Applications of Artificial Intelligence (AI) and Machine Learning (ML) in the Mobile Banking Services Industry: A Bibliometric Review.

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Abstract. *This study aims to explore the research on AI and ML Applications in Mobile Banking Industry Services conducted by previous researchers. Data was collected from the Scopus database using five keywords with the addition of terms and phrases, namely OR and AND according to the researcher's theme. The search results resulted in 283 publications published according to related issues. The data was analyzed using the VOS-Viewer and Biblioshiny applications in R-Studio. The results of the bibliometric analysis with biblioshiny describe the five categories identified by the researchers, namely: articles, sources, authors, institutions and countries described in each of the 10 most relevant images. Meanwhile, the results of bibliometric analysis with VOS-Viewer are described using Co-occurance with item analysis all keywords which shows that Artificial Intelligence and Machine Learning citations are often used or encountered in research. This can be a source of insight for new researchers in the growing future.*

Keywords – *AI; ML; Mobile Banking Finance*

I. INTRODUCTION

The use of AI and ML has changed the way businesses operate in recent years [1]. The banking sector is no exception, artificial intelligence (AI) and machine learning (ML) are delivering major changes that can be implemented to improve operational efficiency and improve customer experience in the use of applications Mobile banking [2]. The availability of large digital data resources and advances in algorithms and computing are enabling the banking industry to adopt AI more broadly. This is able to provide impetus and demand in the banking industry for the need for more flexible and responsive services to global trends, this trend is also reinforced by demographic shifts, where many millennials prefer the convenience of online and mobile transactions [3]. One of the AI features that is often used in Mobile banking be Chatbots and Biometric which is capable of being a tool for detection, security and information in financial transactions [4]. So it is not surprising that the increasing number of generations that Mobile Banking is one of the most efficient and flexible transaction alternatives that are often used and because of the existence of useful features according to customer needs. Therefore, the researcher used bibliometric analysis which aims to provide a comprehensive overview of the current research conditions, namely AI and ML applications in the use of Mobile banking [5].

Banks leverage increased consumer understanding to personalize their products and services. ML algorithms analyze customer data starting from transaction services, managing accounts, and making payments. Several banks are already implementing AI to improve customer service, including chatbots, natural language processing, and sentiment analysis. On the service Chatbots Functions to communicate with customers as bank representatives [6]. In addition, before making a transaction, of course, you need a method Biometric, namely fingerprint scanning or facial recognition that is useful for authenticating customer identity [7]. So that customer identity can be verified safely and easily when transacting.

The emergence of Chatbots has several uses, such as being interactive in conducting conversations or chatting like humans but using the help of AI and being able to study the history of activities carried out by customers so that they are able to complete information while providing fast, complete and accurate solutions [8]. In addition to chatbots, there are other uses of AI that help transaction activities that require authentication known as personal identity or personal biometrics consisting of fingerprint recognition, iris and photo so that activities can be verified easily, quickly and safely and avoid theft of M-Banking data [9]. Overall, the application of AI enables the industry to automate business processes, big data processing and deep analytics to provide faster and more accurate solutions for customers. In addition, the use of AI can also improve efficiency on the internal side of banking, including decision-making, risk management, and fraud or cyber detection. [10].

In the context of growing technology with M-Banking research breakthroughs over the past period, there has been a review of researchers on AI and ML in Mobile banking providing an understanding of the sophistication

of technology produced from smartphones and applications, so that customers choose to use M-Banking for their transaction needs [11]. However, there hasn't been much research that provides a thorough understanding of how AI and ML applications can provide personalized experiences and customer satisfaction that can be achieved in Mobile banking [5]. To address this gap, researchers use Bibliometric Analysis to explore previous research on AI/ML technology in the industry Mobile banking [12]. Bibliometric analysis comes from the word bibliography meaning book and metric meaning to measure, so bibliometric is defined as measuring or analyzing books and literature using a statistical approach [13]. Systematically researchers analyze citations, themes and scientific publications based on case studies [14]. To provide a broad and comprehensive overview of artificial intelligence (AI) and machine learning (ML) in the industry Mobile banking and provide direction in the future [15].

In research, data collection methods are essential to substantiate results. The researcher used previous studies as a guide to develop more innovative research. Two studies related to bibliometrics and AI/ML in mobile banking were found. The first study by Melly Susanti & Heru Kreshna Reza (2022) analysed 200 publications (2012-2016) to understand consumer behaviour in mobile banking using VOS-viewer. The second study by Ayman A. Alsmadi et al. (2020) analysed 1206 publications (2000-2020) to see the development of mobile banking globally with VOS-viewer and Excel. Both studies used VOS-viewer to map relationships between keywords, authors, institutions, and journals. We applied bibliometric methods with VOS-viewer and Publish or Perish to analyse research trends, identify gaps, and enrich understanding in the banking industry, given the limited studies on mobile banking.

Therefore, it is hoped that this research can provide the disclosure of the latest promising trends in the application of AI and ML in the banking industry from time to time so that it can be used for future researchers to add the latest trends through research. This is also important for the banking industry, which is able to provide an understanding of technology and benefits to the industry, with this study helping to build collaboration between banks and academics as well as support for governments and regulators in making more strategic decisions to adopt AI and ML to improve services in the future.

II. METHOD

This study uses a quantitative method while the analysis carried out by the researcher uses bibliometric analysis by collecting literature results obtained from the Scopus database [16]. Article search using the scopus database on AI and ML Applications in Industry Mobile banking. The search was carried out using three keywords, namely "Artificial intelligence applications", "Machine Learning" and "Mobile banking" accompanied by relevant terms and phrases such as the addition of the phrase OR, AND and the terms AI, ML, Banking and Finance. The results of the article search resulted in 283 publications related to research issues. Then the data of articles, sources, authors, institutions and countries using the biblioshiny application. As for the network of occurrences, the most common keywords are found using VOS-Viewer analysis. Bibliometric analysis is used to describe articles, authors, institutions and countries showing each of the 10 most relevant images [17].

III. RESULT AND DISCUSSION

A. Key Information

This section discusses the main information about the application of artificial intelligence and machine learning in the mobile banking service industry based on the Scopus database. This data is a source for categories in research such as, the growth of research publications in various countries in the world by year, relevant authors in publications, the number of relevant publications by institution and the most relevant publication sources. Although it only uses a span of 5 years, it is only in 2023 that it will become the center of research development in this field. There are two types of documents used to display publication data regarding artificial intelligence (AI) and machine learning (ML) applications in the Mobile banking service industry, namely articles and conference papers, article document types with 107 documents and conference paper document types with 176 documents.

Table 1 Data Information

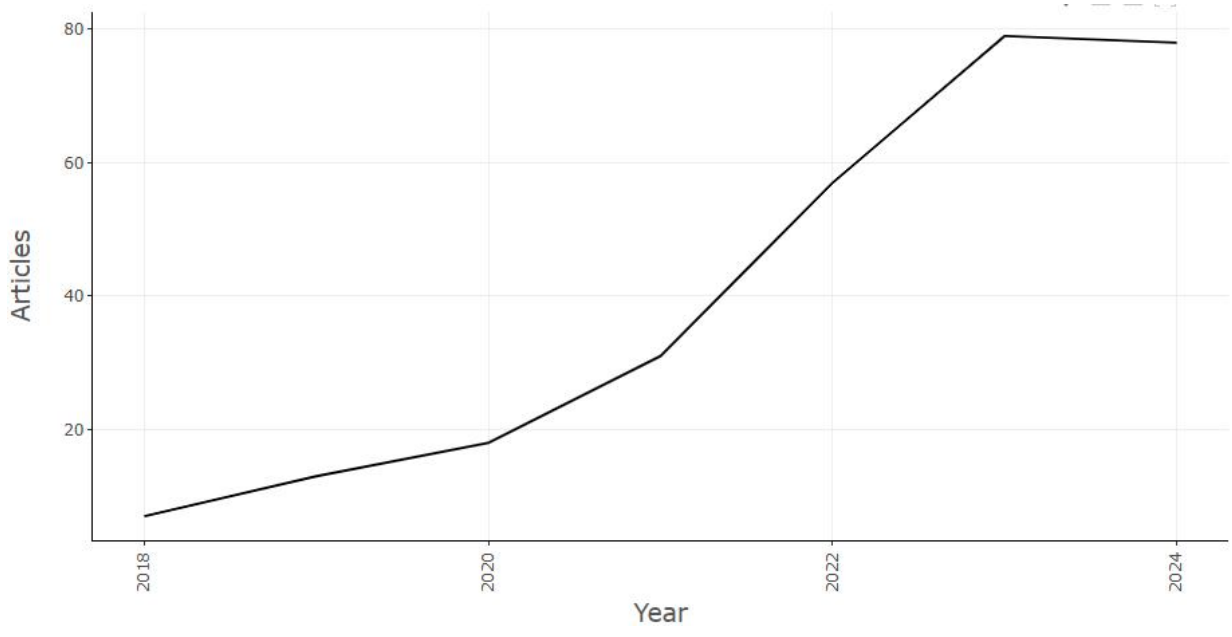
Description	Result
KEY INFORMATION ABOUT DATA	
Time Range	2018:2024
Sources (Journals, Books, etc)	212
Document	283

Annual Growth Rate %	49.45
Average Age of Documents	1.64
Average citations per document	12.84
Reference	9541
CONTENTS OF THE DOCUMENT	
Keywords Plus (ID)	2143
Author Keywords (DE)	883
WRITER	
Writer	988
Single authored document author	26
AUTHOR COLLABORATION	
Single-written documents	26
Co-Authors per Doc	3.64
International co-authors %	18.73
DOCUMENT TYPES	
article	107
Conference Paper	176

Sources: Web Interface Biblioshiny, R Package

B. Annual Scientific Production

The results of the literature search using the Scopus database with three keywords "artificial intelligence applications OR AI", "machine learning OR ML" and "*Mobile banking* OR banking OR finance" resulted in 283 documents. The document was published from 2018 to 2024. All of these documents are sourced from the type of document articles and conference papers. Graph 1 shows the growth of the number of articles per year.



Graph 1. Annual Scientific Production

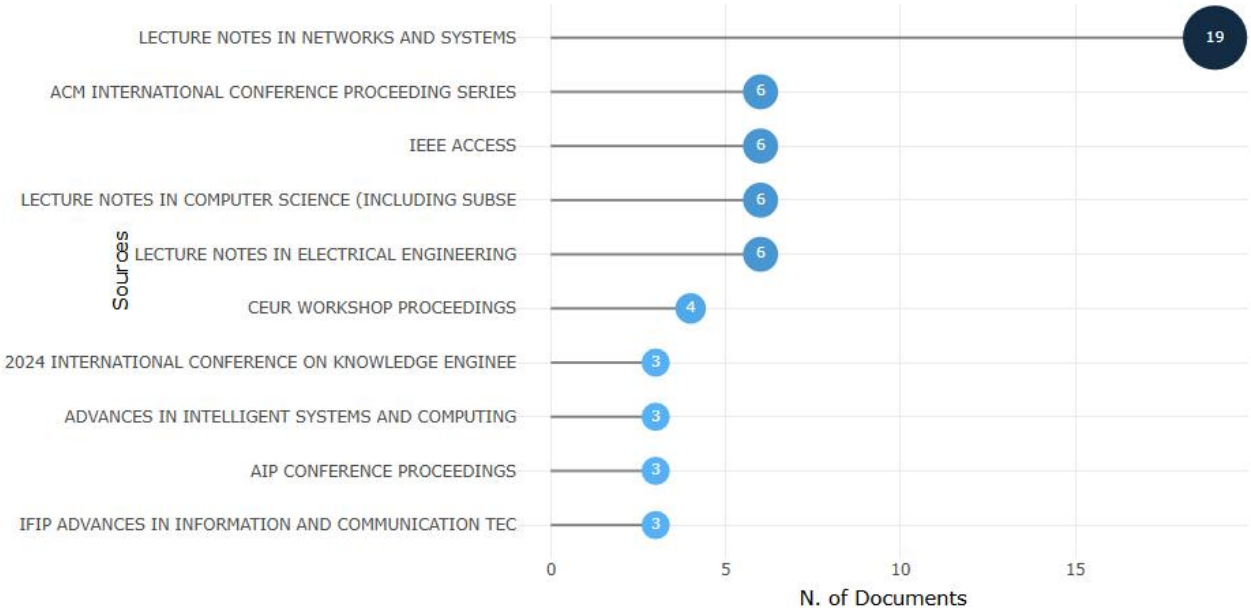
Sources: Web Interface Biblioshiny, R Package

Based on graph 1, the development of article production with the theme of artificial intelligence (AI) and machine learning (ML) applications in the industry Mobile banking tend to increase from year to year. In the 2018-2020 period, articles slowly increased but consistently, meaning that researchers slowly built a more solid scientific network, until in 2020-2023 there was a significant surge in the production of research articles in the field of

technology that discusses Machine Learning and service in use Mobile Banking. So that This happened in 2023, which is the highest peak The number of article publications according to the 5-year period was 79 articles, of which all the articles were sourced from 72 publications that were dominated by one source, namely "Lecture Notes In Networks And System" which consists of 4 articles. But, apparently In 2024, there will be an increase with the number of 12 articles on the dominant source, however, the number of publication sources has also decreased from 72 to 56 sources. That way, the total number of article publications in 2024 is 78 articles with a discussion of education technology and access to information so as to reflect commitment and collaboration in knowledge [18].

C. Relevant Resources

Based on the results of data analysis using Biblioshiny, there are ten most relevant sources for AI and ML themes in the Industry Mobile banking shown in Figure 2.



Graph 2 Most Relevant Resources

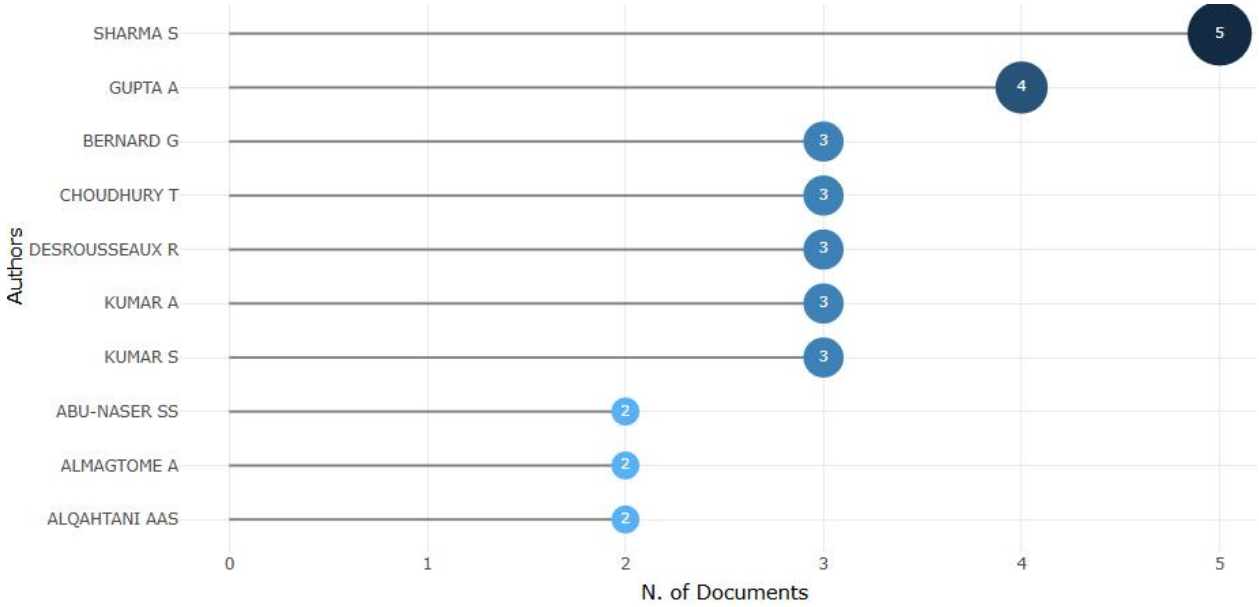
Sources: Web Interface Biblioshiny, R Package

Graph 2 explains that the first of the ten most relevant sources in the research publications of artificial intelligence (AI) and machine learning (ML) applications in the industry Mobile banking be Lecture Notes in Networks and System with a total of 19 articles, This source includes a wide range of research in network and communication systems and this is evident from the contributions of the most authors who use the it is Kumar and his colleagues who show a significant focus of research on learning the use of ML Techniques in the world of banking and finance [19]. Of course, this also applies to other sources, where they also cover the fields of information technology, machine learning, artificial intelligence and computer science. Apparently, the source that ranked first reached its peak of production in 2024, so that this number is included in the most sources among the 212 publication sources that can be identified in the study. Because it is also known that there is a relationship with the development of the production of the number of articles per year where, related sources are indeed superior in article production in 2024.

By including relevant sources in the study, it is possible to find out how many publications there are and the significant impact of the credibility and relevance of the topic on each source. One of the benefits that arises is in the form of access to the latest research trends, increasing the validity of research and being able to spread knowledge more widely, so that it can be accessed by the global scientific community.

D. Most Trelevant Authors

Based on the results of biblimetric analysis using biblioshiny, there are 988 authors in the publications identified in this study and the number of articles written by a single author is 26 articles. Graph 3 shows the ten most relevant authors for related themes.



Graph 3 Most Relevant Authors

Sources: Web Interface Biblioshiny, R Package

Graph 3 shows the most relevant authors, where the researcher took the 10 most relevant authors. In the first place is occupied by Sharma S with the acquisition of 5 articles published in 5 publication sources with 1 article each on related publication sources. This is also influenced because Sharma S is known in his research as the main author so that he is able to identify research topics and is able to integrate research findings into a complete and persuasive narrative [20]. In addition, Sharma S is also a researcher in the field of artificial intelligence and often conducts interesting research in the field of science [21].

While for the second place is occupied by Gupta A and followed by other co-authors, this happens because not all members of the research team prioritize scientific publications, some may focus on data collection, experiments and administration so that their contributions are not reflected in the number of publications [22].

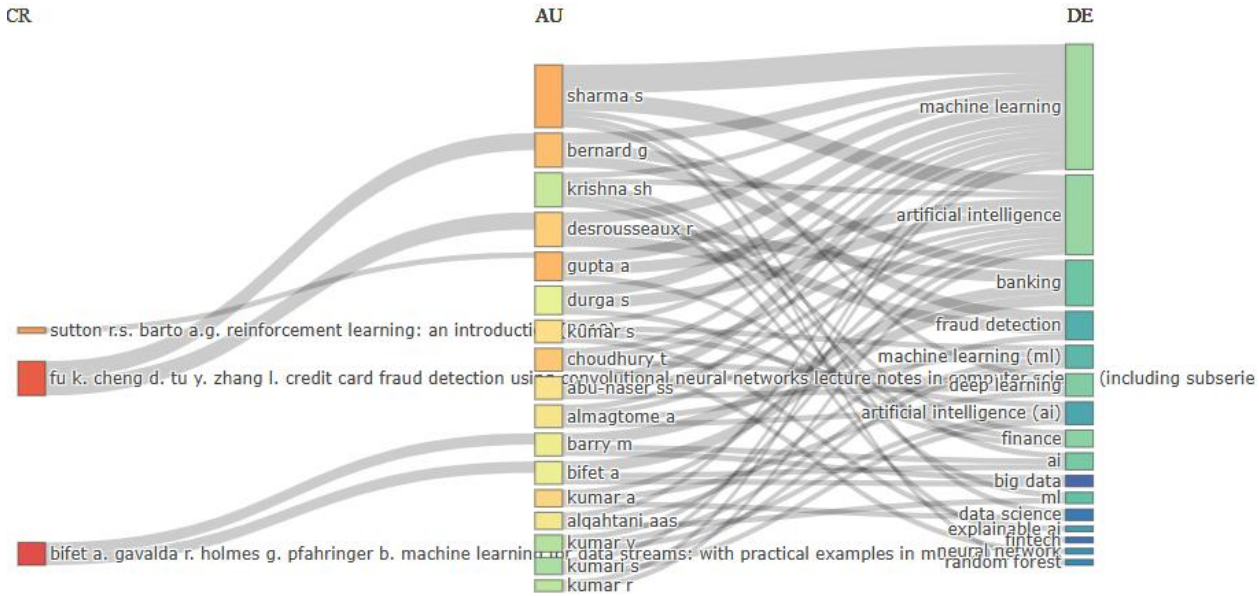


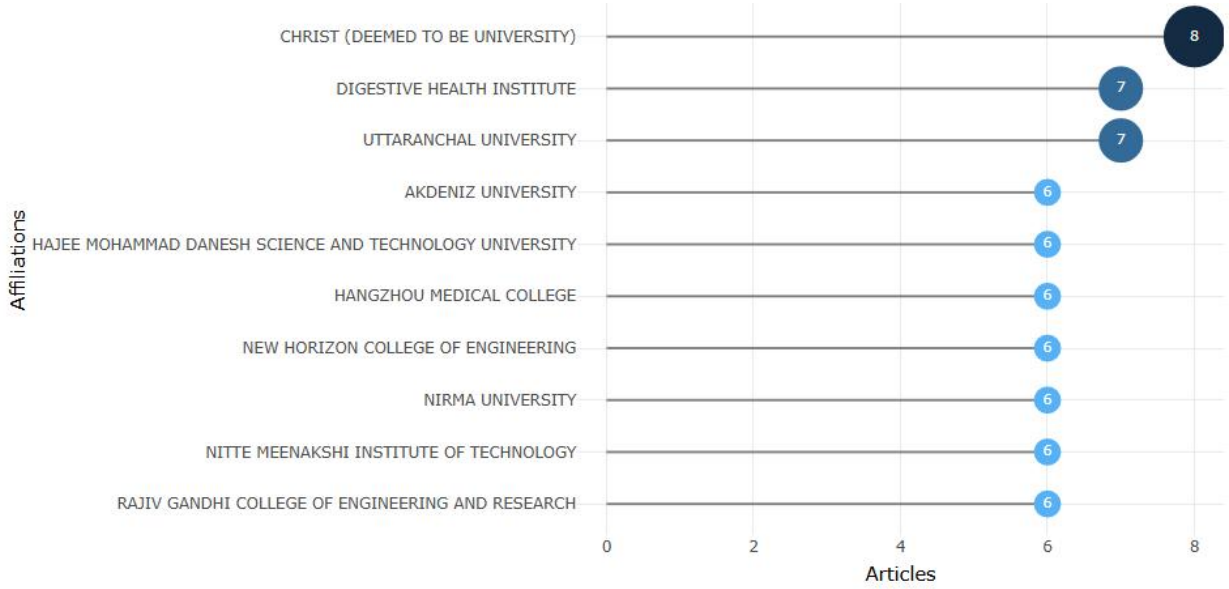
Figure 1 Three Field Plot

Sources: Web Interface Biblioshiny, R Package

It can be seen in figure 1 that the article written by Sharma S uses the most keywords about “Machine Learning”, Where in several articles he writes about the application of machine learning techniques in banking risk management, including operational risk and liquidity. In his research, he found that there are still many areas in banking risk management that have not been adequately explored and can benefit significantly from the application of machine learning, as well as discussing the adoption model of mobile banking services that is governed by the use of machine learning technology and artificial intelligence. [23]. This is done for the knowledge of information from an image, although there are still few that discuss the trend of AI and ML research themes in Mobile banking. This image only shows keywords used by researchers related to previous research to become topics and trends as well as future directions.

E. Most Relevant Institutions

Based on the results of data analysis using bibliometrics, there are ten relevant affiliations/institutions regarding the related research theme in Graph 4.



Graph 4 Most Relevant Institutions

Sources: Web Interface Biblioshiny, R Package

Graph 4 explains that of the ten most relevant institutions/organizations in the study, there is one institution that stands out the most, namely Christ (Deemed To Be University) with a fairly high number of article publications. In addition, it turns out that Christ is a university from India that was previously called Christ College, this is known from the source of the Christ University website. Of course, this institution is very significant with the category of national scientific production, so it is appropriate that India is dubbed as the country with the highest frequency of scientific publication contributions.

The institutions that specialize in the health sector appear in the most relevant graphs, because, researchers use AI and ML keywords in searching for data, so that their research is also identified, but researchers only research on first-ranked institutions.

The comparison of superior institutions with other institutions can be influenced because each institution may have different networks and research fields, as well as the lack of cooperation at the international level [24].

F. State Scientific Production

The researcher also discusses ten countries that contribute to scientific publications on artificial intelligence and machine learning in industry Mobile banking, based on data obtained by researchers, found that the INDIA country ranks first with 409 frequencies of scientific publications related to research, this is reviewed from the country's production every year and occurs in 2024. and then followed by the USA with 99 frequencies. Meanwhile, the tenth place is occupied by the state of INDONESIA with the acquisition of 14 frequencies. It is known that 9 out of 10 countries with the contribution of scientific publications, if combined with the number of frequencies, have not been able to exceed the number of frequencies owned by the INDIAN country, which can be seen in table 2.

Table 2 Countries Contributing Scientific Publications

Country	Frequency
INDIA	409
USA	99
UK	52
CHINA	40
AUSTRALIA	37
FRANCE	23
SAUDI ARABIA	22
MALAYSIA	19
BANGLADESH	14
INDONESIA	14

Sources: Web Interface Biblioshiny, R Package

Overall, this illustrates the inequality of contribution distribution between countries, where some countries, especially India, hold the dominant portion, while other countries have a more evenly distributed distribution but with lower numbers, so that there is a significant variation in representation or activity among these countries. Moreover, India is known for its vast number of Engineering, Scientists and AI research and is the fourth-largest proudsen of AI-related scientific papers since 2020. This factor adds to India's innovation ecosystem to become one of the world's leading research centers [25].

In addition, in India, there are also many researchers who discuss AI and ML in the banking industry that focus on the use of features *chatbots* for customer service automation, then focus on fraud detection and customer segmentation. Banks in India are working with fintech startups to improve customer experience, reduce costs and improve operational efficiency [26] .

So it is very relevant and natural why in this contribution to scientific publicity, India is the country with the greatest frequency among other countries. It is also interrelated with the Institutions identified by the researcher that the category is indeed of Indian origin.

G. Keyword Event Network

In the analysis of the keyword occurrence network, the researcher used the V0S-Viewer analysis shown in Figure 7. In the figure, the network of events contained in the topic of AI and ML in the Mobile banking industry occurs in 6 interconnected clusters. Cluster 1 is marked in red including artificial intelligence, AI learning, AI methods, banking sectors, blockchain, chabots and machine learning. Furthermore, cluster 2 is marked in green covering finance, financial transactions and customer experience, then in cluster 3 it is marked in dark blue which includes AI technology, financial sector and system. Then, in cluster 4 it is marked in yellow which includes bibliometric analysis and finance industry, while in cluster 5 it is marked purple which only includes machine learning and the last in cluster 6 it is marked in light blue which covers the banking industry.

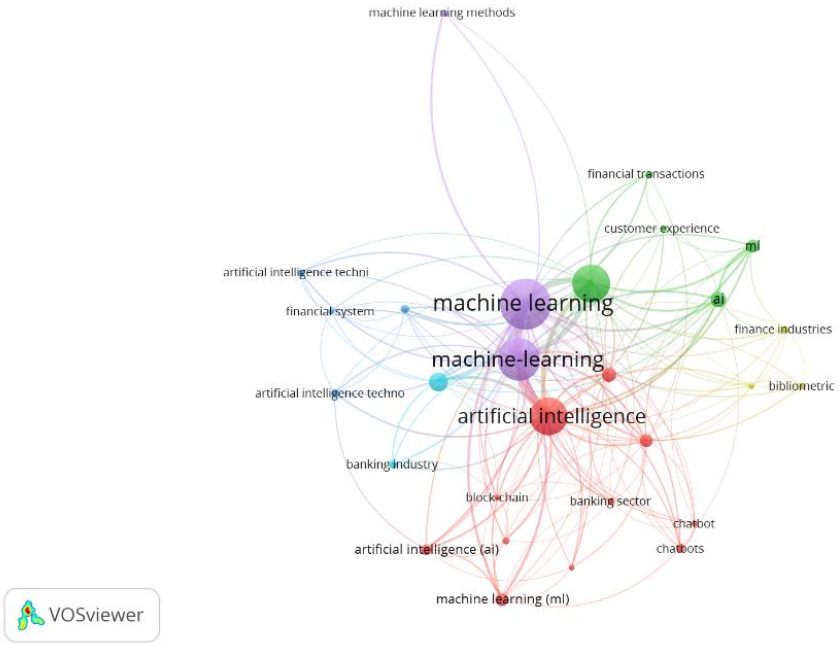


Figure 2 Keyword Event Network

Sources: Web Interface Biblioshiny, R Package

In the event network, it can be displayed that keyword events that are often encountered and interconnected with other networks, namely clusters 1 and 5, include artificial intelligence and machine learning.

IV. CONCLUSION

This research shows that the application of AI and ML in the Mobile Banking industry has experienced rapid development in recent years, using Bibliometric Analysis with data collection obtained through the Scopus database with keywords related to AI, ML and Mobile Banking, documents obtained as many as 283 publications using the time span from 2018 to 2024, where in the development of the number of articles per year there has been a decrease and increase. The findings suggest that technological developments are not just a temporary trend, but part of a broader digital transformation. Therefore, academics and practitioners need to continue to explore the application of more advanced AI to improve the efficiency of banking services.

Meanwhile, the results of the review of the research literature show indications that AI has a significant impact and has been widely used in digital banking business models, especially in transaction security, service personalization and customer service automation. The method used in this study is Bibliometric analysis with a coercive approach carried out using the Biblioshiny data processing program and the VOS-Viewer application. Bibliometric analysis with Biblioshiny is used to describe the number of articles per year, sources, authors, institutions and countries shown with each of the 10 most relevant images. And the VOS-Viewer application is used to describe a network of keyword events that are often encountered or interconnected in scientific publications. Based on bibliometric analysis with biblioshiny, it shows that the most publications occurred in 2023, where the most relevant source results are Lecture Notes in Network and System, with the most prolific author contributing being Sharma S, while Crist (Deemed To Be University) became the most active institution in this research and scientific publications were dominated by the state India, US and UK. Meanwhile, academic institutions and universities in other countries, including Indonesia, need to increase participation in research related to AI and ML in the banking sector. Results of bibliometric analysis with the VOS-Viewer application with Co-occurance, that the network of keyword occurrences that are often encountered and interconnected is Artificial Intelligence and Machine Learning. Among all research categories, there is a significant relationship such as the development of articles per year related to relevant sources and institutions are also related to state scientific production.

This research can provide opportunities and an overview for a more in-depth and comprehensive follow-up study of current research trends. Some of the topics that need to be explored further are service personalization, the impact of AI on customer satisfaction and the development of better security system optimization based on AI and ML in services Mobile banking.

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Conflict of Interest Statement:
The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.