

Mapping the Landscape of Literature on Use of AI in Libraries: A Bibliometric Analysis Using Scopus Database

Pranjit Kalita¹, Mitali Barman², Anupama Chetia³, Priyanka Goyary⁴ and Komal Kumari⁵

¹Assistant Librarian, Pub Bongsar College, Assam, India

²Librarian, Pub Bongsar College, Assam, India

³Library Assistant, Krishna Kanta Handiqui State Open University, Assam, India

⁴Assistant Librarian, Janata College, BTC, Assam, India

⁵Academic Consultant, Krishna Kanta Handiqui State Open University, Assam India

E-mail: ¹Kalitapranjit18@gmail.com, ²mitalibarmanbora@gmail.com, ³anuchetia08@gmail.com,

⁴priyankagoyary3@gmail.com, ⁵komalisonline11@gmail.com

ORCID: ¹<https://orcid.org/0009-0003-3288-2589>, ²<https://orcid.org/0000-0001-7917-254X>,

³<https://orcid.org/0009-0004-6815-3748>, ⁴<https://orcid.org/0009-0007-6101-486X>,

⁵<https://orcid.org/0009-0006-7369-1211>

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Abstract - The study aims to scientifically map the research papers on applications of artificial intelligence or AI in libraries and to analyse its growth pattern from 2013 to 2023 and collaboration network. The study followed a bibliometric approach selecting a decade, 2013 to 2023 for extracting data from the SCOPUS database. Data is analysed using tools like MS Excel, and Bibexcel and bibliometric visualising tools like VOSviewer. The document type for the study was restricted to articles only and a total of 97 articles (single and multiple authored) by 318 authors was recovered from the SCOPUS database. The study shows that not much research work has been made on this topic until 2023 but it is showing a sharp increase. Singled authorship contributing 27% with 26 publications out of 97 is the most liked authorship pattern among the researchers in this field during the period.

Keywords: Artificial Intelligence, AI, Libraries, Scopus, Bibliometrics, Network Visualisation

I. INTRODUCTION

The emerging technology artificial intelligence or AI has become a domain of knowledge which is showing continuously technologies for the betterment of human life. The application of AI is now predominant, even in modern libraries. The integration of AI in libraries helps revolutionise the process of information being organized, accessed and utilized. Libraries now have more opportunities than earlier to boost their services and upgrade user experience. Cloud computing which is a critical part of modernizing libraries; has now become an imminent technology like artificial intelligence (Islam, 2019). By utilizing artificial intelligence, social bots communicate on social media in a way which appears natural to humans. In the future, it is suggested to perform further research on social bot objects outside of the Twitter network (Chen et al., 2022). The use of AI in libraries still has not received much attention, but given the field is still developing, more multidisciplinary study is needed in this field. Research on utilizing AI to enhance home tasks, library services, and

management may be prioritized, followed by the merger of cross-technology exercises such as robots in libraries (Borghain et al., 2024).

II. REVIEW OF LITERATURE

There are several studies on the use of AI in libraries. A summary of some of these is given below.

(Das & Islam, 2021) the article “Application of Artificial Intelligence and Machine Learning in Libraries: A Systematic Review” considered the application of machine learning (ML) and artificial intelligence (AI) in libraries as the main topic of the comprehensive overview of the literature. Thirty-two papers were chosen from data collected from Web of Science, Scopus, LISA, and LISTA databases, according to standards provided (Kitchenham & Brereton, 2013). According to the review, the majority of recent AI and ML research in the LIS field consists of theoretical works, with a smaller focus on case studies or implementation initiatives. The purpose of this study is to provide a thorough overview of AI and ML in libraries so that scholars, practitioners, and educators can better comprehend technology-oriented methods and foresee upcoming developments.

(Jha, 2023) the article “Application of artificial intelligence in libraries and information centers services: prospects and challenges” tried to fill in the knowledge gaps regarding artificial intelligence (AI) in library services by concentrating on its use in library operations (Asadov, 2018). Utilizing content analytic techniques and a qualitative methodology, the study reviews literature on artificial intelligence, smart libraries, and associated technologies (Jyothi et al., 2024). The results show that although AI has great potential to improve library services, issues with finance, librarian attitudes, and technical

expertise prevent its widespread use. Several economically viable AI applications are also identified by the study. The study, taken as a whole, highlights how AI is changing library services and urges politicians, researchers, and library professionals to become more aware of and utilize AI (Cao, 2020).

Borgohain et al., (2024), “Mapping the literature on the application of artificial intelligence in libraries (AAIL): a scientometric analysis” aimed to investigate through the mapping and analysis of pertinent publications, the patterns and growth of AI applications in libraries. Data for the years 2012 through 2021 was taken from Scopus using a bibliometric technique. The results show that whereas artificial intelligence (AI) is widely used in many domains, such as health and education, there has been comparatively little study on AI applications in libraries (Utomo & Latukismo, 2022). There are currently 1462 papers on this topic, written by 5400 writers, and the number is increasing exponentially. “Journal of Chemical Information and Modelling” and “The Journal of Machine Learning Research” came out to be the most prolific and influential open-access journals (Arora, 2024). The most dependable and influential writer is J Chen. China is the top nation at the institutional level, whereas the United States leads in terms of the quantity of papers. Currently, some of the rising topics are deep learning, big datasets, and machine learning (Kutlu & Camgözlü, 2021; Kesana et al., 2021). As per the assessment, using AI technology might greatly enhance library information systems. Policymakers, library stakeholders, academicians, and the government may all benefit from the findings, which emphasize the strategic significance of artificial intelligence in decision-making processes (Hakkaraki, 2023; Jelena & Srđan, 2023).

III. OBJECTIVES OF THE STUDY

1. To determine the growth and pattern of studies on AI applications in Libraries from 2013 to 2023.
2. To highlight the authorship pattern in research on the application of AI in libraries.
3. To analyze the co-authorship of authors and countries to determine which authors and countries collaborate closely based on the total link strength (TLS) and number of documents.

IV. METHODOLOGY

The study follows a bibliometric approach that uses both qualitative and quantitative methods to analyze the previously published literature on the given subject. Bibliometrics is a quantitative discipline that studies many facets of scholarly literature and information sources through systematic study and measurement. This discipline evaluates the significance, visibility, and influence of scholarly publications, authors, journals, and research fields using statistical techniques and data-driven methodologies. Through the analysis of co-authorship networks, publication trends, citation patterns, and other bibliographic information, bibliometrics offers important insights into the

spread of knowledge, the development of study fields, and the recognition of significant works and scholars (Ashikuzzaman, 2018). For the collection of data; SCOPUS by Elsevier, a leading abstract and citation database that covers all traditional, trans-disciplinary, and interdisciplinary fields and includes bibliographic and citation data has opted. For data extraction compatible important keywords such as “Artificial Intelligence”, “AI”, “Libraries” and “Library Services” are put into the TITLE-ABS-KEY. The search string used is:

(TITLE-ABS-KEY ("Artificial Intelligence") AND TITLE-ABS-KEY ("Libraries")) AND PUBYEAR > 2012 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE, "AR") AND LIMIT-TO (EXACTKEYWORD, "Libraries") OR LIMIT-TO (EXACTKEYWORD, "Library Services") OR (EXACTKEYWORD, "AI")) (Islam et al., 2023).

97 articles (single and multiple authored) by 318 authors were recovered from the search. They were then exported in CSV and RIS format and analysed on MS Excel, Bibexcel and VOSviewer.

V. ANALYSIS AND INTERPRETATION

The Pattern of Growth of the Research Output from 2013 to 2023

Figure 1 shows the annual growth pattern of publications on AI applications in Libraries from 2013 to 2023. Data is shown using a 2D scatter plot with a linear and exponential trendline with their R^2 values. The equation ($y = 8E-253e^{0.2885x}$) represents the exponential trendline and ($y=2.4865x - 5008.8$) represents the linear trendline as displayed in Figure 1. Price law was employed for the assessment or whether the growth was exponential or not. For this, correlation coefficients for both the exponential and linear trendlines were calculated. It is found that the correlation coefficient for the exponential curve with $R^2 = 0.8389$ is $r_1=0.9159$ is greater than the linear trendlines with $R^2 = 0.6611$ which is $r_2= 0.8130$. Since $r_1 > r_2$, the Price law is satisfied, and thus, the growth rate is exponential in this case.

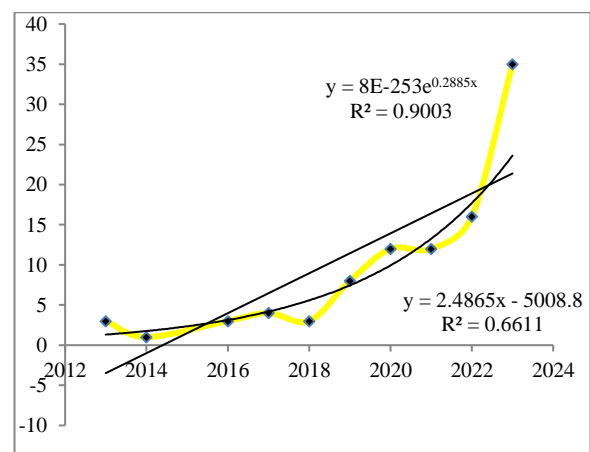


Fig. 1 Growth of Publications from 2013-2023

TABLE I AUTHORSHIP PATTERN IN RESEARCH IN USE OF AI IN LIBRARIES

No. of Authors	No. of Publications	% Out of 97	No. of Authors	% of Total Authors
1	26	27%	26	8%
2	20	21%	40	13%
3	13	13%	39	12%
4	17	18%	68	21%
5	10	10%	50	16%
6	4	4%	24	8%
7	0	0%	0	0%
8	3	3%	24	8%
9	1	1%	9	3%
10	1	1%	10	3%
11	0	0%	0	0%
12	0	0%	0	0%
13	0	0%	0	0%
14	2	2%	28	9%
	97	100%	318	100%

The research pattern in the use of AI in libraries displays a range of patterns of authorships ranging from single authorship up to fourteen authorships. The study shows that the most dominant authorship is single authorship contributing the highest of 27% (26 publications) followed by double authorship as second with 21% (20 publications) and four authorships in third most dominant authorship pattern with 18% (17 publications). Thus single authorship is more popular among the researchers in the field of use of AI libraries.

Co-authorship Networking of Authors

Figure 2 shows the collaboration of authors using VOSviewer using the type of analysis as co-authorship and authors as the units of the analysis. The analysis followed full counting with a maximum number of documents of the author to 25. A total of 34 authors are found linked with the highest number of documents per author as 1 with 50 minimum numbers of citations per author. The co-authorship linkage with other authors is thus calculated for these 34 authors out of the 317 authors. In Figure 2, the circles or nodes show a single author and the size of the circle or node is directly proportional to the number of articles for each author. These 34 authors are again grouped into 4 clusters. Authors placed within the cluster with the same colors signify close cooperation among them while the lines linking them indicate the occurrence of collaboration. The largest cluster (Red) contains 15 authors like Christansen, Silke h, Munno, Hemabessiere Ludovic, cluster 2 (Green) contains 8 authors like Bobak, Martin, cluster 3(Blue) contains authors like Deniela Trisciuzzi, Nicola Gambacorta and cluster 4 (yellow) contains 5 authors like Kim Taeguen, Im Eul Gyu.

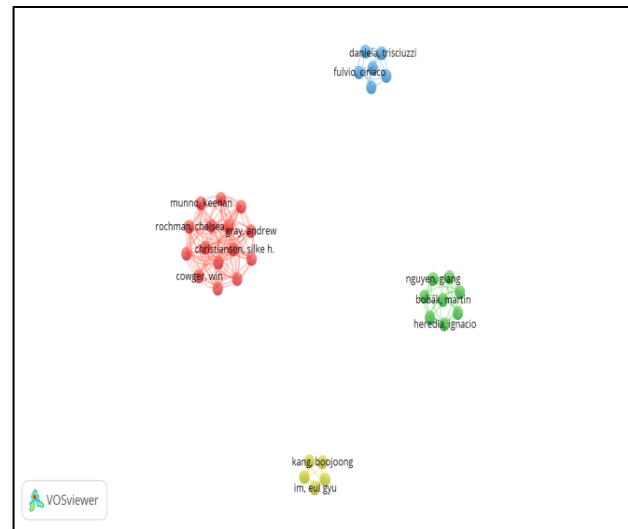


Fig. 2 Co-authorship of Authors

Co-authorship Networking of Countries

Figure 3 shows the visualization of collaboration of countries where the circles denote a single nation and the size of the circle is directly proportional to the amount of documents associated with the country. The lowest number of documents for each country is taken as 5 and out of 44 countries, 7 meet the threshold. The analysis used full counting and the resultant 7 countries are grouped under 3 clusters. Cluster 1 (Red) contains 3 countries namely China, Saudi Arabia and India, Cluster 2 (Green) contains 2 countries which are Germany and Spain and Cluster 3 (Blue) contains 2 countries namely the United States and Canada.

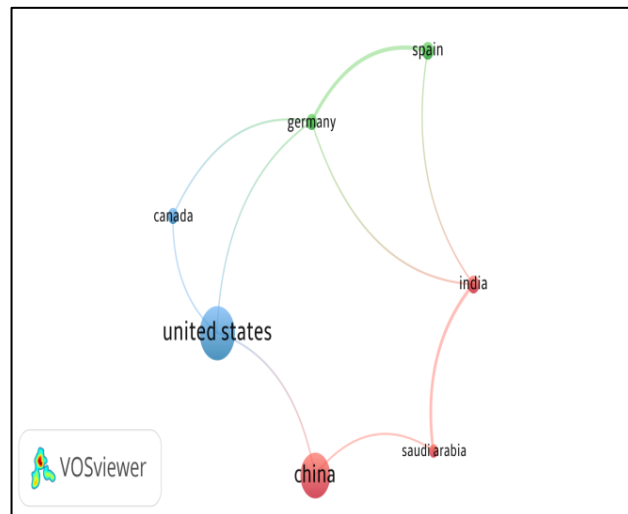


Fig. 3 Co-authorships of Countries

VI. DISCUSSION AND FINDINGS

The study of the growth pattern of research outputs published on the application of AI in libraries between 2013 and 2023 shows a fascinating trend. Figure 1 depicts the growth using a 2D scatter plot with both exponential and linear trend lines. The Price law was applied to compare the

correlation coefficients ($r_1 = 0.9159$ for the exponential curve and $r_2 = 0.8130$) for the linear trendline) to determine whether the increase is, in fact, exponential or not. As the correlation coefficient of the exponential trendline is found to be greater than that of the linear trendline, it is concluded that the growth is indeed exponential, indicating a sharp increase in production research outputs in this field, demonstrating its escalating scope and significance. Table I shows the authorship pattern in the topic and it is found that 27% of total publications are single authored followed by 21% double authored and 18% are four authored indicating that single authorship was the most popular authorship pattern in the topic between 2013 to 2023. Figures 2 and 3 show the co-authorship analysis giving more insights into the collaborative dynamics among authors and countries in the field of AI applications in libraries. Co-authorship network among authors is illustrated in Figure 2 where 34 authors are categorised into 4 clusters according to their pattern of collaboration. This analysis highlights the establishment of research networks and clusters among authors, underscoring the collaborative character of this field's research. The co-authorship network across nations can be seen in Figure 3, which highlights the international scope of research on AI applications in libraries. Based on their patterns of collaboration, seven nations are shown in the graphic divided into three groups. This worldwide cooperation shows how interested people are in this topic and the way they are working together to further research and understanding of it. All things considered, the examination of cooperation networks and growth patterns gives insightful information about how AI applications are developing in libraries. These findings and outcomes have practical implications for policymakers, researchers, and practitioners looking to use AI technology in library settings, apart from adding to the body of knowledge on this subject.

VII. CONCLUSION

The study of research outputs on AI applications in libraries from 2013 to 2023 reveals a fascinating growth pattern as depicted in Figure 1. The utilisation of a 2D scatter plot with exponential and linear trend lines with the use of Price's law implies an exponential growth trend. This exponential growth implies a sharp increase in research output and reflects the expanding scope and importance of AI in libraries. The authorship patterns as highlighted in Table I, indicate a preference for single-author papers in this field during the specified period. Co-authorship analysis, as illustrated in Figures 2 and 3, gives insights into collaborative dynamics among authors and countries. Figure 2's co-authorship network clusters 34 authors into four groups based on collaboration patterns, intensifying the establishment of research networks among authors. Figure 3 demonstrates the international collaboration among authors of different countries, with seven nations piled into three clusters considering the collaboration patterns, demonstrating a worldwide interest and collaboration with the United States securing the top place in advancing

research on AI applications in libraries. The results from this study are valuable for researchers, policymakers, and practitioners interested in leveraging AI technology in library settings, contributing to the growing body of knowledge in this field.

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