Artificial Intelligence Applications in Banking and Financial Services: A Bibliometric Perspective

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Abstract: Artificial Intelligence (AI) has become a significant driver of innovation in the banking sector, especially in the context of post-pandemic digital transformation. AI is widely utilized in areas such as fraud detection, credit evaluation, risk management, and customer interaction, attracting considerable interest from both academics and industry professionals. This research explores the recent advancements in AI within the banking industry, focusing on studies published between 2020 and 2025. A bibliometric approach is employed, using data from the Scopus database and bibliometric tools like VOSviewer and R Studio to visualize keyword networks and track emerging trends. The study aims to identify influential authors, journals, and countries contributing to AI research in banking. By analyzing these developments, the research highlights the contributions of AI to improving operational efficiency, data security, and financial inclusion, particularly in the Indonesian context. This work offers valuable insights into the ongoing integration of AI in the banking sector and its potential to shape future financial services, emphasizing its relevance to both global and regional markets.

Keywords: Artificial Intelligence; Banking Industry; Bibliometric Analysis; Financial Inclusion; Digital Transformation

1. Introduction

The rapid digital transformation triggered by the COVID-19 pandemic has significantly altered the landscape of banking and financial services. At the center of this shift, Artificial Intelligence (AI) has become a key enabler, driving efficiency while introducing innovative service approaches. AI is applied in crucial areas such as fraud prevention, credit assessment, and risk management, and it also enhances customer interaction through automated solutions. Beyond operational improvements, AI empowers banks to process vast amounts of data, identify behavioral trends, and deliver personalized services, thereby reinforcing security, widening access to financial products, and advancing the broader objectives of financial inclusion and digital sustainability. The adoption of modern information and communication technologies, including artificial intelligence (AI), the Internet of Things (IoT), and blockchain, is accelerating technological and industrial transformation worldwide (Mbaidin et al., 2024). The presence of this technology not only enables banks to operate faster and more cost-effectively, but also strengthens data security and expands public access to formal financial services.

This trend has attracted growing interest from both scholars and industry professionals regarding the potential of AI in banking. Artificial Intelligence is recognized as a powerful tool with the ability to revolutionize practices in financial reporting. Artificial intelligence (AI) has the capability to automate processes, process large volumes of data, and detect patterns that may be overlooked by conventional methods (Mbaidin et al., 2024). A number of studies have highlighted the benefits and challenges of implementing this technology, but comprehensive research is still limited. To understand the direction of study development and the trends in topics that are in the spotlight, bibliometric analysis can be used as an effective approach. Bibliometrics is an analysis method used to identify scientific trends and

system atize research, ensuring the quality of information and the production of the results generated (Barbosa et al., 2022). Through this method, scientific publications can be mapped based on citation trends, keyword networks, and the contributions of authors, journals, and countries, thereby providing a more comprehensive picture of the research landscape related to AI in financial services.

In Indonesia, the urgency of this type of research is growing alongside the rapid pace of banking digitalization and the expansion of financial technology (fintech). Many banks have begun adopting AI-driven solutions, for instance chatbots for customer interaction, machine learning for credit assessment, and systems that detect suspicious transactions in real time. Nevertheless, its adoption still faces several challenges, including inadequate digital infrastructure, concerns over data security and privacy, as well as gaps in digital literacy. Hence, mapping AI-related studies in this sector is not only valuable for academic advancement but also serves as a strategic reference for regulators, practitioners, and policymakers in shaping a more inclusive and sustainable development path.

Based on this background, this study was conducted to analyze the development of literature on AI in banking and financial services during the period 2020–2025. Data were obtained from the Scopus database using analysis tools such as VOSviewer and R Studio to visualize keyword networks, trace key authors and journals, and identify country contributions. The software VOSviewer was used for the construction and visualization of bibliometric networks. This software allows extracting information from publications, such as authorship, periodicals, organizations, countries, and keywords (Barbosa et al., 2022). The results of this study are expected to provide an up-to-date perspective on the dynamics of AI research in the banking sector while emphasizing its role in improving operational efficiency, strengthening data security, and expanding financial inclusion, particularly in the Indonesian context.

2. Literature Review

Artificial intelligence (AI) is now pervasive, driving transformation across diverse sectors, including manufacturing, retail, and services(Rahman, 2025). Various studies show that AI plays an important role in supporting the main functions of banking. For example, the use of machine learning and deep learning has proven to be effective in identifying fraudulent practices and suspicious transactions that are difficult to detect using traditional methods (Achmad et al., 2022). Furthermore, the application of AI algorithms in credit scoring enables banks to assess creditworthiness more quickly and accurately, thereby expanding the reach of formal financial services to previously unbanked populations (Pamungkas & Sari, 2023).

In the financial context, AI provides opportunities to improve operational efficiency, strengthen data security, and drive service innovation (Mbaidin et al., 2024). Several studies also emphasize the link between the application of AI and other digital technologies, such as blockchain and the Internet of Things (IoT), which together are driving transformation in the global financial industry. (Barbosa et al., 2022) shows that this combination of technologies encourages more sustainable innovation while also requiring adaptive regulations to protect data security and consumer interests. On the other hand, research conducted by (Mbaidin et al., 2024) highlights that the use of AI in accounting and risk management can improve financial reporting transparency while strengthening internal control systems.

Globally, publications related to AI in the financial sector have increased rapidly after the COVID-19 pandemic. This increase not only focuses on technical aspects, such as the use of natural language processing in chatbots or anomaly detection algorithms, but also covers strategic issues such as financial inclusion, sustainability, and governance (Achmad et al., 2024). However, the majority of research is still concentrated in countries with high research capacity, such as India, the United States, and China, while contributions from developing countries, including Indonesia, are still minimal.

3. Research Method

The initial step involved conducting a search within the Scopus database, followed by evaluating the retrieved documents in three stages (Figure 1). Phase 1 focused on setting the search parameters to identify and refine relevant records (data collection stage). Phase 2 involved exporting the selected documents into VOSviewer software to perform bibliometric mapping of publications, authors, countries, institutions, journals, and subject areas (data

visualization stage). Finally, in Phase 3, the data were analyzed to highlight the key themes addressed in studies related to AI In Banking in Indonesia.
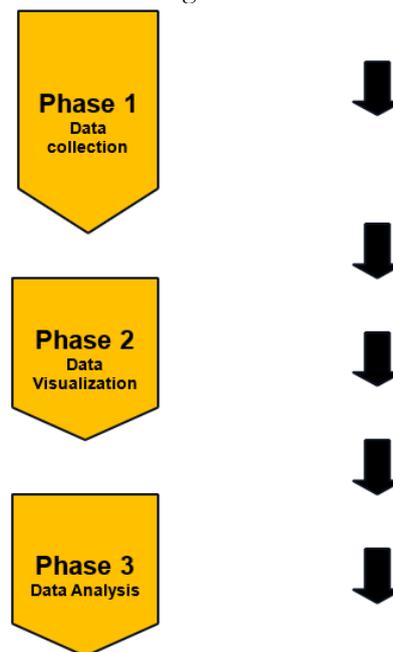

Figure 1. Methodology Phases Applied to the Present Work

This research utilized bibliographic data from the Scopus article database covering the years 2020 to 2025 (Fig. 1). A total sampling approach was applied, with the analyzed variables including publication title, author, abstract, keywords, year of publication, journal publisher, publication type, and author affiliation. Data were retrieved from the Scopus repository using Mendeley Desktop, based on a single English query keyword: *AI in Banking.*

The search results were exported in CSV format through the Scopus export tool and subsequently synchronized with Mendeley Desktop. Descriptive statistics such as annual publication trends, number of publications per author, and journals were processed using Microsoft Excel. A topic trend map was then generated with VOSviewer version 1.6.19 using the CSV data. Keyword co-occurrence analysis was applied as the unit of analysis, producing both keyword mapping network visualizations and keyword density (hotspot) maps.

4. Results and Discussion

The results of bibliometric analysis of publications on the application of artificial intelligence (AI) in the banking sector for the period 2020–2025 show significant dynamics. Overall, 1,506 documents from 428 publications were identified, representing research growth with an annual increase of 47.92%. This figure indicates that the topic of AI in banking is gaining increasing attention among academics and practitioners. In terms of authorship, 7,239 authors were involved in the publications analyzed, and interestingly, there were no works written by a single author. On average, nearly ten authors collaborated on each article, indicating a tendency for research to be conducted through large-scale teamwork. This condition is in line with contemporary research trends that emphasize multidisciplinarity and collaboration across institutions and countries.

Figure 2. Main Information Overview (Using R Studio)

In addition to authorship, the data also shows a fairly prominent pattern of international collaboration, with about a quarter of publications involving authors from different countries. This confirms that research on AI in banking is not only developing locally but has become part of a global discourse that connects various regional contexts. In terms of publication content, there are 6,721 keywords used by authors, while the number of references recorded reaches 11,217, reflecting the breadth of the topics studied as well as the high intensity of academic references.

The average age of documents in this research database is relatively young, at 1.47 years, which means that the literature analyzed can be considered current and relevant to the latest developments. In addition, the citation rate also shows quite strong results, with an average of 9.446 citations per document. This indicates that research on the topic of AI in the banking sector is not only growing quantitatively but also has a significant influence in international academic discourse. Overall, these findings illustrate that the topic of AI in the financial sector is in a phase of rapid growth, supported by extensive academic collaboration, up-to-date literature, and a fairly high citation rate, thereby strengthening its position as a strategic research field that continues to attract attention.
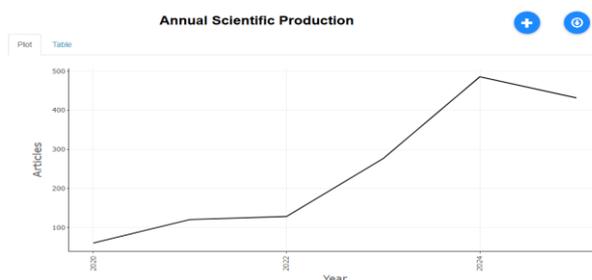

Figure 3. Annual Scientific Production (Using R Studio)

The figure above shows Annual scientific production trends for the 2020–2025 period show consistent and progressive development in studies on the application of AI in the banking sector. In 2020, the number of publications recorded was still relatively small, reflecting the early stages of academic interest in this topic. However, entering 2021 and 2022, publications began to show a steady increase, in line with the wider adoption of digital technology in the financial industry. This increase indicates that research on AI is no longer considered merely experimental, but has begun to enter the stage of concept strengthening and practical application.

A significant increase began to be seen in 2023, where the number of articles published nearly doubled compared to the previous year. This surge can be attributed to several factors, such as the increased availability of digital data, accelerated technological innovation, and the post-pandemic push for digital-based financial solutions. This trend continued into 2024, which recorded the highest number, approaching 500 publications. This year can be considered the peak phase of research development, when AI is increasingly seen as a key instrument in driving operational efficiency, data security, and the expansion of banking services.

Although there was a decline in the number of publications in 2025, the figure was still much higher than in the early period. This decline does not mean a weakening of interest in the field of research, but can be interpreted as a consolidation phase. At this stage, research tends to move from initial exploration to more in-depth, targeted research focused on strategic issues such as the integration of AI with financial regulations, data protection, and the achievement of sustainable financial inclusion. Thus, the pattern of annual publication development shows healthy dynamics, where a surge in quantity at the beginning of the period is followed by efforts to improve quality in the next stage.
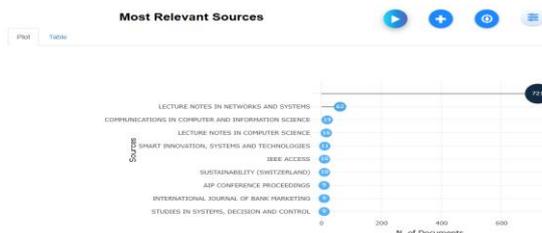

Figure 4. Most Relevant Sources (using R Studio)

Analysis of publication sources shows that topics related to the application of Artificial Intelligence (AI) in banking and financial services are widely disseminated through conference proceedings and journals focusing on technology and computer science. Lecture Notes in

Networks and Systems ranks first with 62 documents, a number far greater than other sources. This dominance can be interpreted to mean that most research related to AI in the banking sector is still published through conference-based scientific forums, where discussions on technological innovation are the main focus. Conferences with such broad coverage usually provide a space for interdisciplinary researchers to present their latest ideas, models, and empirical findings.

Other contributing sources are Communications in Computer and Information Science with 19 publications, and Lecture Notes in Computer Science with 16 documents. These two sources are also known as channels that are often used to disseminate applied research results in the field of information technology. The presence of Smart Innovation, Systems and Technologies with 11 documents, IEEE Access (10 documents), and Sustainability (Switzerland) (10 documents) further emphasizes that the theme of AI in banking has touched various scientific fields, ranging from engineering technology, information systems, to sustainability aspects.

In addition, several journals that are more specific to finance and marketing also appear on the list, although the number is relatively small. For example, the International Journal of Bank Marketing, Studies in Systems, Decision and Control, and AIP Conference Proceedings each contributed nine documents. This pattern shows that even though the focus of the research is banking, the dominant publication channels still come from academic forums with a technological orientation. In other words, research on AI in finance is still largely positioned as part of technical innovation rather than as a purely economic or managerial issue.

This distribution also provides an overview of the direction of research development. The high concentration on proceedings indicates a tendency to explore and test new models that require a fast forum for sharing preliminary research results. Meanwhile, the presence of journals such as Sustainability indicates that in recent years there has been a shift in attention towards sustainability issues and the social impact of technology implementation. This shows a transition from research that initially focused on technical aspects to more multidisciplinary research, linking the dimensions of technology with regulation, marketing, and economic sustainability.

Thus, analysis of publication sources not only reflects the main channels for knowledge dissemination, but also confirms how the topic of AI in the banking sector is positioned in the global academic discourse: from pure technology to integration with cross-disciplinary strategic issues.

Figure 5. Countries' Scientific Production (Using R Studio)

Mapping the distribution of scientific publications shows an uneven concentration of research across countries. Based on the visualization, India appears to be a center of scientific production with the highest publication intensity, as indicated by the dominant dark blue color. This position signifies that India has a significant contribution to the relevant literature, while also illustrating its strong academic capacity and more established research ecosystem support in the fields of technology and digital finance. Other countries such as the United States, China, South Korea, and several Western European countries are also quite active, although with a relatively lower intensity compared to India. This pattern shows strong international competition and collaboration, especially in regions known as centers for information technology and digital banking development.

Meanwhile, countries in the Southeast Asian region, including Indonesia, show a limited level of scientific production. Although their contribution is not as significant as countries with a long tradition of research, the presence of publications from this region indicates the potential for broader research growth in the future, in line with the increasing digitization of the financial sector.

Overall, this distribution confirms that research on the application of artificial intelligence in the banking sector is global in nature, but with a strong dominance from countries with high research capacity. The imbalance in the distribution of publications also indicates that opportunities for strengthening research in developing countries remain open, especially in the context of more inclusive financial technology integration.

Figure 6. Most Cited Countries (Using R Studio)

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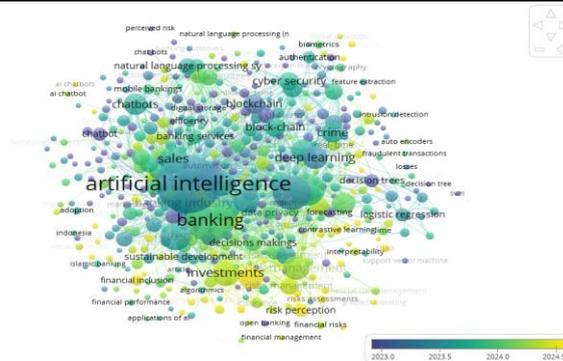

Figure 7. Network Visualization of AI in Banking (Using Vos Viewer)

The image above shows a bibliometric mapping in the form of a visualization of keywords used in publications related to artificial intelligence (AI) in the banking sector. The size of the nodes reflects the intensity of keyword usage, while the colors indicate the connections between theme groups. It can be seen that the terms artificial intelligence and banking dominate the map with the largest node sizes, indicating that these two topics are the center of academic discourse in the analyzed literature.

In addition, there are a number of clusters grouped based on thematic proximity. The red cluster, for example, is largely related to the topics of chatbots, banking services, and natural language processing, which indicates the important role of conversation technology in digital financial services. Meanwhile, the green cluster focuses on issues such as deep learning, cyber security, blockchain, and fraud detection, confirming researchers' great attention to security aspects and advanced algorithms in supporting banking systems. The blue cluster highlights the interrelationship between the banking industry, investments, and sustainable development, which shows the economic and sustainable development dimensions in AI adoption.

The interconnection between clusters shows that research in this field does not run separately, but rather complements each other. For example, the application of deep learning and blockchain is not only related to security, but also supports chatbot-based banking services and more efficient investment strategies. Thus, this keyword map provides a comprehensive overview of the direction of AI research in banking, where issues of technology, security, services, and economic sustainability are interconnected in a single scientific ecosystem.

Figure 8. Overlay Visualization of AI in Banking (Using Vos Viewer)

The image shows a keyword-based bibliometric visualization that takes into account the temporal dimension of publications. The overlay visualization provides perspective on the temporal dynamics of research in the field of artificial intelligence in the banking sector. The color representation in this map shows the dimension of time, where darker shades generally reflect long-studied themes, while lighter colors indicate relatively new and developing issues. Thus, this visualization allows readers to explore how the focus of academic studies has shifted from basic aspects to more complex and cutting-edge topics.

In the early stages, research focused on basic concepts such as artificial intelligence, data mining, and conventional banking services. These topics served as a foundation for understanding how AI technology could be applied to improve efficiency and support operational functions. As the need for security and reliability in digital financial systems increased, academic interest began to shift to topics such as fraud detection, cyber security, and blockchain integration. This shift in research direction was in line with the emergence of new challenges faced by the banking industry, particularly in dealing with transaction risks and data protection. In the more advanced visualization layer, a number of keywords are displayed in bright colors, including chatbots, natural language processing (NLP), customer experience, and financial inclusion. The presence of these themes reflects a new orientation that emphasizes user interaction and the socio-economic aspects of AI implementation. For example, NLP-based chatbots are seen as capable of expanding access to financial services while improving customer experience, while the issues of financial inclusion and sustainable development demonstrate the role of AI in supporting an inclusive and sustainable development agenda.

In addition to confirming the shift in focus from the past to the present, the overlay visualization also implies the direction of future research development. Issues highlighted in bright colors are likely to become major themes in the literature in the coming years. This situation opens up opportunities for cross-disciplinary collaboration between technology experts, economists, and policy makers. In other words, this visualization not only serves as a trend map, but also as a strategic basis for developing a further research agenda, including the identification of areas that are still rarely studied but have the potential to make a significant contribution.
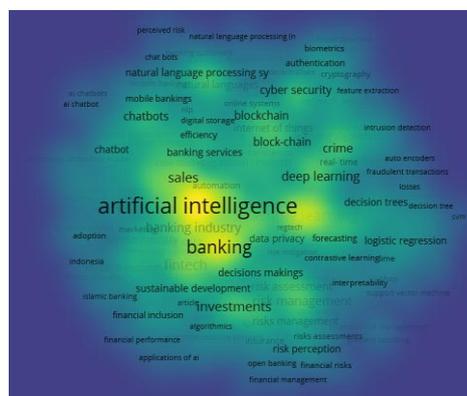

Figure 9. Destiny Visualization of AI In Banking (using Vos Viewer)

Density-based visualization mapping provides an overview of the intensity and interconnectedness of topics in research on the application of artificial intelligence in the banking sector. In this map, the density of colors and the size of terms indicate the frequency of keyword occurrences while also marking their strategic position in the literature. The brighter or denser an area is, the greater the contribution of that topic in shaping scientific discourse in this field.

The mapping results show that the terms artificial intelligence and banking occupy the center with the highest dominance. This position is reasonable because these two terms are the main conceptual frameworks that bind all related research. Surrounding them are other keywords such as deep learning, cyber security, blockchain, and natural language processing, which form a dense cluster. This interconnection shows that studies on AI in banking do not only focus on basic algorithms but also develop issues such as data protection, system transparency, and the strengthening of digital-based services. In addition, there are other important nodes that link technology with economic and managerial aspects. Keywords such as investments, risk perception, decision making, and sustainable development indicate an increasingly multidisciplinary direction of research. This confirms that the use of AI in banking is not solely intended for technical automation, but also serves as a strategic instrument in risk management, supporting financial inclusion, and strengthening the sustainable development agenda.

Furthermore, the density map also displays more specific themes, such as fraud detection, logistic regression, interpretability, and customer experience. The presence of these terms reflects a trend toward increasingly detailed research, both in technical aspects and practical implementation challenges. This is in line with global developments, where artificial intelligence is seen not only as a tool for automation, but also as a means to increase public trust, service effectiveness, and the operational efficiency of financial institutions.

Overall, this density visualization not only shows the dominant keywords, but also illustrates the evolution of the direction of research. Topics with high concentration in the center represent established foundations of study, while keywords on the periphery open up opportunities for new, rarely explored avenues. Thus, this map can be used as a reference for understanding the dynamics of knowledge and identifying areas of research with potential for further development.

5. Conclusions

This study provides evidence of the increasing role of Artificial Intelligence (AI) in banking and financial services, particularly in the era of accelerated digital transformation. The bibliometric analysis of Scopus data from 2020–2025 shows a significant upward trend in scientific output, with the peak occurring in 2024. Research activity during this period highlights strong collaboration among authors and institutions, as well as notable international contributions, reflecting the global relevance of AI in financial innovation.

The mapping and visualization results underline the central position of AI and banking in the research landscape, while keyword clusters reveal diverse focal points ranging from fraud detection, cybersecurity, and blockchain to customer service applications such as chatbots and natural language processing. The overlay visualization further illustrates the temporal dynamics of the field, showing how earlier studies concentrated on technical functions, whereas more recent publications have shifted attention toward broader themes such as financial inclusion, investment strategies, and sustainable development.

Taken together, these findings suggest that AI research in banking is evolving from a purely technological orientation toward a multidisciplinary domain that integrates efficiency, security, and socio-economic goals. For Indonesia, this trajectory is particularly relevant as the banking sector faces both opportunities and challenges in digital adoption, including infrastructure limitations, privacy concerns, and gaps in digital literacy. Thus, the study contributes not only to mapping the scholarly discourse but also to informing policymakers and practitioners about the strategic role of AI in building a more secure, inclusive, and innovative financial ecosystem.

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