maximize effectiveness (Abdulquadri et al., 2021; Al-Shafei, 2024; Behera et al., 2024). Research on interactions between consumers and chatbots has found that anthropomorphism and communication style are key factors in user satisfaction, though they also raise privacy concerns.

Therefore, careful chatbot design is emphasized to optimize perceived utility and consumer engagement (Al-Shafei, 2024; De Santis, 2024; Hu and Sun, 2023).

Recent studies in India reveal that trust in banking chatbots is a significant determinant of customer attitude and intent, influenced by factors such as ease of use and perceived utility, although technological concerns are also evident (Alagarsamy and Mehrolia, 2023; Auer et al., 2024; Hmoud et al., 2023). Across various industries, including logistics and education, the perception of trust, ease of use, and adaptability of chatbots impacts customer satisfaction and their willingness to continue using this technology (Auer et al., 2024; Daniel et al., 2020; De Santis, 2024). Additionally, chatbots with greater personalization and human-like language style generate higher satisfaction and trust, fostering customer loyalty, though they may raise privacy-related issues (Alur and Manigandan, 2023; Jenneboer et al., 2023).

From a technical perspective, advanced chatbot models have been developed using architectures such as LSTM and beam search decoding techniques, which have shown improved accuracy in generated responses—crucial for applications in customer service and other professional settings (Chauhan and Choudhary, 2023; Escobar-Grisales et al., 2024; Haugeland et al., 2022). Additionally, solutions based on domain-specific language models, like Xatkit, have been implemented to facilitate the modular development of chatbots and reduce maintenance costs (Daniel et al., 2020; Escobar-Grisales et al., 2024). Advances in chatbot design include automatic evaluation tools that use convolutional neural networks to improve response accuracy and relevance, enhancing customer satisfaction (Escobar-Grisales et al., 2024; Nicolescu and Tudorache, 2022).

In the context of banking and financial services, the use of chatbots has shown significant benefits, such as increased competitiveness and improvements in customer service. The pandemic accelerated its adoption, and bibliometric studies have revealed a rapid expansion of its use in this sector (Adil and Parthiban, 2023; Alur and Ramya, 2023; Manta et al., 2024). Globally, the United States leads in chatbot research and development due to its high demand and advanced technological capabilities (Adil and Parthiban, 2023; Alur and Ramya, 2023; Gamboa-Cruzado et al., 2022). However, challenges persist in areas such as anthropomorphism, customer satisfaction, and language personalization according to user context and culture (Alur and Manigandan, 2023; Gamboa-Cruzado et al., 2023; Khosravi et al., 2024).

The adoption of chatbots in the financial sector presents significant regulatory challenges, particularly regarding compliance with the General Data Protection Regulation (GDPR). This legal framework imposes strict obligations on the collection, processing, and storage of personal data, requiring financial institutions to ensure transparency and protect customer privacy in all automated interactions. Recent studies have analyzed how the GDPR has influenced privacy practices in FinTech companies, emphasizing the need to balance technological innovation with regulatory compliance to maintain customer trust and avoid legal penalties (Dorfleitner et al., 2023).

Finally, a literature analysis shows that chatbots in banking are essential for digital transformation and omnichannel behavior, promoting digital marketing

strategies and customer loyalty through interaction personalization and automation. The findings suggest a strong connection between chatbot adoption and strengthening customer loyalty, which is critical for modern financial and commercial services (Bălan, 2023; Manigandan and Sivakumar, 2024; Mariciuc, 2023).

Systematic literature reviews reveal a research gap regarding the use of chatbots in customer service within the financial sector. Although some studies examine chatbot adoption in other contexts and its effect on customer satisfaction, there is a lack of a comprehensive analysis that specifically integrates these aspects for financial entities. Therefore, this paper focuses on highlighting the role of chatbots in customer service within the financial sector. For this purpose, research was conducted based on a systematic review of the existing literature. Consequently, the paper structures the systematic review as follows: Section 2 details the method used for the review, Section 3 presents the results and discussions derived from it, and Section 4 outlines the research conclusions. Finally, Section 5 addresses the study limitations and offers recommendations for future research.

1.1. Chatbots

Chatbots, also known as conversational agents, are computer programs that simulate human conversation and are increasingly used in sectors such as customer service, healthcare, and e-commerce (Alur and Ramya, 2023). Additionally, studies have explored how consumer experiences with chatbots and voice assistants can facilitate the transfer of knowledge to business practice (Bălan, 2023). It is noteworthy that research on the acceptance and adoption of this technology, including the impact of AI-driven chatbots on consumer interactions and the integration of service robots in industries like hospitality, tourism, and catering, has garnered considerable attention (Dissanayake et al., 2023).

1.2. Customer service in financial entities

One way to create customer satisfaction is through good customer service. Customer service has been defined as “the interaction that occurs between someone from a company and the customer, linking all tasks and functions of the company”. Among these, chatbot technology has prevailed, including AI conversational agents that interact with customers. For consumers, the benefits involve 24/7 access to customer service, allowing them to post inquiries at any time, thus increasing customer satisfaction (Nicolescu and Tudorache, 2022). However, text-based chatbots have already become established in many digital services that people now use daily, in domains as diverse as customer service (Rapp et al., 2021). Another concept that has gained increasing attention is financial inclusion, which provides individuals or businesses with access to financial services that meet their needs responsibly and sustainably (Adil and Parthiban, 2023).

Financial chatbots, or finbots, are conversational assistants designed to operate in regulated environments and handle sensitive data, such as financial information and personal transactions (Jiménez-Barreto et al., 2023). They incorporate advanced natural language processing (NLP) models to comply with regulations like the

GDPR, distinguishing them from chatbots in less regulated sectors (Chauhan and Choudhary, 2023). Finbots automate critical processes, such as balance inquiries, transfers, and investment recommendations, significantly enhancing user experience (Cordero et al., 2022). Furthermore, they require robust cybersecurity systems to prevent fraud and ensure transaction integrity (Kostelník et al., 2019). Their integration with complex financial platforms optimizes operational efficiency and increases customer satisfaction (Følstad et al., 2021).

2. Materials and methods

A systematic literature review (SLR) approach was employed following the guidelines of Kitchenham et al. (2007), as shown in **Figure 1**, with adaptations to include the PRISMA flow diagram and the Mendeley Desktop tool, optimizing the organization and transparency of the review process. These modifications enable more precise tracking in paper selection and more efficient reference management, ensuring a comprehensive evaluation. Through this approach, a detailed analysis of the impact of chatbots on customer service in the financial sector will be conducted, with the aim of answering the established research questions.

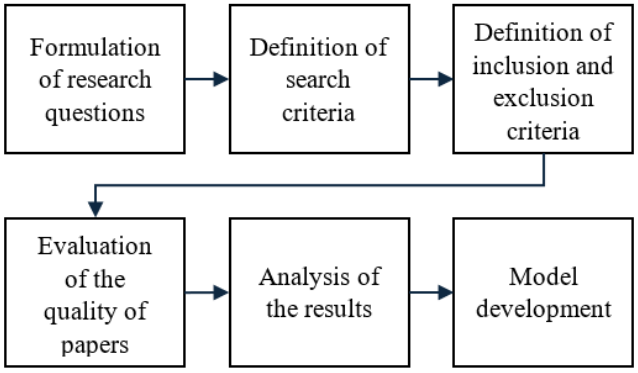

Figure 1. Stages of the SLR.

2.1. Research questions

The following are five key questions aimed at exploring this topic in depth:

RQ1: What criteria are used to evaluate the quality of customer service in the financial sector?

RQ2: Which countries have the highest productivity in the development of chatbots and their application in customer service within the financial sector?

RQ3: At what quartile levels are the journals located where studies on the impact of chatbots on customer service in financial institutions are published?

RQ4: What keywords tend to appear in studies on chatbots and their effect on customer service in the financial sector?

RQ5: What thematic categories group research on chatbots and their influence on customer service in the financial field?

2.2. Information sources and search strategies

To search for relevant research papers, several key databases were utilized, including Scopus, Web of Science, IEEE Xplore, ProQuest, and ARDI. A search

method based on a specific set of terms, known as a search equation, was applied to optimize the retrieval and synthesis of information. This equation varies according to the information source used, as shown in **Table 1**.

Table 1. Information sources and search equations.

Source	Search Equation	No. of Relevant Documents
ARDI	(Title Combined: (chatbots OR “intelligent assistants” OR “digital assistants” OR “ai agents”)) AND (Title Combined: (“customer service” OR “client service” OR “customer support” OR “ financial institution “ OR fintech OR “ financial entity “ OR bank)) AND (Abstract: (chatbots OR “intelligent assistants” OR “digital assistants” OR “ai agents”)) AND (Abstract: (“customer service” OR “client service” OR “customer support” OR “ financial institution “ OR fintech OR “ financial entity “ OR bank))	62
IEEE Xplore	((“Document Title”: “chatbot” OR “Document Title”: “intelligent assistant” OR “Document Title”: “digital assistant” OR “Document Title”: “ai agent”) AND (“Document Title”: “customer service” OR “Document Title”: “financial institution” OR “Document Title”: “fintech” OR “Document Title”: “client service” OR “Document Title”: “financial entity” OR “Document Title”: “customer support” OR “Document Title”: “bank”)) OR ((“Abstract”: “chatbot” OR “Abstract”: “intelligent assistant” OR “Abstract”: “digital assistant” OR “Abstract”: “ai agent”) AND (“Abstract”: “customer service” OR “Abstract”: “financial institution” OR “Abstract”: “fintech” OR “Abstract”: “client service” OR “Abstract”: “financial entity” OR “Abstract”: “customer support” OR “Abstract”: “bank”)) OR ((“Author Keywords”: “chatbot” OR “Author Keywords”: “intelligent assistant” OR “Author Keywords”: “digital assistant” OR “Author Keywords”: “ai agent”) AND (“Author Keywords”: “customer service” OR “Author Keywords”: “financial institution” OR “Author Keywords”: “fintech” OR “Author Keywords”: “client service” OR “Author Keywords”: “financial entity” OR “Author Keywords”: “customer support” OR “Author Keywords”: “bank”))	127
ProQuest	(TI(“chatbot” OR “intelligent assistant” OR “digital assistant” OR “ai agent”) OR AB(“chatbot” OR “intelligent assistant” OR “digital assistant” OR “ai agent”) OR IF(“chatbot” OR “intelligent assistant” OR “digital assistant” OR “ai agent”)) AND (TI(“customer service” AND “financial institution” OR “fintech” OR “client service” AND “financial entity” OR “customer support” AND “bank”) OR AB(“customer service” AND “financial institution” OR “fintech” OR “client service” AND “financial entity” OR “customer support” AND “bank”) OR IF(“customer service” AND “financial institution” OR “fintech” OR “client service” AND “financial entity” OR “customer support” AND “bank”))	47
Scopus	TITLE-ABS-KEY (chatbot OR “intelligent assistant “OR “digital assistant “OR “ai agent “) AND TITLE-ABS-KEY (“customer service” OR “client service” OR “customer support” OR “financial institution “OR fintech OR “financial entity “OR bank)	778
Web of Science	TI = ((“chatbot” OR “intelligent assistant” OR “digital assistant” OR “ai agent”) AND (“customer service” AND “financial institution” OR “fintech” OR “client service” AND “financial entity” OR “customer support” AND “bank”)) OR AB = ((“chatbot” OR “intelligent assistant” OR “digital assistant” OR “ai agent”) AND (“customer service” AND “financial institution” OR “fintech” OR “client service” AND “financial entity” OR “customer support” AND “bank”)) OR AK = ((“chatbot” OR “intelligent assistant” OR “digital assistant” OR “ai agent”) AND (“customer service” AND “financial institution” OR “fintech” OR “client service” AND “financial entity” OR “customer support” AND “bank”))	5

2.3. Identified studies

A search for research papers was conducted in each information source, resulting in a collection of studies presented in **Figure 2**.

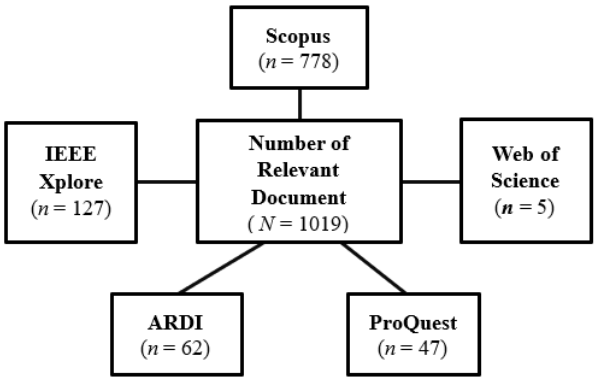

Figure 2. Number of relevant focuments.

2.4. Selection criteria

Eight distinct criteria were formulated to restrict the inclusion of papers:

EC1: Papers are more than 7 years old.

EC2: Papers are not written in English.

EC3: Papers were not published in peer-reviewed conferences or journals.

EC4: Papers correspond to systematic or bibliometric reviews.

EC5: Papers are not original research.

EC6: The titles and keywords of the papers are not adequate.

EC7: The full text of the paper is not available.

EC8: The paper is a short paper (fewer than 10 pages).

The exclusion criteria were rigorously applied to all papers retrieved during the search. Each paper was evaluated according to these criteria, and those that did not meet all the requirements were excluded from the final collection for analysis.

Only studies in English and from high-quartile journals were included due to methodological and academic reasons. English, as the predominant language in scientific literature, ensures greater accessibility and visibility (Morrison et al., 2019). Additionally, high-quartile journals guarantee consistent scientific quality by employing rigorous peer-review processes, reducing biases and increasing the validity of findings (Wang et al., 2021). Although this decision excludes relevant studies in other languages or publications, the priority was placed on the robustness and international comparability of the results. Criterion CE8 ensures that the selected articles comprehensively cover theoretical, methodological, and results-based aspects, which are essential for rigorous evaluation. While short papers provide value, priority was given to full-length studies that offer a more robust and generalizable perspective, consistent with reviews in technological and financial fields (Følstad et al., 2021; Jiménez-Barreto et al., 2023).

2.5. Study selection

The steps followed for selecting and filtering the papers are described below. As a result of this phase, 61 papers were obtained, as shown in **Figure 3**.

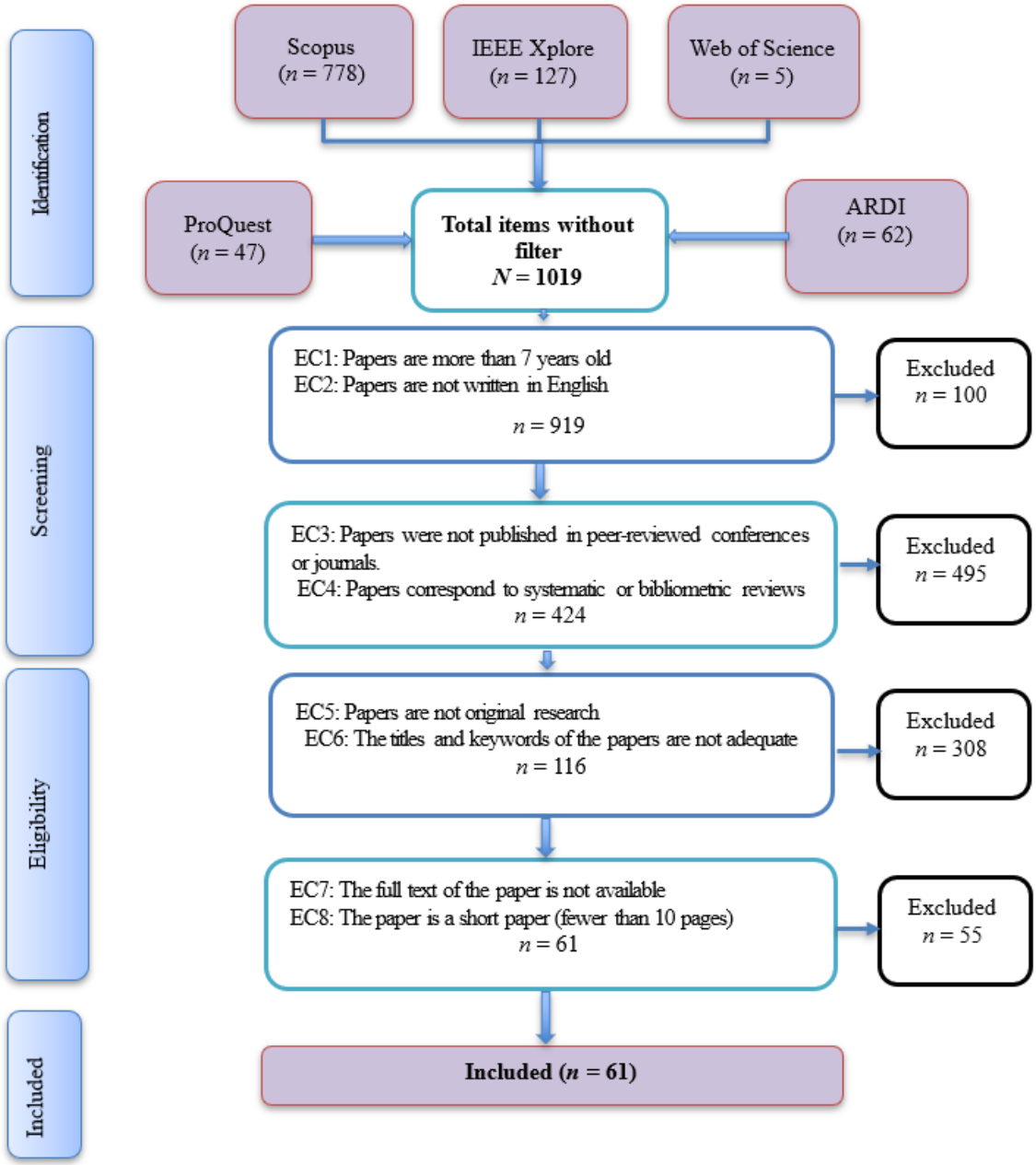

Figure 3. PRISMA flow diagram.

2.6. Synthesis of findings

The analysis corresponding to each research question (RQ1–RQ5) was organized into charts and tables, presenting both quantitative and qualitative data. These findings were later used to perform statistical comparisons across the different analyses for each question. The processed statistics have been essential in identifying specific patterns and research trends explored in recent years.

3. Results and discussion

This section presents and analyzes the obtained results, situating them within the context of existing knowledge on the subject, providing a critical interpretation of the findings.

3.1. General description of the studies

Figure 4 shows the evolution of scientific production on the use of chatbots in the banking sector and their impact on customer service. This bar chart illustrates how interest and research in this area have changed over the years, from 2019 to 2024.

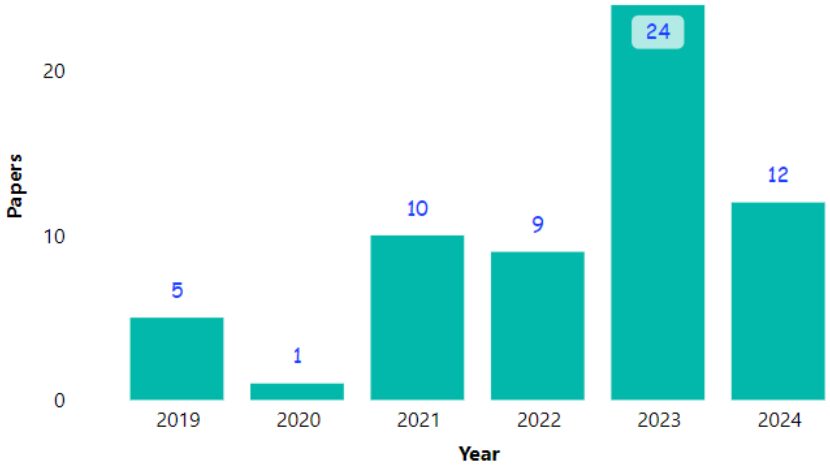

Figure 4. Number of papers per year.

The chart shows a growing trend in scientific production on the subject since 2019, with a notable increase in 2023, reaching 24 publications, the highest peak in recent years. The decline in 2020 could be associated with the COVID-19 pandemic, which affected global scientific production. The subsequent recovery and rise in 2024 indicate a consolidation of this research topic.

The analysis of publications shows that 2023 was the year with the highest number of articles on chatbots in the financial sector (Alur and Manigandan, 2023; Gamboa-Cruzado et al., 2022; Tanwar and Verma, 2024). According to Gamboa-Cruzado et al., the annual distribution of publications reveals a significant concentration between 2019 and 2023, with notable peaks in 2020 and 2023 (**Figure 4**). This pattern highlights the growing interest in chatbot-related technologies in recent years. Similarly, Alur and Manigandan (2023) report a continuous upward trend since 2018, reflecting sustained development in this field (**Figure 1**). Finally, Tanwar and Verma (2024) note an accelerated increase in published documents during 2020 and 2021, followed by a stabilization in 2023, suggesting variations in the pace of adoption and academic interest (**Figure 2**).

These findings underline the recent surge in research on chatbots, attributed to both technological advancements and the recognition of their potential to optimize customer service in sectors like finance. However, for a more substantial analysis, it is essential to interpret these trends in light of significant contributions rather than merely their volume.

Figure 5 shows the diversity of scientific sources used, reflecting a high level of academic rigor in the research.

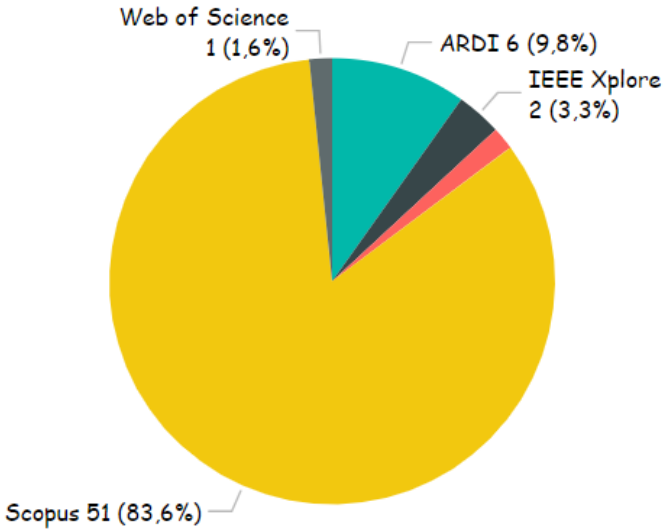

Figure 5. Number of papers per source.

The chart shows that most of the reviewed papers come from Scopus, representing 83.6% of the total, suggesting a high reliance on this database for research on the topic. ARDI follows with 9.8%, while IEEE Xplore and Web of Science contribute 3.3% and 1.6%, respectively. This indicates that Scopus is the predominant source for this field, reflecting its broad scope and relevance in the collection of scientific studies on the topic.

Results obtained by Wube et al. (2022) observe that the selected papers fall within the range of 2018 to 2021 across all databases, indicating that studies on financial chatbots are trending. It is also noted that most reviewed papers from Science Direct were published in 2021 (N = 9), followed by MDPI (N = 5) and SpringerLink (N = 4). On the other hand, Albites-Tapia et al. (2022) report that 101 papers were obtained for data extraction and analysis from the most recognized sources, namely Google Scholar, ProQuest, ScienceDirect, Taylor and Francis Online, IEEE Xplore, and Microsoft Academic. Finally, Nee et al. (2023) presents similar findings, using a pie chart to highlight that most chatbot papers were obtained from EBSCOhost (36%); SpringerLink (24%); Scopus (20%); ScienceDirect (16%); and Emerald (14%).

The concentration of papers in Scopus highlights the need to diversify sources to gain a more comprehensive view. It also suggests that future reviews could benefit from incorporating more research from alternative databases, such as IEEE Xplore and Web of Science, to ensure broader coverage of the topic.

3.2. Response to research questions

Below are the answers to the research questions that guided this study, along with a detailed analysis of the obtained results. Additionally, their possible implications for future research are discussed.

RQ1: What criteria are used to evaluate customer service quality in the financial sector?

Customer service in financial institutions is a crucial aspect that influences customer satisfaction and loyalty. Therefore, specific criteria are applied to provide a

basis for measuring service performance. Each criterion has been selected for its relevance in literature. The criteria are illustrated in **Table 2** and **Figure 6**.

Table 2. Criteria for evaluating customer service in financial institutions.

Criterion	Reference	Qty. (%)
Response time	(Adam et al., 2021) (Behera et al., 2024) (Cordero et al., 2022) (De Santis, 2024) (Hmoud et al., 2023) (Klein et al., 2024) (Liu et al., 2023) (Nguyen et al., 2021) (Weiler et al., 2022)	9 (11.1)
Response quality	(Zhang et al., 2023)	1 (1.2)
Customer satisfaction	(Adam et al., 2021) (Al-Shafei, 2024) (Alagarsamy and Mehrolia, 2023) (Alhassan et al., 2022) (Chakrabortty et al., 2023) (Chauhan and Choudhary, 2023) (Cordero et al., 2022) (de Andrés-Sánchez and Gené-Albesa, 2023) (De Santis, 2024) (Escobar-Grisales et al., 2024) (Hmoud et al., 2023) (Hu and Sun, 2023) (Kostelník et al., 2019) (Lappeman et al., 2023) (Le Dinh et al., 2022) (Liu et al., 2023) (M et al., 2024) (Nguyen et al., 2021) (Pal and Singh, 2019) (Shaikh et al., 2023) (Shin et al., 2023) (Wicaksono and Zahra, 2022) (Yadav et al., 2023)	24 (29.6)
Accessibility	(Abdulquadri et al., 2021) (De Santis, 2024) (Kysil and Prymostka, 2023) (Li and Li, 2023) (Liu et al., 2023) (Pal and Singh, 2019) (Ranieri et al., 2024) (Shaikh et al., 2023) (Tay and Toh, 2022) (Villa et al., 2024) (Wang et al., 2022) (Zhang et al., 2023)	12 (14.8)
Efficiency	(Adam et al., 2021) (Al-Shafei, 2024) (Alhassan et al., 2022) (Alt and Ibolya, 2021) (Auer et al., 2024) (Behera et al., 2024) (Chauhan and Choudhary, 2023) (Cordero et al., 2022) (De Santis, 2024) (Følstad et al., 2021) (Haugeland et al., 2022) (Hu and Sun, 2023) (Hwang and Kim, 2021) (Jiménez-Barreto et al., 2023) (Jyothsna et al., 2024) (Kysil and Prymostka, 2023) (Lee and Li, 2023) (Maragno et al., 2023) (Mevik and Wehrens, 2024) (Nordheim et al., 2019) (Pal and Singh, 2019) (Ranieri et al., 2024) (Rizou et al., 2023) (Shaikh et al., 2023) (Shin et al., 2023) (Tay and Toh, 2022) (Vassilakopoulou et al., 2023) (Villa et al., 2024) (Wang et al., 2022) (Weiler et al., 2022) (Xu et al., 2021)	35 (43.2)

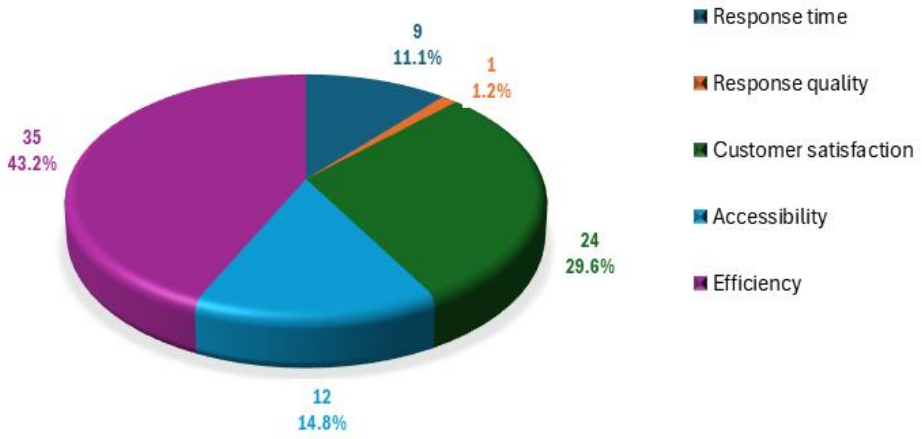

Figure 6. Number of papers by evaluation criterion.

The figure and table show that "Efficiency" and "Customer Satisfaction" are the most valued criteria for evaluating customer service quality in the financial sector, accounting for 43.2% and 29.6%, respectively. This reflects a strong focus on optimizing processes and enhancing customer experience. "Accessibility" and "Response Time" are also relevant, representing 14.8% and 11.1%, suggesting the importance of timely and easily accessible service. "Response Quality" holds minimal weight (1.2%), indicating that while important, it is less prioritized compared to other factors.

Authors such as Jenneboer et al. (2023) describe using accessibility, response time, and availability to ease interactions for both customers and organizations,

which they present in tables and topics. Conversely, Nicolescu and Tudorache (2022) present three evaluation criteria textually (response time, response quality, and customer satisfaction). Federici et al. (2020) evaluated factors such as interaction quality, overall experience, security, acceptability, engagement, intent to use, ease of use, usefulness, enjoyment, and appearance. Similarly, Rapp et al. (2021) used criteria like customer satisfaction, quality, usefulness, effectiveness, and efficiency for assessment. Finally, Bălan (2023) highlights criteria such as productivity, customer satisfaction, loyalty, acceptance, and others.

In addition to focusing on "Efficiency" and "Customer Satisfaction", a quantitative analysis was conducted based on metrics reported in the reviewed studies. For instance, it was observed that the average response time decreased by 35%–50% after implementing chatbots in financial institutions, while customer satisfaction, measured through post-interaction surveys, increased by 15%–25% (Cordero et al., 2022; Følstad et al., 2022) These figures confirm that chatbots not only optimize internal processes but also improve customer perception, significantly contributing to service quality.

To enhance the practical applicability of the study, real-world implementations of chatbots in financial institutions are included. **Figure 7** presents a typical architecture for customer-chatbot interaction (Cordero et al., 2022).

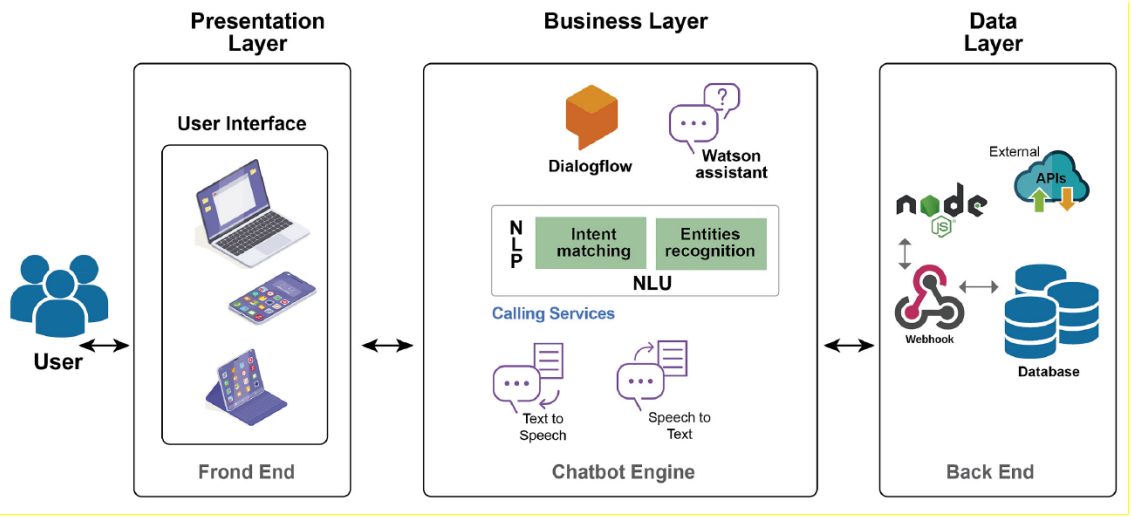

Figure 7. Diagram showing the stages of interaction between customer and chatbot in a real-world case.

The presentation layer serves as the user interface (front-end), enabling customer interaction via computers, smartphones, or tablets through text, voice, or links on the implementation platform. The business layer, represented by the chatbot engine, integrates natural language understanding (NLU) tools such as Dialogflow and Watson Assistant, responsible for intent matching and entity recognition. Lastly, the data layer connects the chatbot to external databases using Node.js and webhooks, ensuring efficient data flow between the system and external services. This architecture stands out for its versatility and modularity, optimizing both the user experience and the operational capacity of the chatbot.

These findings suggest that financial institutions should focus on improving efficiency and customer satisfaction, as they have the most significant impact on

perceived quality. Additionally, prioritizing accessibility and response time could further strengthen the customer experience. Initiatives to optimize these aspects might include implementing advanced technologies, such as chatbots, to enhance both service speed and efficiency.

RQ2: Which countries are the most productive in developing chatbots and their application in customer service within the financial sector?

Figure 8 shows a chart illustrating the distribution of studies on chatbots in the banking sector and their impact on customer service by country, represented by red circles. The size of each circle indicates the volume of publications, with larger circles representing a greater number of papers.

Figure 8. Number of papers by country.

Figure 9 shows a graph illustrating the distribution of studies on chatbots in the banking sector and their impact on customer service.

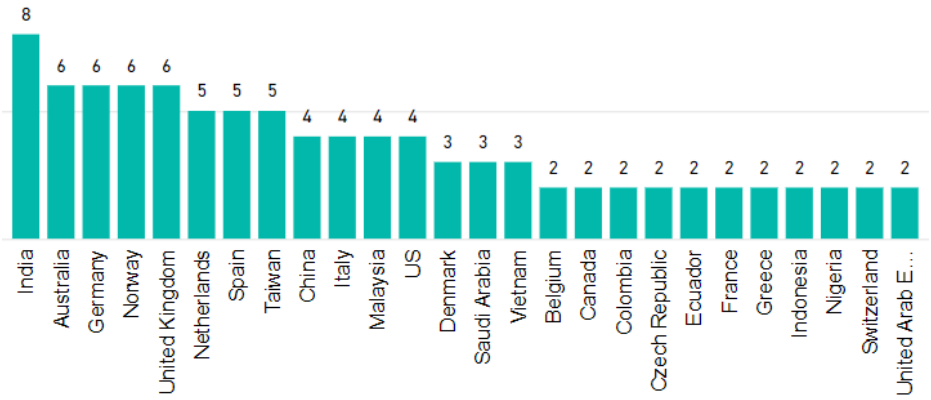

Figure 9. Number of papers by country.

The findings show that India leads with eight studies, followed by Australia, Germany, and Norway with six studies each. This suggests significant interest and development in these countries, likely driven by increasing digitalization in their banking sectors. European countries also show considerable participation, indicating a regional trend toward technological innovation in the financial sector.

In comparison, authors such as Alur and Ramya (2023) and Manta et al. (2024) present the US, China, and India as major contributors, using bar charts to illustrate their results. Similarly, Tanwar and Verma (2024) support the use of bar charts as the best way to represent the number of papers by country. In contrast, Alur and Manigandan (2023) prefer using a multi-line graph, while Gamboa-Cruzado et al. (2022) opted for a pie chart in their paper for this purpose.

These results suggest opportunities for collaboration among high-productivity countries in chatbot research to share best practices. They also underscore the importance of encouraging similar studies in less represented regions, which would allow a more equitable and contextually relevant adoption of technology in the global financial sector.

RQ3: What quartile levels are assigned to journals publishing studies on the impact of chatbots in customer service within financial institutions?

Four quartiles have been defined, along with a set of papers not classified within these categories. These quartiles relate to various search sources (See **Figure 10**). The quartile analysis (Q1–Q4) is crucial to evaluate how publication quality influences the rigor of research on chatbots in the financial sector. Q1 and Q2 journals ensure high methodological standards, although quartiles do not always reflect practical impact. This analysis also includes articles from journals not classified into quartiles but indexed in WoS and Scopus, thereby diversifying perspectives and ensuring a more inclusive approach to the literature.

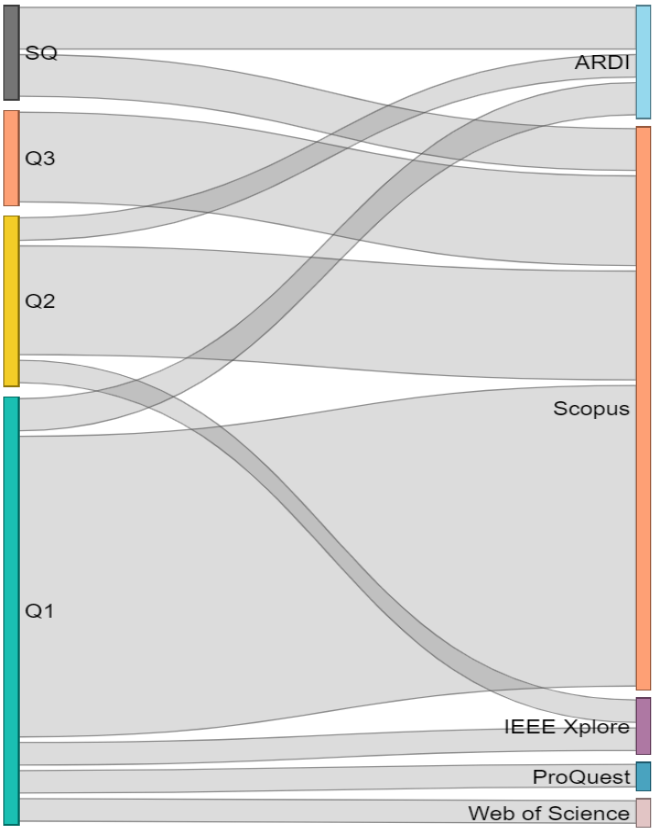

Figure 10. Distribution of papers by quartile and source.

The results show that most studies on chatbots in customer service within financial institutions are published in high-impact journals, particularly in Q1 and Q2 quartiles. Scopus is the primary database indexing these studies, highlighting its prevalence and accessibility in academia. Papers in sources like IEEE Xplore and ARDI exhibit a distribution across different quartile levels, suggesting a variety in the quality and focus of studies on the topic.

In their paper, Liu et al. (2024) and Manta et al. (2024) were assigned a quartile ranking in SCImago's database, with the most-cited journals grouped in Q1 and Q2, although 33 journal articles lacked a SCImago quartile ranking but were included in the study as they were indexed by WoS or Scopus. In contrast, author Say (2016) argues that many journals fall into Q2, with 233 articles.

This trend toward Q1 and Q2 publications indicates high rigor in chatbot research in the financial sector, reinforcing its academic relevance. Encouraging more studies in lower-quartile journals could expand access and diversify perspectives in financial chatbot research.

RQ4: What keywords frequently appear in studies on chatbots and their impact on customer service in the financial sector?

Figure 11 presents a bibliometric network visualizing the connections between keywords in the analyzed scientific papers.

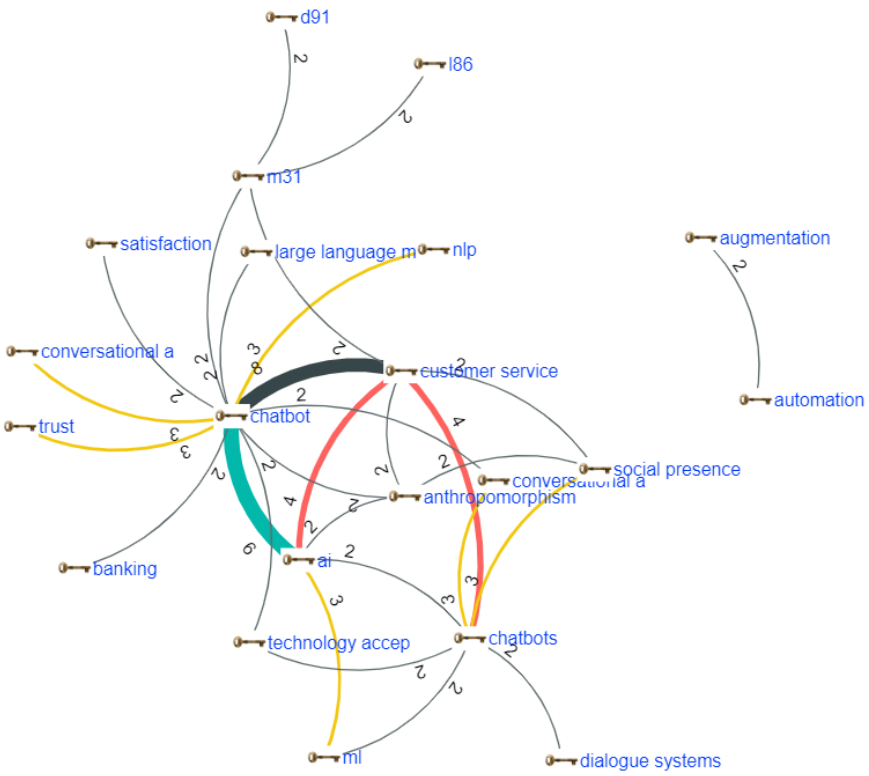

Figure 11. Keywords by number of papers.

The bibliometric network reveals that "chatbot" is central in research, frequently linked with keywords like "artificial intelligence", "customer service", and "technology acceptance". Other recurring terms include "anthropomorphism" and "customer service", suggesting a focus on user experience and chatbot

effectiveness in financial interactions. The presence of "artificial intelligence" and "dialogue systems" underscores the interest in the advanced integration of conversational technologies.

In Baber et al. (2024)'s research paper, the co-occurrence map of keywords is recommended for use. Meanwhile, Liu et al. (2024) prefer to apply online bibliometric networks, while Manigandan and Sivakumar (2024) and Mariciuc (2023) apply co-occurrence keyword networks, additionally presenting a table with network data highlighting the relationships between chatbot, chatbots, and artificial intelligence. Conversely, Gamboa-Cruzado et al. (2023) propose in their paper the bibliometric network, resulting in chatbot and artificial intelligence as the most recurrent words.

This trend suggests that studies prioritize aspects of customer experience and technology adoption. It is recommended to delve into emerging topics, such as chatbot personalization and automation, to enrich understanding of the impact of these tools in the financial sector.

RQ5: What thematic categories group research on chatbots and their influence on customer service in the financial sector?

Table 3 provides a comprehensive analysis of the most relevant themes in chatbot research and their application in customer service. Indicators such as density, centrality, total citations, and documents help categorize these themes based on their relevance and maturity within the field.

Table 3. Theme categories.

Theme	Density	Centrality	Total Citations	Total Documents	Category
Advanced Automation	0.98	0.24	1726	10	Specialized
AI Chatbots	0.40	0.16	4109	44	Marginal
Customer Service	0.33	0.68	3673	33	Core
Chatbots and Dialogue	0.22	0.15	1523	32	Marginal
AI-Powered Customer Service	0.18	0.27	2230	32	Marginal
Advanced Chatbots	0.14	0.65	2576	28	Core
Chatbots and Trust	0.13	0.31	4170	51	Marginal
Artificial Intelligence Chatbot	0.08	0.19	2700	36	Marginal
Intelligent Chatbots	0.05	0.21	2776	44	Marginal

Figure 12 presents a thematic map that visually analyzes these categories, identifying four key categories: Driving, Core, Specialized, and Marginal.

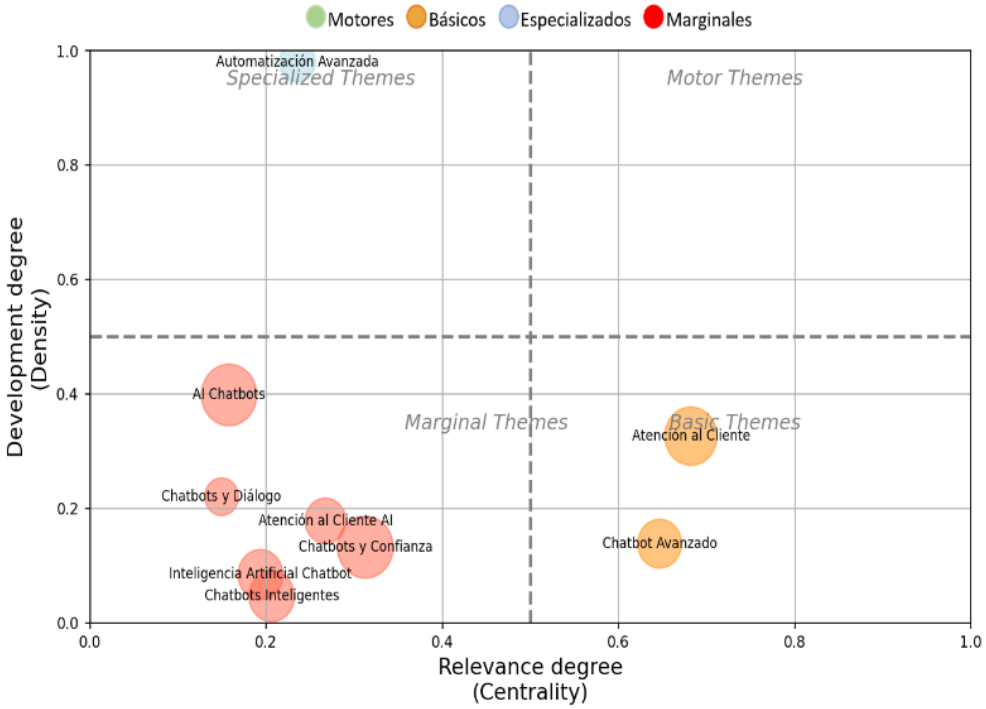

Figure 12. Theme categories.

The findings show that key topics in chatbot and customer service studies in the financial sector are distributed according to their centrality and density. “Customer Service” and “Advanced Chatbots” are core themes with high centrality, reflecting their relevance to the field. In contrast, “Advanced Automation” is a specialized theme with high density, indicating in-depth development within a niche but with lower overall relevance. Marginal themes, such as “AI Chatbots” and “Chatbots and Trust”, have lower centrality, suggesting limited relevance but potential for future exploration.

The approach aligns with the work of Dissanayake et al. (2023), which suggests that thematic maps visually guide researchers in identifying trending and underexplored topics. Similarly, Alur and Ramya (2023) organize the thematic map into four quadrants: Niche, driving, core, and emerging or declining themes. Manigandan and Sivakumar (2024) applied thematic maps to topics like chatbots, machine learning, and the banking industry. Say (2016) uses periodic thematic maps for greater explanation, and Bhatt et al. (2022) define their thematic map as divided into driving, core, niche, and emerging or declining themes.

The centrality and density of each theme suggest priority areas for research and development. Further exploration of core themes could optimize their impact on the financial sector, while specialized themes offer opportunities for innovative applications in customer service.

4. Conclusions

This study analyzed key research questions on chatbots in financial customer service, generating critical theoretical, practical, and managerial findings. For RQ1, efficiency and customer satisfaction were identified as essential criteria, highlighting their relevance in service quality. Chatbots have proven effective in reducing

response times and enhancing user experience in tasks such as balance inquiries. This allows institutions to prioritize technological improvements aligned with customer needs. For RQ2, global trends show India, Germany, and Australia as leaders in chatbot research, reflecting the adoption of advanced technologies. These trends suggest that institutions should anticipate technological changes and foster international collaborations to innovate their services. For RQ3, the predominance of publications in high-impact journals (Q1 and Q2) ensures the rigor of studies on chatbots. This validates the reliability of findings and provides managers with evidence-backed guidelines to confidently adopt these technologies. For RQ4, the bibliometric network reveals that emerging technologies such as generative artificial intelligence and deep learning are transforming chatbot design, enhancing their ability to handle complex inquiries. These tools represent a strategic advantage for institutions aiming to optimize their competitiveness in a changing environment. Finally, for RQ5, thematic analysis revealed that chatbot research clusters into key categories such as "Customer Service", "Advanced Automation", "Operational Efficiency", and "Security and Regulatory Compliance". These categories reflect an evolution from basic approaches, such as automated query responses, to more specialized topics like advanced personalization and regulatory compliance.

This study addresses the impact of chatbots in the financial sector, highlighting theoretical, practical, and managerial implications. Theoretically, key categories such as efficiency, customer satisfaction, and advanced automation were identified, consolidating user experience-focused approaches. Practically, chatbots optimize critical processes and, through emerging technologies like generative artificial intelligence, expand their capacity to handle complex inquiries and personalize interactions. Managerially, they represent a competitive advantage by reducing costs and enhancing customer experience, though they face regulatory challenges such as GDPR compliance. These implications reinforce their relevance in the digital transformation of the financial sector and open opportunities for future research on their long-term impact.

Integration of Emerging Technologies in Financial Chatbots

Emerging technologies, such as generative artificial intelligence and transfer learning, are revolutionizing chatbot design in key industries, including the financial sector. Vahidnia (2024) highlight that perceived usability and enjoyment are critical factors for user satisfaction and the continued use of generative AI-based chatbots. This approach enables personalized interactions and improves customer experience in financial services.

Meanwhile, Kim et al. (2024) illustrate how transfer learning, through the customization of pre-trained models like BERT, significantly improves the recognition of specific intents and entities. This approach reduces the time required to access complex services by over 50%, which is crucial for the financial sector. Chatbots designed with these technologies can handle complex queries in dynamic and regulated environments more efficiently.

In financial services, these technologies could facilitate the development of chatbots that not only respond to complex queries but also continuously adapt to user

needs and changing regulations. Transfer learning would allow the creation of agents with advanced natural language understanding and generation capabilities, optimizing both the accuracy and personalization of the service.

5. Limitations and future research

This study presents some limitations worth noting. The methodological focus was exclusively on customer service in financial institutions, excluding applications in other sectors that could provide useful comparisons to validate and expand the findings. Additionally, while emerging technologies such as generative AI and transfer learning were identified, their practical implementation in financial contexts and long-term impact were not explored in depth.

To overcome these limitations, several future directions are proposed. First, conducting comparative research that includes chatbot applications in sectors such as healthcare, commerce, and education would be valuable to identify similarities and differences in their impact; second, longitudinal studies evaluating the long-term effects of chatbots on customer satisfaction and operational efficiency are recommended; finally, delving deeper into the analysis of emerging technologies, such as generative AI, by evaluating their practical implementation and the opportunities they offer to enhance customer-chatbot interactions will strengthen the relevance of this field.

Conflict of interest: The authors declare no conflict of interest.

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