Artificial Intelligence and Financial Inclusion: A Systematic Literature Review

Anam Fazal[1], Alia Ahmed[2] and Shoaib Nisar[3]

Abstract
Artificial Intelligence (AI)'s revolutionary impacts have transformed all sectors of the economy, including financial services. AI has brought a paradigm shift in increasing financial inclusion in an economy. Financial inclusion provides financial services to all segments of society according to their needs at affordable costs. It is an essential enabler of the sustainable development agenda set by the United Nations. The prosperity of countries is highly dependent on the level of financial inclusion, and AI plays a significant role in its achievement. This concept's importance has grabbed researchers' attention in the last decade. This paper presents a systematic literature review of scholarly research on implementing AI for financial inclusion. It began by reviewing two databases' articles, including Emerald and Science Direct. From this, the paper presents dimensions of research on AI and financial inclusion that researchers have explored. This systematic review finds significant concluding remarks. The literature explains the importance of AI in achieving financial inclusion, but there needs to be more AI and ML methodologies in research. The research identifies implications for future research and critical practice areas in AI and financial inclusion.

Keywords: Financial inclusion; Artificial intelligence; Systematic review

Introduction

The latest report by Global Findex data is reporting that financially included people in the world are 76%. Despite all the efforts at the macro level, there remains a specific percentage of unbanked adults worldwide. It implies that a lot of people in the economy are facing the issue of financial exclusion. Financial exclusion results in discrimination among economies, leaving a particular class of people unserved (Kling et al., 2020). These facts appeal to researchers to continue their research on financial inclusion. Moreover, there is a need to understand the body of research on this critical topic.

With technological advancements, the financial sector has been supervised by the technological revolution. Big data, Artificial Intelligence (AI), industry 4.0., Internet of Things (IoT) and Machine Learning (ML) techniques are revolutionizing the provision of products and services from the financial sector to the people. The most remarkable impact of technology is seen in AI. AI takes the concepts of human intelligence and machines are trained to learn, predict, and decide based on data (Hassani et al., 2020; Truby et al., 2020). Machines are inclined to think, create, and react to data with the help of AI.

[1] *Ph.D Scholar, School of Business Administration, NCBA&E, Lahore, and Lecturer, Department of Management Sciences, Lahore Garrison University, Lahore, Pakistan, Email: anamfazal@ncbae.edu.pk*
[2] *Dean & Professor, School of Business Administration, NCBA&E, Lahore, Pakistan. Email: dralia@ncbae.edu.pk*
[3] *Assistant Professor, Department of Management Sciences, Lahore Garrison University, Lahore, Pakistan, Email: shoaib.nisar.210@gmail.com*

All over the world, governing bodies are working to improve their efforts in enhancing financial inclusion with the help of digitalization and technology. Moreover, the United Nations' sustainable development agenda stresses financial development and financial inclusion in countries. The Alliance for Financial Inclusion (AFI) (2018) proposed a four-pillar system for ensuring financial inclusion in an economy, with infrastructural and regulatory assistance. Pillar 1 provides digital identification, electronic KYC, and a streamlined account opening procedure. The facilitation of open electronic payment systems and supporting policy and regulatory infrastructure is pillar 2. The third pillar is the electronic availability of tools for gaining access to financial services. The fourth pillar is developing a digital financial system for value-added products and services to assure access, utilization, and stability. These efforts imply that policyholders should work on the provision of financial services and products by taking advantage of AI.

Considering this debate, over the last two decades, countries of the world have started putting their efforts into the advancement of financial inclusion with the help of technology. Similarly, researchers are also trying to bring the attention of policyholders towards introducing AI tools and techniques for including people in the financial sector. It raises a need for a systematic review of research papers on the topic of AI and financial inclusion. Mhlanga (2020) performed a documentary analysis on studying the effects of AI on digital financial inclusion. This study discusses the need for AI adoption in the financial sector to achieve financial inclusion.

Moreover, the usage of ML techniques has also been highlighted. This current study aims to explore the areas the researcher has studied for AI implementation to achieve financial inclusion. The second objective is to recommend solutions based on previous research for achieving optimal financial inclusion in a country. Based on these objectives, this research addresses the following question: What areas have researchers studied related to AI and ML implementation for achieving financial inclusion?

In order to answer these questions, this research is adopting the PRISMA technique for systematic literature review. Research articles from two important databases have been selected for review. After analysis of selected articles, dimensions of research related to AI implementation for financial inclusion have been highlighted.

This research article has been organized as follows. Part 1 is the introduction of the research article explaining the research objectives. The second part presents a literature review regarding AI and financial inclusion. The methodology of the systematic literature review has been explained in the third section. Part 4 discusses the research findings. In the last section, the conclusion of the study is presented.

Literature Review

Since the last two decades, there has been a tremendous wave of disruptions in the financial sectors due to technology. There are many dramatic stories of the impact of digitization in financial services. One famous example is M-Pesa, which has lifted the people from the poverty line in Kenya. Digitalization in China's financial system and the example of the 'India stack' in India are some of the remarkable breakthroughs of increased financial access with the help of technology (AFI, 2018). Hua, Huang, Zheng (2019) reviewed articles about emerging areas in finance like crowdfunding and blockchain. They talked about the benefits of fintech inventions. Such discoveries attract inventors and have a favorable impact on society.

The fact cannot be denied that technology is compulsory for all the financial system processes and for achieving financial inclusion. This fact is also demonstrated in a paper by Mogaji et al. (2021), who discussed that Marketing should use innovation and technology to reach out to the most vulnerable members of society. This study reports this fact by studying Nigerian banks' product portfolios and marketing strategies for reaching the unbanked populace.

A critical paper in this regard is by Kshetri (2021), who explained the role of AI in promoting financial inclusion in developing countries in a theoretical paper. This study has added to the literature by stating the revolutionary effect of AI reforms in regulatory compliance, fraud reduction, investment suggestion, and collections management through real-world examples. Barruetabeña (2020) discussed the role of technology in financial services in a theoretical paper. He stressed the significance of innovations in finance as a sure means to enhance financial inclusion. In another theoretical paper, Ozili (2021) discussed the benefits and challenges of AI and big data. Big data and analytics generate credit scores, reduce credit risk, improve client identification, and increase financial inclusion.

In recent years, most studies have focused on assessing the penetration of AI applications in the financial services business. Many studies investigate mobile money penetration, while others investigate the impact of chatbots or related applications. Abdulquadri, Mogaji, Kieu, and Nguyen (2021) examined the influence of chatbots on financial inclusion in Nigeria as a digital transformation tool. They used Search-Access-Test (S-A-T) to examine chatbot usage and discovered that most Nigerian banks use chatbots in English and by female identity. This change has enhanced customer involvement and financial inclusion. Hentzen, Hoffmann, Dolan, and Pala (2021) built a systematic literature review on AI and customers facing financial services in the banking sector. This research paper indicates that substantial research has been conducted in this area to evaluate the accuracy of AI in credit scoring and to analyze customer behavior toward AI adoption.

ML is a more advanced version of AI. Non-parametric models are used in machine learning, and they make the fewest assumptions from the data to allow for greater flexibility. Ismail et al. (2021) analyzed the status of financial inclusion in Africa using ML algorithms, including Random Forest, Decision Tree, Logistic Regression, Xgbossting Classifiers, Naive Bays, KNN, Gradient Boosting, Adaboosting Voting Ensemble and SVM. This study discovered that the XGBoost model has greater accuracy when comparing account holders to non-account holders in Africa. Using unsupervised ML, Kebda et al. (2021) constructed a multidimensional financial inclusion index. This study examined the association between financial inclusion and bank market structure using panel data from 17 African nations from 2004 to 2018. According to the study's findings, the effect of bank market power on the availability and accessibility dimensions of financial inclusion is supported. Akinnuwesi, et al. (2020) applied ML on financial inclusion data for governance in Eswatini. They discovered that demand-side data for financial inclusion needs to be updated. ML approaches are required to remove outliers and ensure the data quality for measuring financial inclusion.

AI plays a promising role in enhancing financial inclusion in economies. Yasir et al. (2022) discussed many barriers that restrain people from involvement in the financial sector. This paper puts forth the attention towards constraints in achieving financial inclusion. Besides mentioning all of the barriers, the authors of this research paper suggest AI as a solution to remove these barriers. Recently, a term named 'Intelligent financial inclusion' has been introduced by Fazal Ahmed (2023). This concept is the implementation of AI for removing the barriers to financial inclusion and will assist countries in achieving an optimal level of financial inclusion. One example is the ease of opening accounts in financial institutions with the help of AI. Minimum documentation requirements encourage people to participate in the formal financial sector. Another concept is robo-advisory services, which assist people in receiving honest and bias-free advice in their wealth and portfolio management (Shanmuganathan, 2020). Distributed ledger technologies and blockchain have also facilitated economic transactions and payments (Pal et al., 2021). Various other practical examples, like M-Pesa and loan applications, stress the need for time to implement AI in financial inclusion.

Considering the literature on AI and financial inclusion, it is analyzed that it is necessary to synthesize and interpret previous research on this topic to find areas for future research. This rationale becomes the base for this research.

Research Methodology

A systematic literature review technique has been adopted to fulfill the research objectives of this article. Systematic review is a best practice to answer research questions from a database of articles in a systematic way (Page, 2021, p. 3). There are various methods to perform systematic research. This article uses Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). There is an updated PRISMA 2020 guidelines, a twenty-seven-item items checklist, and a flow chart explaining the Preferred Reporting Items for Systematic Reviews and Meta-Analyses process. This paper uses the checklist and flow chart to filter the articles for systematic review (Haddaway et al., 2022). Articles in the systematic review focus on how any innovation or technology affects the financial industry and how this impacts the financial industry, increasing financial inclusion.

A table containing a checklist of all the items of PRISMA guidelines is presented below in Table 1, and a flow diagram of the PRISMA technique is presented in Figure 1.

**Table 1:** **PRISMA 2020 items checklist for systematic review on AI and financial inclusion**

Item #	Checklist item
1	Title: The title of the article implies that it is a systematic review.
2	Abstract checklist guidelines of PRSIMA 2020 are considered.
3	Rationale: There isn't a comprehensive evaluation of the literature on AI and financial inclusion.
4	Objective: The fundamental purpose is to assess the body of knowledge and research on AI and financial inclusion.
5	Eligibility criteria: Articles related to objective of the study are included only.
6	Information sources: Emerald and ScienceDirect.
7	Search strategy : Using the emerald database's advanced search site, the search phrases "artificial intelligence" AND "financial inclusion" are entered, with the 1980–2022 timeframe chosen. Research articles, book chapters, case studies, and other sorts of content (both open access and others) are all chosen. The search phrases "Financial Inclusion" AND "Artificial intelligence" are used for the Science Direct database. This search covered the topics of finance, econometrics, and economics.
8	Selection process: Manual selection of research articles.
9	Data collection process: Abstracts, methods sections, and conclusions from research articles are used to create a systematic review.
10	Data items: items are considered including Journal name, article, methodology, time span, and findings.
11	Study risk of bias assessment: No risk.
12	Effect measures: Compilation of data items.
13	Synthesis method: For synthesis, data from selected articles are added to the table. This table was reviewed by the study.
14	Reporting bias assessment: No bias.
15	Certainty assessment: No need
16	Study selection: 192 research results in emerald: (Article (96), Book part (50), Early cite article (42), Case study (2), Expert briefing (1). Executive summary (1)).

53 results in ScienceDirect.

A total of 62 studies are included in systematic review. 47 from emerald database and 15 from ScienceDirect database.

17	Study characteristics: Each study is examined using data elements.
18	Risk of bias in studies: No risk.
19	Result of individual studies: Discussion is in section 4.
20	Result of syntheses: AI and financial inclusion are the key points of research investigation.
21	Reporting biases: No biases
22	Certainty of evidence: There is certainty that that all aspects have been included.
23	Discussion: Significance of AI in achieving financial inclusion is indispensable
24	Registration and protocol: No.
25	Support: No financial support.
26	Competing interests: No competing interests.
27	Availability of data, code, and other materials: No.

Figure 1: Flowchart for selection of studies for systematic review
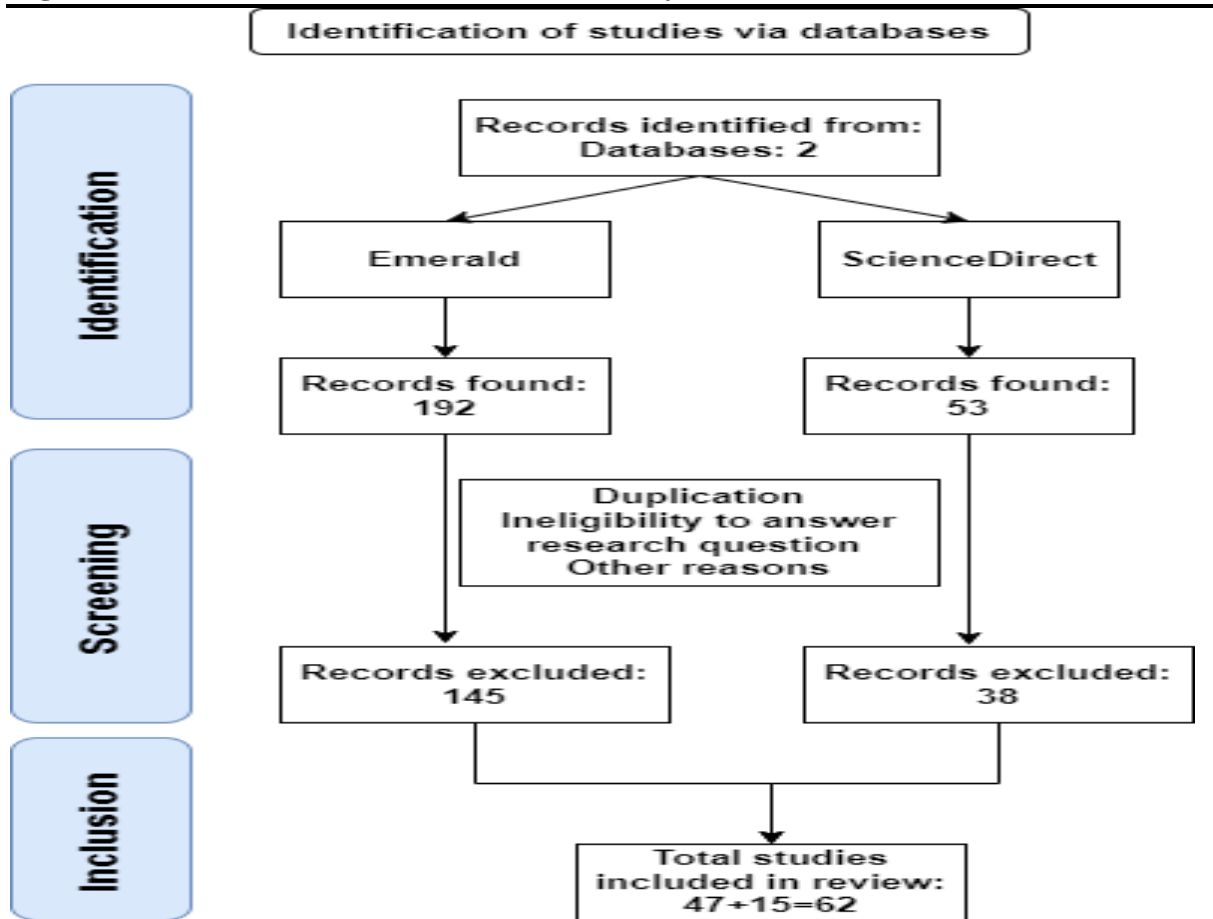
Results and Discussion

This study employs the PRISMA technique for identifying and including articles for a systematic literature review of AI in financial inclusion. The study of included articles reveals

dimensions of the research encompassing financial inclusion and AI. These core areas are discussed below as the findings of this paper.

Disruption of AI in achieving financial inclusion
The most researched area by researchers is the impact of AI techniques on enhancing financial inclusion in economies. By having a look at research articles, the significance of AI in the enhancement of financial inclusion is highlighted (Nejad, 2022; Pal et al., 2021; Mihet & Philippon, 2019; Ding et al., 2018). Studies related to this topic equally adopt qualitative and quantitative methodology. The focus of qualitative studies is the contribution of knowledge regarding AI risks or challenges and getting people's attention towards critical areas. On the other hand, quantitative studies search for people's behaviors towards AI adoption. Many research articles talk about the adoption of people and their behaviors for AI penetration in the financial sector.
Some of the research articles discuss the paradigm shifts of AI in the financial sector, while others talk about the factors affecting fintech adoption. Areas of AI advancements in finance are highlighted. Researchers also consider the critical areas of the COVID-19 pandemic Islamic-based models. Future research directions of fintech and AI are part of the papers also.

Implications for Financial Institutions
The marketing area must be allowed even in finance (Mogaji & Nguyen, 2022; Mogaji et al., 2021). Marketing manager's adoption of technology and attraction of customers have also attracted researchers. Some of the research articles also propose models for AI and finance. Big data, big tech, microfinance lending through AI, and cloud tech are prominent points of these articles.
Areas of payment, loan advancement, and investment opportunities are at the core of the revolution (Chen, 2018; Gupta & Xia, 2018). It has also improved the financing methods for firms (Jiang et al., 2022; Shao et al., 2022). AI-enabled chatbots are best for reducing risk and encouraging risk-averse investors to make decisions (Cui, 2022). There is a need for networking, an urge to change, and entrepreneurship competencies to compete with Industry 4.0. (Santoso et al., 2021; Rahim, Bakri, Fianto, Zainal, & Hussein Al Shami, 2022) There must be collaboration among banks and fintech companies to cope with innovation (Elsaid, 2021; Alblooshi, 2022).

ML in Financial Inclusion
An analysis of ML articles reveals that the benefits of big data and regtech models are the most discussed (Jiang et al., 2021) (Kurum, 2020). The efficiency of ML models is being discussed in various research articles. Moreover, credit evaluation models and other models for efficient working of the financial sector have been proposed (Zhang et al., 2022; Alonso-Robisco & Carbó, 2022; Gao et al., 2022).
Besides AI, blockchain technology also contributes to banking and financial sector innovations. A stream of articles focuses on mobile penetration for financial inclusion (Shaikh et al., 2022; Okello et al., 2020). Most of the research articles also talk about the constraints people face in accessing financial services. For example, Arora (2020) mentions that privacy issues, cultural barriers, and financial illiteracy are some barriers to financial inclusion.

AI-based Business Models
Some studies have developed models for implementing tech in the financial sector. One example includes introducing the Shariah-based model in a study by (Altwijry et al., & and Selim, 2022) (and Elia et al., 2022). In a pandemic and crisis, financial inclusion is the best

enabler of UN SDGs (Odularu et al., 2022). Digital financial inclusion has gained much attention from people in the COVID-19 era (Mansour, 2022; Karim et al., 2022).

A few articles look at the behaviors of people. Facilitating conditions can change the behavior of semi-rural women toward technology adoption (Manrai et al., 2021). In Islamic countries, fintech adoption is affected by the level of knowledge, related attitudes, and, specifically, by industry norms (Oladapo et al., 2021). Finance through mobile penetration among people in affected by the level of awareness, security, and privacy (Al-Okaily et al., 2022). Performance expectancy, effort expectancy, social influence, and facilitating conditions are necessary for adopting fintech innovations for people (Rahim et al. Shami, 2022).

Based on the review of studies, this research article suggests some points to both researchers and policymakers. Research on AI and financial inclusion should adopt AI and ML tools for analysis or prediction. For example, fuzzy logic and other ML techniques must be used to interpret data or market conditions. For policymakers, AI implementation for achieving financial inclusion should be aligned with specific objectives. The behavior of people, financial infrastructure, and government policies must be considered before applying AI to provide financial services to people. One prominent area is to address the barriers to financial inclusion, and technology must be applied in response to these barriers. It will not only remove the obstacles in achieving financial inclusion but the true purpose of technology must also be served.

Conclusion

This research article is written to identify areas of AI and financial inclusion that have been researched in articles. Secondly, it aims to provide recommendations for future research and practical implementation of AI tools. For this, a systematic literature review is conducted. PRISMA technique is used to screen the articles for inclusion in systematic review.

From the review of articles, some of the highlighted areas have been discussed in Chapter 4. The significance of AI in achieving financial inclusion must be addressed. Both qualitative and quantitative methodologies have been adopted in studies. COVID-19 has also drawn the attention of researchers. Most of the research articles suggest some business models, such as Islamic-based tech implementation. In the last few years, ML modes have also been employed in financial services. One of the significant examples is robo-advisory services in financial markets. People tend to use these services instead of traditional portfolio advisors. In this way, they escape from the problems of biasness and dishonesty.

The study of research articles reveals a need for AI and ML methodologies in research. Policymakers should identify weak areas, and efforts of applying AI must be oriented towards specific areas, like barriers to financial inclusion must be removed.

The results of this research article are limited in their scope as only two databases with limited filters have been used. This systematic literature review guides future researchers as they can understand the body of knowledge on a specified topic in one study. Policymakers can use the results to work on the implementation of AI in the financial infrastructure of countries.

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