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# Status-quo of Publications on the Application of 'Artificial Intelligence' in Library and Information Science Research

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## ABSTRACT

***Context:*** The present paper analyses the publication output on 'Artificial Intelligence (AI)' and compares it with the publication output in the research domain of Library and Information Science (LIS).

***Aim:*** The aim of this paper is to quantify, critically analyse and visually present the prolific literature on AI and its applications in LIS domain using bibliometric techniques.

***Settings and Design:*** Bibliometric and keyword analysis were employed in analysing the secondary data sourced from the Clarivate Analytics Web of Science database.

***Methods and Material:*** Data extraction was carried out using the Web of Science database for the study period 2000-2023. 2,05,470 Articles in English language were included for the study. It was found that 1351 Articles were published with applications of AI in LIS domain.

***Statistical analysis used:*** The Compound Annual Growth Rate (CAGR) was calculated to measure the growth trend of AI research globally and within LIS. Activity Index (AI) and Relative Specialization Index (RSI) were calculated to assess the research focus of different countries. Data visualization was used to map the findings.

***Results:*** The study identifies the annual growth rate of publications on AI across disciplines to be 13.42% and 20.01% within LIS discipline. The study reveals apart from USA and China, India also features among the top 10 prolific countries and institutions contributing to AI research globally and in LIS discipline.

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***Conclusions:*** AI research in LIS has gained significant momentum, reflecting a growing interest in applying AI-driven solutions to library operations and services. While China leads in the overall AI publication output, the USA dominates in LIS-specific AI research. The study highlights the need for interdisciplinary and international collaboration to enhance the adoption of AI in LIS. Further efforts are required to strengthen AI research in LIS, particularly in developing regions, to bridge the gap in technological advancements and applications.

**KEYWORDS:**

• Artificial intelligence • AI in Libraries • LIS research • AI tools • bibliometrics

## INTRODUCTION

Humans have progressed from being food gathers and hunters to getting food served with just a few clicks using a smartphone. There is no denying that intelligence and its applications have played a significant role in this transition. Progressive as it is, human intelligence is constantly pursuing new and efficient ways of performing day-to-day routines. This has resulted in applying human intelligence to fuel the technological workings of the world. It is difficult to imagine a world without technological implications be it any field or discipline. The developments have now reached a stage where R & D is focused on creating machines that can think! And the technology implying or rather imitating human intelligence is AI-Artificial Intelligence!

According to OECD, 2022 AI is defined as 'a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments'. It is a wide range of technologies encompassing machine learning, natural language processing, deep learning, neural networks, computer vision, and robotics. It has the ability to imitate complex human skill such as reasoning, learning, problem-solving, perception, and language understanding (Chen *et al.*, 2020).

The journey of AI has evolved significantly since its inception in the 1950s. The 1950s and 1960s saw the birth of AI, with pioneers like Alan Turing proposing the Turing Test to determine if a machine could exhibit intelligent behaviour (Roser, 2022). From 1950 to 2023 humanity has witnessed tremendous technological developments transforming and revolutionising all walks of life. The late 2000's witnessed the introduction of personal assistants like Siri, Alexa, Cortona, Bixby playing an imperative role in enhancing human capabilities and improving efficiency across day-to-day operations. Today, AI is permeating in all facets of knowledge such as computer sciences, management, engineering, health sciences, architecture, agriculture, arts and humanities, social sciences and so on. Libraries are no such exception in adopting to the advances in technology. It is a thriving repository which forms the essential crux of the information storage and retrieval process. Artificial intelligence is brought into libraries to redefine user experience and serve as a powerful ally to the librarians. It is a realm of personalized service to the users and the librarians. It can enhance user experience by leveraging data analytics which makes AI provide tailored research articles, suggest relevant reading materials, and provide alerts to users about new acquisitions that match their level of interest.

Bibliometric studies provide a systematic analysis to identify research trends, areas of interest and gaps in literature. The quantitative approach of evaluating bibliometric parameters such as publication frequency, authorship patterns, assessing the prolific countries and institution, researchers can gain an insight about the emerging research in their discipline. Mapping of the intellectual structure of a field is essential as it will guide new researchers in navigating existing literature effectively, preventing redundancy in research efforts. Ultimately, bibliometric studies contribute to advancement of knowledge by providing a clear framework for evaluating scientific output and guiding future enquiries.

## RELATED WORKS

The review of existing literature provides a scientific framework to the present study.

Shrivastava & Mahajan, 2016 analysed the literature on Artificial Intelligence for the period

1968-2014 as available on the Scopus database. The authors studied various bibliographic indicators such as research performance of a country, institution and individuals, average citation per paper and relative citation index. They found that conference proceedings were the most productive document type, and the preferred communication language was English. The research pointed to 2.84 as the average number of authors per paper, with Computer Science being the most prolific subject. The authors highlighted the international collaboration pattern among Indian researchers, which is found to be highest with USA and Anna university to be the most productive institution.

Gupta and Dhawan (2018) found that India's research output has grown by 27.45% with USA being the leading collaborator. The authors also classified that AI research in India is distributed across 8 subject field, among which computer science has the highest publication share. The most productive Institution in India was Anna University, IIT Delhi and Jadavpur University and the most prolific authors were S. Das 36, A Singh and D. Das. The authors observed that India stands third highest in the world ranking in artificial intelligence research but while analysing the qualitative research part it stands low with 2.76 citations per paper in 10 years and 0.25% share in highly citated paper.

Afjal, 2023 carried out a scientometric analysis on ChatGPT and the AI revolution using Scopus database for the period of 2022 to 2023. They visualised it using Biblioshiny and VOS viewer software. The research highlighted significant growth in publications related to ChatGPT, revealing articles were the most common type of document, and *Nature* was identified to be the leading publication. Their study also noted that the USA and the University of New York are prominent contributors to ChatGPT and AI research. Keywords like Artificial Intelligence, machine learning, and natural language processing were frequently mentioned, underscoring their importance in current scholarly discourse.

A study by Borgohain *et al*., 2024 focused on exploring the growth patterns of AI research, journal productivity, and contributions at the country and institutional levels. The study identified the most productive journals as the *Journal of Chemical Information and Modelling*. They have highlighted key trends and emerging topics like machine learning, deep learning, large datasets, and high-level languages. Additionally, the authors examined the relationship between h-index and z-index, finding a strong correlation due to their dependence on citation counts. The analysis also covered co-authorship networks among authors and countries, with data visualized through VOS viewer and Biblioshiny.

A systematic bibliometric study on existing literature on 'big data, chatbot, datamining' on Scopus database was conducted by Islam *et al*., 2024. Their study focused on bibliographic indicators such as annual growth rate, publication and citation structure, influential authors, countries and institutions, influential journals, authorship patterns, highly cited papers, and country collaborations. The findings revealed a significant annual growth in literature related to big data applications in libraries. Conference papers were the most common type of publication, and China emerged as a leading contributor, Kyushu Institute of Information Sciences as the most prominent institution. The journal *Library Hi Tech* was identified as an influential source, with a strong impact in terms of citations.

Review of literature revealed though there are lot of studies on the concept of artificial intelligence and its implications in various sectors, a study measuring the growth and reach of AI in the LIS discipline is warranted. The present study attempts to present a vivid picture of the research and development activities of implementing AI tools in the LIS profession.

## OBJECTIVES

The aim of this paper is to quantify, critically analyse and visually present the prolific literature on AI and compare the same with the LIS domain using bibliometric techniques.

## METHODOLOGY

Bibliometric and keyword analysis were employed in analysing the secondary data sourced from the Clarivate Analytics Web of Science database. Data extraction was carried out in two phases:

**Phase I: Extraction of literature about AI in global output**

The search was carried out using the string 'Artificial Intelligence' for the period '2000-2023' in the WoS search box, which yielded a result of *2,06,882 (figure 1)*. The search was refined by the English language and the results was narrowed down to *2,05,470 (figure 2)*. The results were further limited by the document type to include only articles. The results *1,76,964 (figure 3)* were extracted into MS Excel spreadsheets titled 'AI literature Global' for further analysis.

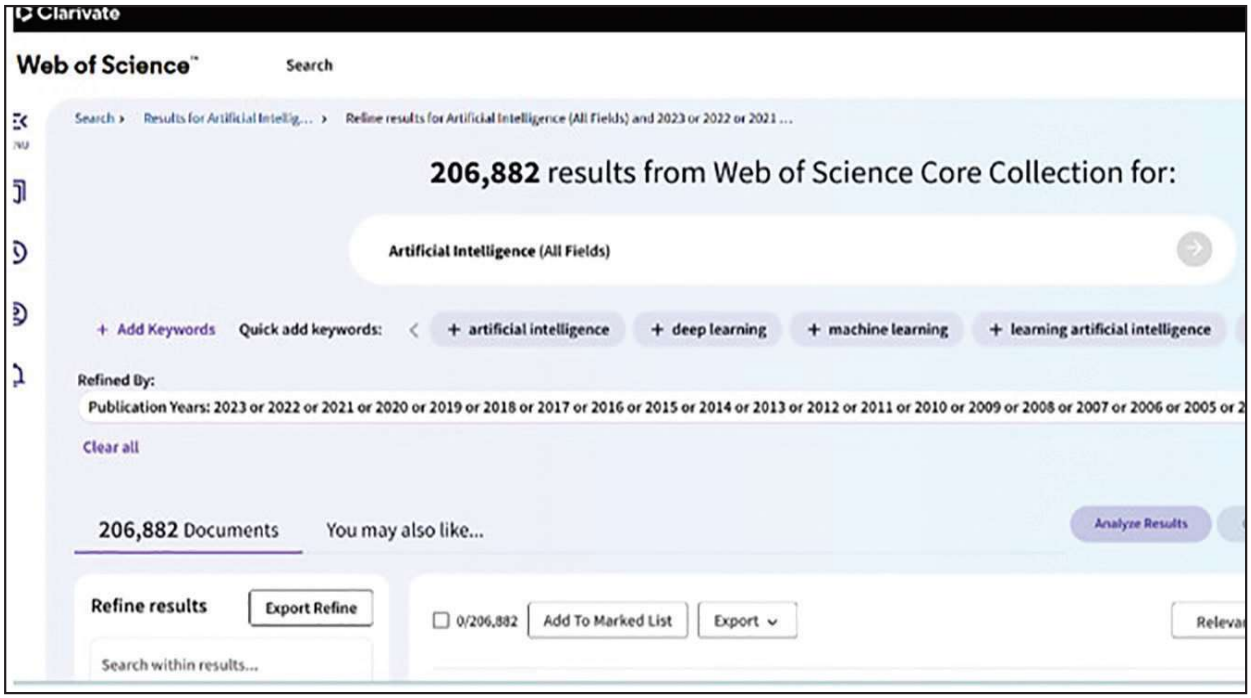



**Figure 1:** Screenshot of keyword and year refinement

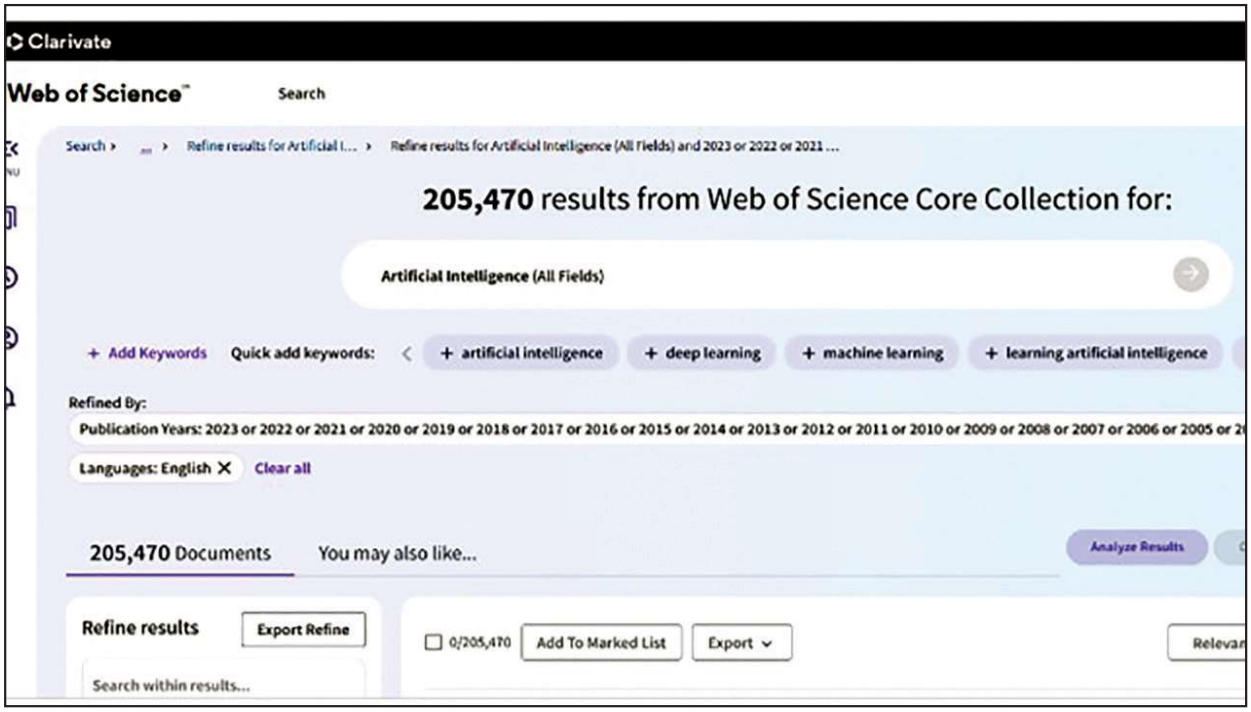



**Figure 2:** Screenshot of language refinement

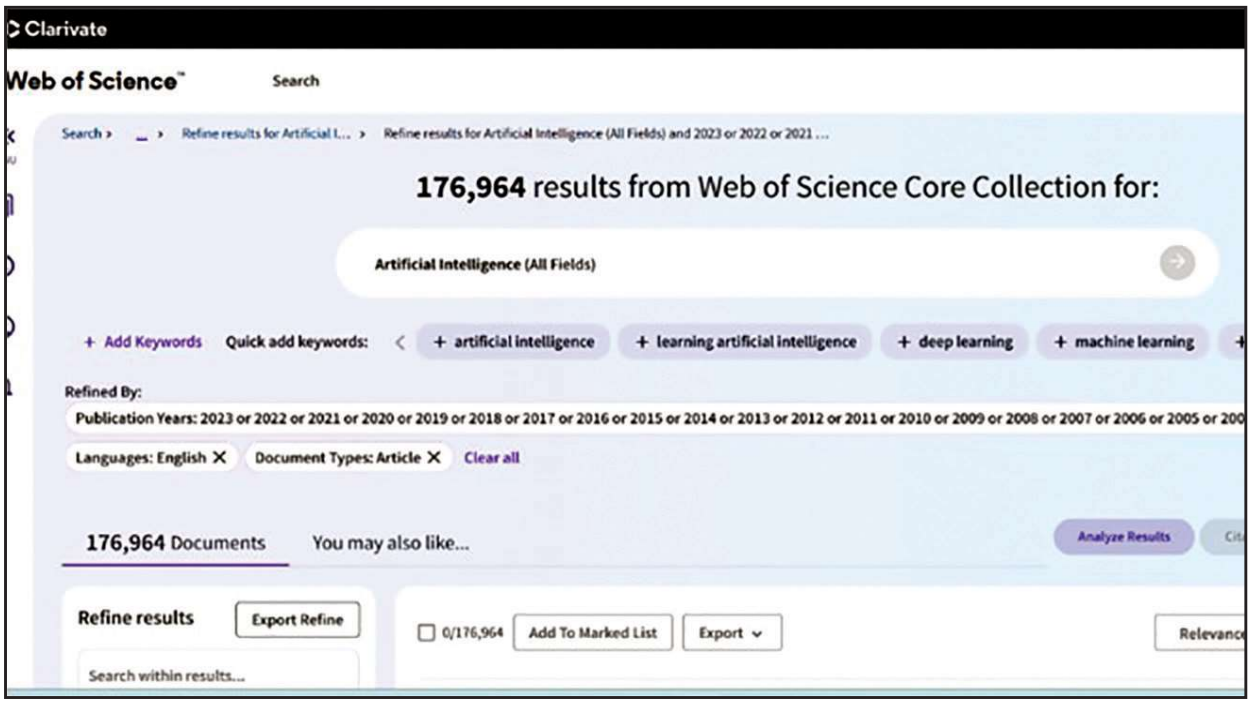



**Figure 3:** Screenshot of type of document refinement

## Phase II: Extraction of literature about AI in LIS discipline

The above search was refined by research areas to include the research area '*Library and Information Science*' resulting 1351 articles *(figure 4)* which were extracted into another MS Excel Spreadsheet titled 'AI literature in LIS'. These results were extracted as a second set of data which primarily focuses on AI literature in LIS discipline. A comprehensive analysis of the extracted data is studied by organising it in the spreadsheets. The analysed data are presented with the help of charts and tables. Furthermore, a keyword analysis of the results was performed using Wordcloud.com to visualise the findings.

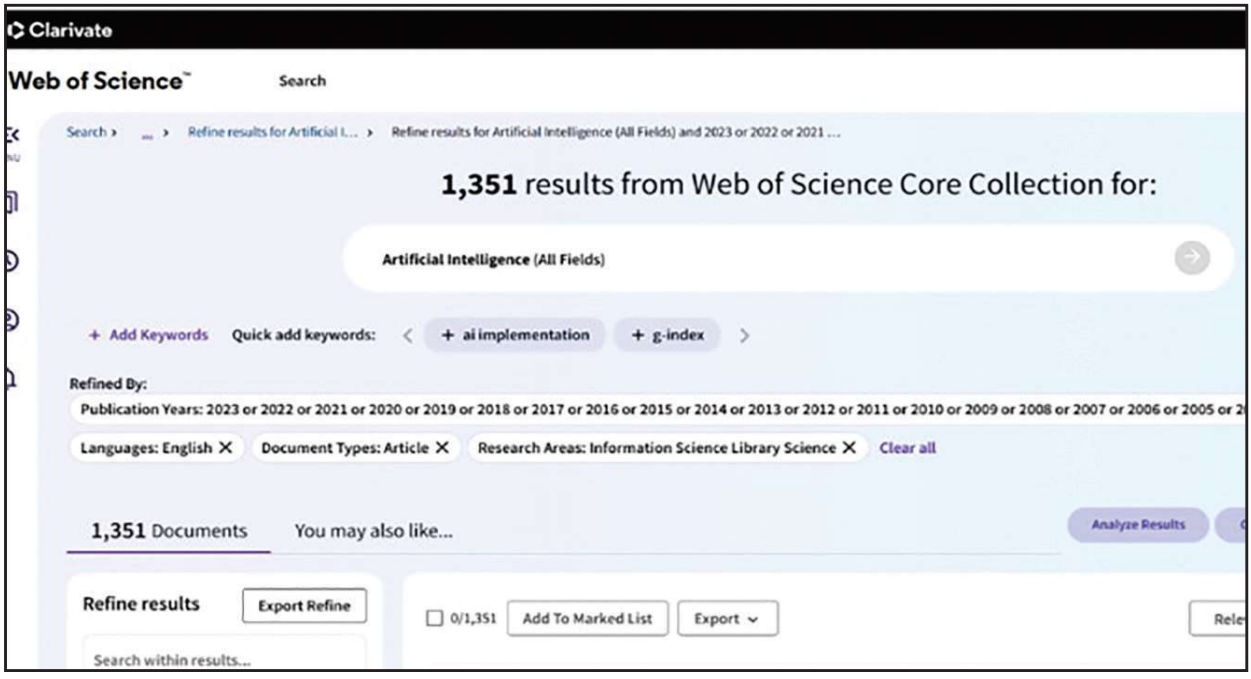



**Figure 4:** Screenshot of refinement of research domain

## Analysis and Interpretation

### *The chronological output of AI vs AI in LIS*

The annual production of literature on artificial intelligence was analysed, and the results show progressive growth throughout the years 2000-2023. The growth of the years 2010-2023 is visualised as indicated by the trendline in *figure 5*. The growth rate of the literature published in *Web of Science* database is calculated. To calculate the growth rate, Compound Annual Growth Rate (CAGR) method is used.

$$\text{CAGR} = \left( \frac{\textit{Ending Value}}{\textit{Beginning Value}} \right)^{\frac{1}{25}} - 1$$

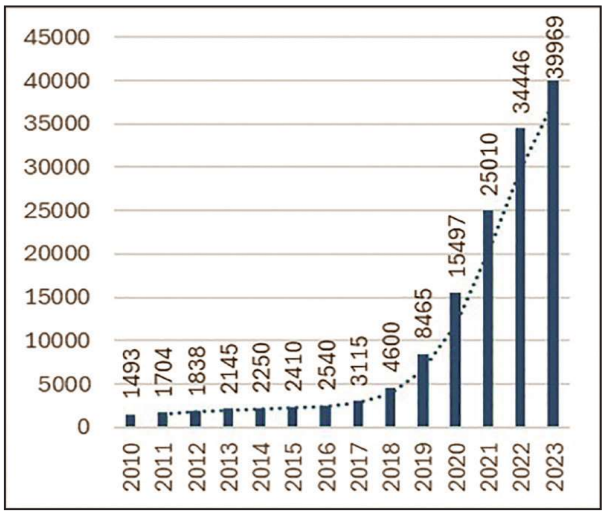



**Figure 5:** Annual Scholarly Output on AI

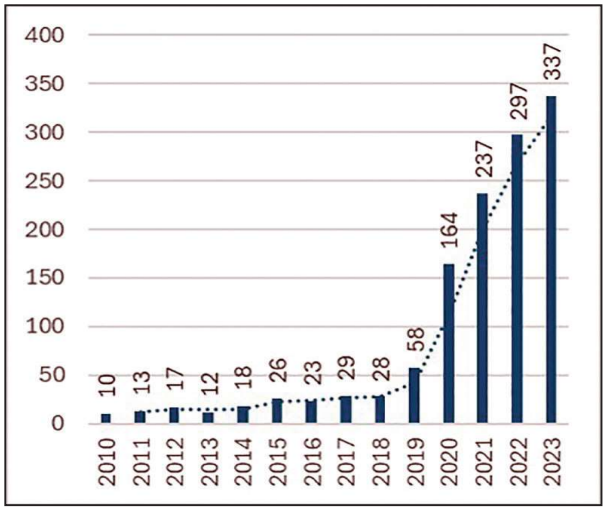



**Figure 6:** Annual Scholarly Output of AI in LIS

The growth rate calculated for a period of 23 years is found to be *13.42%*. This highlights that there is steady growth in the R & D activities in Artificial Intelligence (AI). The trendline on figure 6 also corroborates the increasing trend in the annual productivity of literature on the selected domain with a significant growth rate of 20.01%. The progression of growth rate indicates that the LIS research corresponds to the latest technological advances and the LIS fraternity is open to exploring current means of information sharing and transfer.

### *Publication profile of Prolific countries on AI*

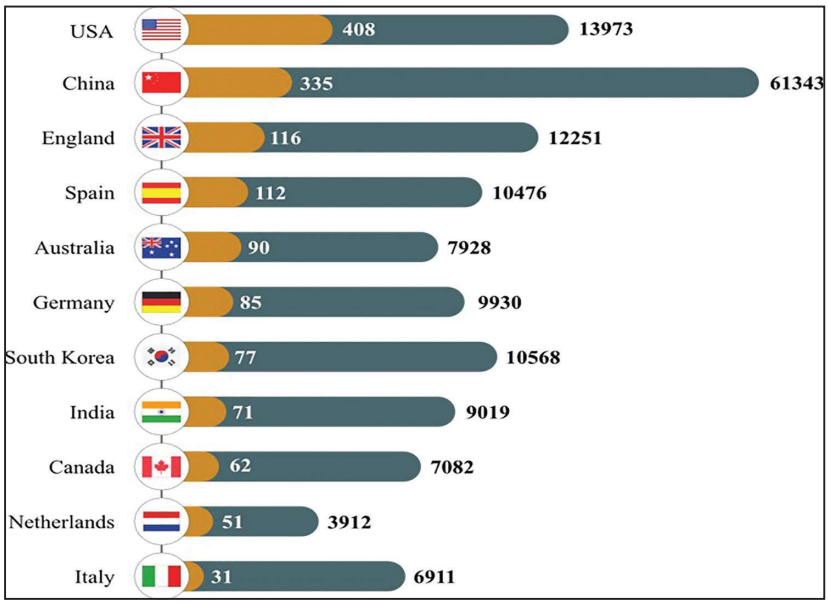



**Figure 7:** Country Wise Comparison of Publication Productivity in AI vs AI in LIS

A comprehensive analysis of the 195 countries publishing literature on Artificial Intelligence (AI) and 83 countries publishing literature on AI within the Library and Information Science (LIS) discipline with focus on the top ten prolific countries in both domains is shown in *figure 7.* The above graph reveals the following:

1. **China,** with 61343 articles is found to be the most prolific country producing research literature on 'Artificial Intelligence'; whereas while comparing publications pertaining to application of AI in LIS, the publication output of China (335) falls behind that of **USA** (408). USA is found to be the most prolific country pertaining to publications on AI in LIS.
2. It is observed that **England** is on third rank both publication profiles in AI (12251) as well as AI in LIS (116).
3. **India** with 9019 articles is found to be on the seventh rank in publishing research on AI globally and is ranked eight among countries publishing research on AI in LIS with 71 articles.
4. **Netherlands** has emerged among the top 10 prolific countries with 51 publications in the LIS arena, which indicates considerable research at the global level.
5. Comparatively, **Italy** is found to be among thetop 10 prolific countries contributing to AI literature, whereas it is ranked 15th in LIS discipline.
6. The activity index of the top 10 prolific countries comparing research literature on AI and AI in LIS is presented in table 1.

**Table 1:** Countries Rank, Activity Index and RSI

| Countries | Quantum of articles on AI | Rank | Quantum of articles on AI in LIS | Rank | Activity Index on AI in LIS | RSI= (AI - 1) / (AI + 1 ) |
|---|---|---|---|---|---|---|
| Peoples R China | 61343 | 1 | 335 | 2 | 0.715 | -0.166 |
| USA | 30973 | 2 | 408 | 1 | 1.725 | 0.266 |
| England | 12251 | 3 | 116 | 3 | 1.240 | 0.107 |
| South Korea | 10568 | 4 | 77 | 7 | 0.954 | -0.023 |
| Spain | 10476 | 5 | 112 | 4 | 1.400 | 0.167 |
| Germany | 9930 | 6 | 85 | 6 | 1.121 | 0.057 |
| India | 9019 | 7 | 71 | 8 | 1.031 | 0.015 |
| Australia | 7928 | 8 | 90 | 5 | 1.487 | 0.196 |
| Canada | 7082 | 9 | 62 | 9 | 1.147 | 0.068 |
| Italy | 6911 | 10 | 31 | 15 | 0.588 | -0.260 |
| Netherlands | 3912 | 16 | 51 | 10 | 1.708 | 0.261 |

## Activity Index and Relative Specialization Index of Countries

'Activity Index' and the 'Relative Specialisation Index' are determined for the top 10 prolific countries to map their research activity on the selected topic.

The Activity Index (AI), introduced by Frame (1977) is recalled as

$$AI = \frac{\textit{the world share of the given country in AI publications in LIS discipline}}{\textit{the overall world share of the given country in AI publications}}$$

According to Ganzel (2000), the Relative Specialisation Index (RSI) is defined as

$$RSI = \frac{AI - 1}{AI + 1}$$

where,

i. RSI = 1 indicates that the country is not actively publishing about AI in LIS.
ii. RSI = 0 indicates that the country's share in AI in LIS is equal to that of the global share on AI.

iii. RSI = +1 indicates that the country is actively publishing about AI in LIS.

The Activity Index of the top 10 prolific countries is calculated and tabulated in table 1.

After deriving the Activity Index, the Relative Specialization is calculated and depicted in figure 4.

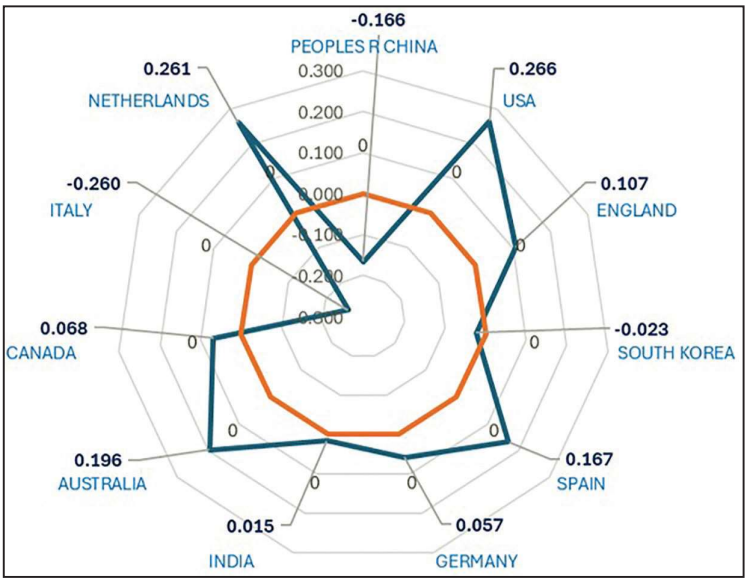



**Figure 8:** Relative Specialisation Index of Prolific countries

It is observed that the research activity in application of AI in LIS discipline is higher in **USA (0.266)**, followed by **Netherlands** (**0.261) and Australia** (**0.196)**, which are observed to be higher than the global average. Similarly, **Spain** (**0.167), England** (**0.107**), **Canada** (**0.068**), **Germany** (**0.057**) and **India (0.015)** are the other prolific countries that are close to the global average and have moderate level of research activity, whereas activity profiles of Asian and South Asian countries like **China (-0.166),** and **South Korea (-0.023)** along with **Italy (-0.260)** indicate scope for more research specialisation in application of AI.

***Publication Profile and Activity Index of Prolific Institutions on AI vs AI in LIS***

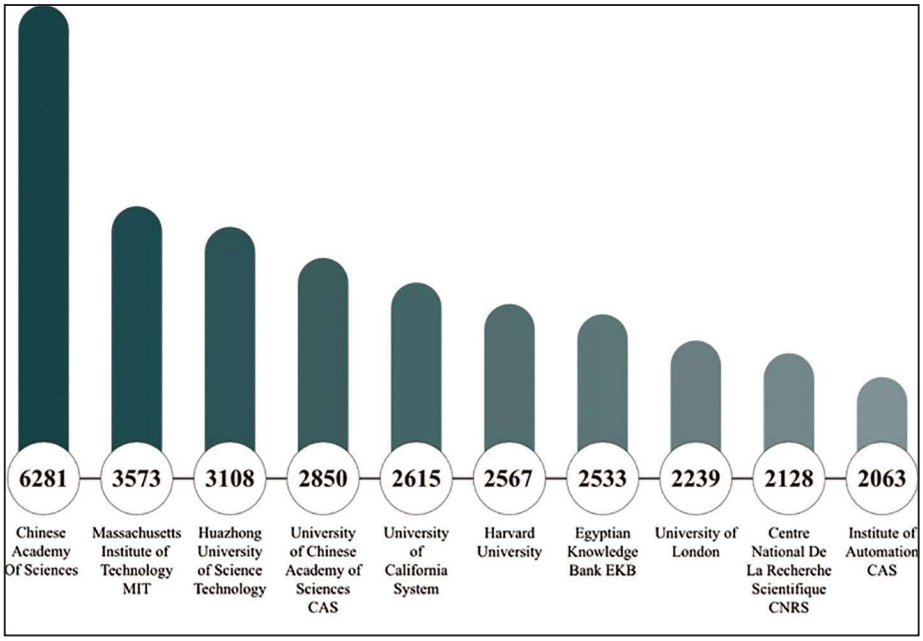



**Figure 9:** Publication Productivity of Institutions on AI

Figure 9 presents the productivity pattern of the top 10 institutions and affiliations that publish articles on Artificial Intelligence. The analysis revealed a total of 52,251 affiliations across the world that contribute to research literature on artificial intelligence. Keeping in line with the prolific countries, the **Chinese Academy of Sciences** (6281 articles), **followed by Massachusetts Institute of Technology MIT** (3573), **Huazhong University of Science Technology** (3108), **University of Chinese Academy of Sciences CAS** and the **University of California System** with 2850 and 2615 respectively, are found to be the most prolific institutes

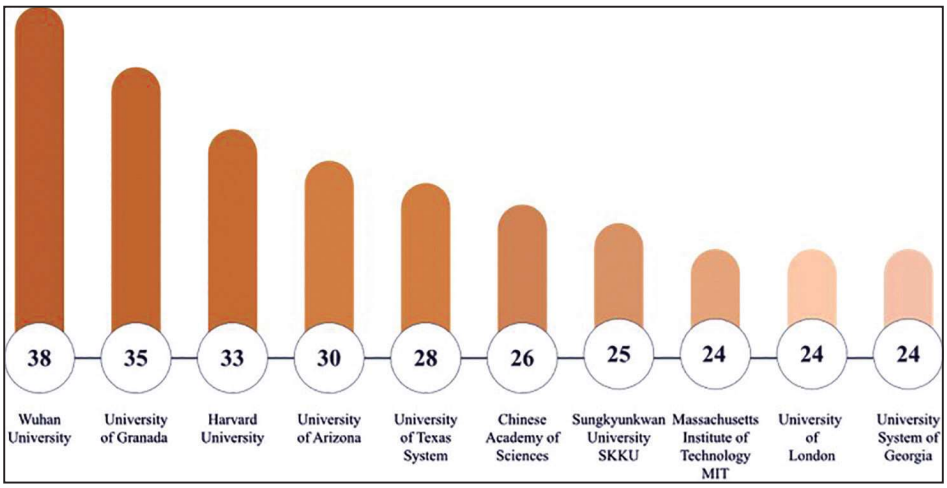



**Figure 10:** Publication Productivity of Institutions on AI in LIS

Similarly, figure 10 indicates the publication productivity of top 10 institutions in the discipline of LIS. Among a total of 1771 institutions, top 10 major contributors of research on AI in LIS were selected for the study which is depicted in *figure 6*. It is found that **Wuhan University** with 38 articles is the leading contributor followed by, **University of Granada** with 35 articles, followed by **Harvard University** with 33 articles.

***Keywords Analysis of Literature on AI in LIS***

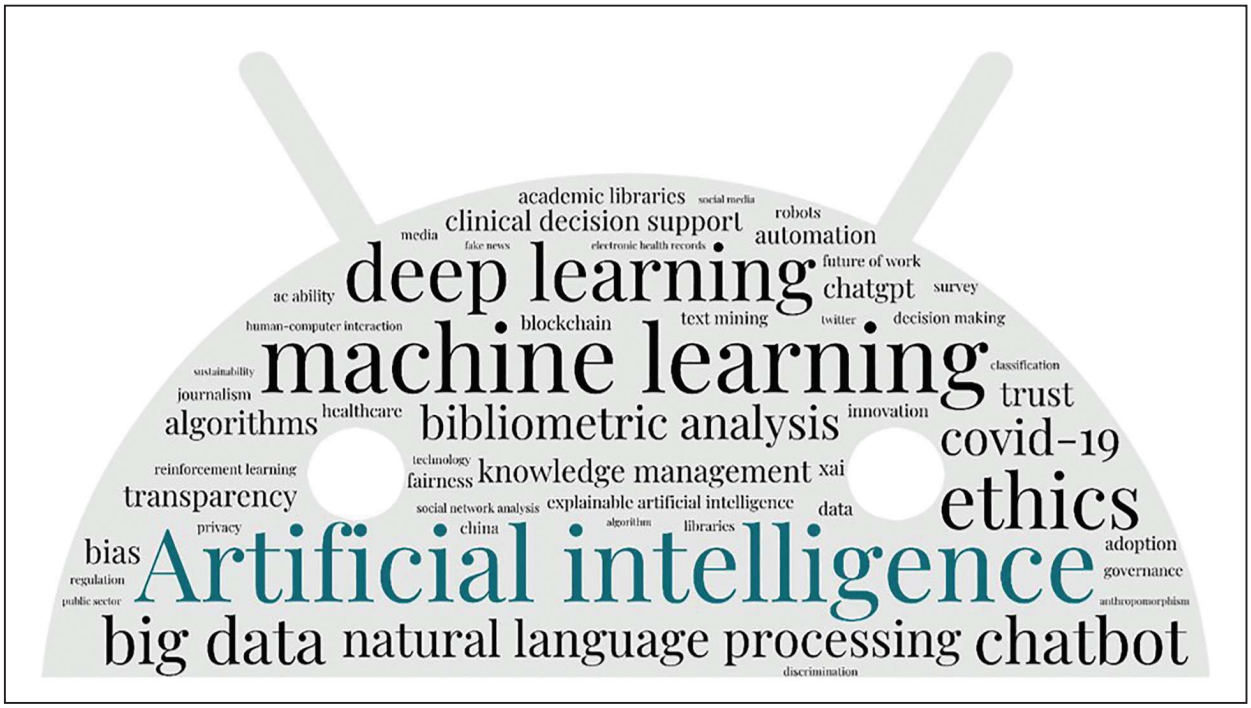



**Figure 12:** Keywords Analysis of Literature on AI in LIS

An analysis of author keywords explores the most frequent keywords by researchers in their publications on application of Artificial Intelligence in the LIS domain. A total of **5312** keywords were studies in the ***1351*** selected articles, among these **3460** unique keywords were identified and ranked based on their frequency of occurrence. Figure 12 visualises a word cloud using the identified keywords, representing the most frequent ones using large, bold font size and reducing the same as the frequency decreases. The figure illustrates that *'artificial intelligence (577)'* is the most frequent keyword, followed by *machine learning (116), ethics (33), deeplearning* (34), *naturallanguageprocessing* (29), *chatbot (21), bigdata (21)* and so on. Keywords that are not directly relevant to the central theme such as *clinical decision support, fairness, ac abilty, healthcare* also finds a mention. This also prompted the researchers to identify and study the highly cited papers in the selected field.

### *Highly cited Articles on AI in LIS*

The top ten papers out of 1351, based on the number of citations received are listed in the below table 2. It is interesting to observe that 7 of the top ten highly cited articles appear in the journal - *International Journal of Information Management* published by Elsevier, United Kingdom with a JCR impact factor of 20.1 and Cite Score of 53.1. The other 3 journals that feature among the top ten highly cited articles are *Journal of Informetrics, Journal of the American Society for Information Science and Technology* and *Information & Management*. It is observed that out of the total 31,710 citations received by 1351 articles, the top 10 highly cited articles contribute to 26% of the total. The analysed data indicates that 1351 articles are published in 82 unique source titles, out of which just 4 contribute to the top 10 citations received, whereas quantitatively the '*Information Processing Management*' (153) tops the list by the number of articles published, whereas the journal publishing highly cited article '*International Journal of Information Management*' *(71)* is at the fifth among the 82 publication titles.

**Table 2:** Highly cited articles in AI and LIS for the study period of 1983-2023

| S. no | Title | Citation Count | Journal Name | Impact Factor | Publisher & Country |
|---|---|---|---|---|---|
| 1 | An approach for detecting, quantifying, and visualizing the evolution of a research field: A practical application to the Fuzzy Sets Theory field | 1395 | Journal of Informetrics | 3.4 | Elsevier, United Kingdom |
| 2 | Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy | 1200 | International Journal of Information Management | 20.1 | Elsevier, United Kingdom |
| 3 | So what if ChatGPT wrote it? Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy | 1067 | International Journal of Information Management | 20.1 | Elsevier, United Kingdom |
| 4 | Artificial intelligence for decision making in the era of Big Data - evolution, challenges and research agenda | 998 | International Journal of Information Management | 20.1 | Elsevier, United Kingdom |
| 5 | Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy | 855 | International Journal of Information Management | 20.1 | Elsevier, United Kingdom |
| 6 | SciMAT: A new science mapping analysis software tool | 734 | Journal of the American Society for Information Science and Technology | 2.8 | Wiley-Blackwell, United States |
| 7 | Setting the future of digital and social media marketing research: Perspectives and research propositions | 671 | International Journal of Information Management | 20.1 | Elsevier, United Kingdom |
| 8 | Consumers acceptance of artificially intelligent (AI) device use in service delivery | 551 | International Journal of Information Management | 20.1 | Elsevier, United Kingdom |

| S. no | Title | Citation Count | Journal Name | Impact Factor | Publisher & Country |
|---|---|---|---|---|---|
| 9 | Impact of COVID-19 pandemic on information management research and practice: Transforming education, work and life | 504 | International Journal of Information Management | 20.1 | Elsevier, United Kingdom |
| 10 | Artificial intelligence capability: Conceptualization, measurement calibration, and empirical study on its impact on organizational creativity and firm performance | 408 | Information & Management | 8.2 | Elsevier, United Kingdom |

## CONCLUSION

Artificial intelligence, a burgeoning field in the Library and Information Science (LIS) domain is serving as a crucial element in catering to the information needs of the user community. It can facilitate functional sectors such as automated reference services, enhance information accessibility for users, and personalize user experiences. The applications of artificial intelligence in libraries such as chatbots can offer 24/7 support to the patrons enabling remote information retrieval beyond the standard hours. This will help not only in serving the users but also aiding to assist the librarians in high service demands. The potential of AI to foster personalized learning experiences aligns with librarian's core mission to support users with their specific needs. The present bibliometric study unveils critical insights into the publication pattern of global literature on Artificial Intelligence and its applications in the Library and Information Science discipline. The cumulative growth rate (CAGR) of global AI literature over the past 23 years is observed to significantly increase by 13.42% whereas growth of publications pertaining to 'application of AI in LIS' is observed to be higher with 20.01%. The steady increase in the publication profile indicates that active R&D in exploring the application of AI tools in libraries. An analysis of the publication profile of the top ten countries reveals that although China leads quantitatively in R&D on AI, it is still behind USA which specialises in 'application of AI in LIS'. It is interesting to note that India is among the top ten most productive countries (ranked 7th globally and 8th in LIS), which indicates increased R&D activity AI and AI in LIS. Although there is an upward trend observed, the RSI suggests that there is scope to increase research pertaining to application of AI in LIS, particularly for China (-0.166) and South Korea (-0.023). It is also observed that though a Chinese institution ranks first by the quantum of publications, the University of Arizona, United States has topped among other institutions by actively publishing research about AI in LIS. Although China leads the publication count both in country wise and institution wise but none of the top ten most productive journals are published in China, which also points towards the dominance of the developed nations such as UK and USA in the journal publication arena. Majority of the citations are received by just 4 journals out of the 82 unique source titles publishing research on AI. There is a need for acceptance from the academic and research community in the prolific developing nations to support and enhance publication of quality journals. The present study warrants necessary efforts to increase interdisciplinary research and broaden geographical engagement which could advance the field, enhancing AI's impact on LIS practices worldwide. These insights emphasize the need for globally collaborative efforts to ensure balanced development and maximize AI's impact on libraries, librarianship, and communities.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

## FUNDING

The authors declare that no funding was received for the research, authorship, or publication of this article.

## ETHICS DECLARATION

The authors hereby state that there is no ethical issue involved in this study as it is a bibliometric study, it is a study using secondary database, and it is an original study.

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