Research Article

Quantitative Insights from Research on Artificial Intelligence for Digitally Empowered Teachers: A Bibliometric Analysis

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Abstract

To implement AI-enhanced pedagogy in Indian schools, educators must understand the importance of AI in education, stay updated on current research, know India's position in this field, and identify what digitally empowered teachers need to become professionals in this area. Using bibliometric analysis, this study provides the insights needed to guide these educators. We can properly implement AI-enhanced pedagogy in schools only if digitally empowered teachers improve their awareness of artificial intelligence. As shapers of today's students, their expertise is essential. In this study, the researchers conducted a Bibliometric analysis based on publications collected from the dimension database. The key term for the study was "artificial intelligence". The researchers used a quantitative method, and the search strategy was limited to title and abstract only, the publication year was limited to 2014-2023, and the research field is limited to education to exclude research other than the field of education like robotics, machine learning, programming, etc. The research findings throw light on the need for international collaboration for digitally empowered teachers in India for their professional development in artificial intelligence. The recorded citation count of 443 for India suggests a discernible variance in global academic recognition when compared to the United States. This dissimilarity in citation metrics may signify disparities in research output, levels of international collaboration, or the overall impact of Indian research within the broader global academic community, thereby highlighting important considerations for further investigation and analysis. This investigation revealed quite a few interesting findings related to citation, co-citation, and bibliography.

Keywords: Digitally Empowered Teachers, Bibliometric Analysis, Publication and Citation Trend, Co-Citation, Bibliographic Coupling

Introduction

With the emergence of technology, particularly artificial intelligence, we can reimagine the classrooms, replacing the four walls, blackboard, and constricted space with immersive virtual worlds. As the world around us is changing at an unprecedented pace, shouldn't our learning spaces change the traditional education model to keep pace? (Chen et al., 2020) highlight the importance of artificial intelligence in education, especially in instruction, administration, and learning. Artificial intelligence will help in personalized learning and prepare learners and educators to face the challenges of educational technology (Hamal et al., 2022). (Xue & Wang, 2022) suggest that as there are many possibilities for artificial intelligence in education, it is necessary to create awareness among teachers in this field. The research possibilities on

artificial intelligence will certainly create such an awareness among teachers (Hagger & Mcintyre, 2000). Here the researchers are trying to do this by bibliometric analysis. Bibliometric analysis, a crucial tool in research evaluation, involves quantitatively examining scholarly publications (Sethi et al., 2016). For Digitally empoweredteachers, navigating the vast sea of academic information is essential for staying current in their fields. Bibliometric analysis assists researchers in identifying influential publications, tracking research trends, and making informed decisions about resource allocation (Scientometrics Recent Advances, n.d.-b). The databases and visualization tools are used by educational researchers to give valid information regarding emerging research areas and trends to provide guidelines for Digitally empowered teachers to focus on academic efforts related to such areas. Digitally empoweredteachers can enhance their professional development and contribute their best to the educational field by using Bibliometric data. We can use VOSviewer as a powerful tool to extract research data files from various database types for Bibliometric analysis and visualization.

Literature Review

AI and Big Data Analytics research is expanding in five fields: Business, Engineering, Healthcare, Sustainable Operations, and Hospitality Tourism (Thayyib et al., 2023). As an emerging field of expertise, educational artificial intelligence has the potential to transform our learning experiences (Bates et al., 2020). Artificial intelligence can influence human performance (Yang et al., 2021). Hwang et al. (2022) studied the role of artificial intelligence in nursing and found its positive impact. Park and Kwon (2023) suggested that AI programs were effective in technology education. Garcia et al. (2024) highlight the need for integrating artificial intelligence in medical education. Through a bibliometric analysis, it was concluded that artificial intelligence can advance health education (Zapata et al., 2024). Singh et al. (2023), through a bibliometric pattern, say that artificial intelligence can help attain sustainable development goals. Nica et al. (2024) highlight the influence of fuzzy logic and AI in financial analysis, marked by a growth in research outputs and global collaborations. Fijačko et al. (2024) explain the capabilities of generative artificial intelligence in their bibliometric analysis. Rahman et al. (2024), in their bibliometric study, indicate a rising pattern of artificial intelligence in language learning. Ivanova et al. (2024) understand artificial intelligence as a transformative force. Looking at the research done on artificial intelligence, it is clear that it has a lot of impact on today's society. The relevance of the current study lies in how to effectively raise awareness among digitally empowered teachers so that they can successfully incorporate this into Indian school education pedagogy. For this purpose, primarily they should be aware of the research updates in this field and should know where India lies in the area of this research.

Need and Significance Of The Study

Androshchuk (2022) suggests that bibliometric analysis helps teachers understand where to find relevant information and how to apply it in practice, allowing for the qualitative use of information and communication technologies in teaching Generation Z students. For digitally empowered teachers, it's crucial to keep up with the latest education research. Bibliometric

analysis helps them do this by using a systematic approach to figure out impactful academic articles (Donthu et al., 2021). By using tools for Bibliometric analysis, digitally empowered teachers can quickly find key publications, spot new trends, and make the most of scholarly resources (Kalantari et al., 2017). This not only makes their research easier but also helps them make smart choices, creating a culture of always learning and innovating in the classroom. A trend analysis of research in artificial intelligence (AI) within the field of pedagogy is essential to stay abreast of the rapidly evolving landscape of educational technology. Our teaching and learning methodologies can be improved by integrating artificial intelligence into pedagogical practices. Tracking trends allows educators, researchers, and policymakers to identify emerging patterns, innovative applications, and best practices in AI-driven educational tools. This analysis not only informs the development of more effective and personalized learning experiences but also facilitates the identification of potential challenges and ethical considerations associated with AI in education. By keeping pace with the evolving trends in AI pedagogy, stakeholders can make informed decisions, foster collaboration, and ultimately contribute to the enhancement of educational outcomes in the digital age.

Objectives of the Study

The main objective of the study is to answer the following research questions.

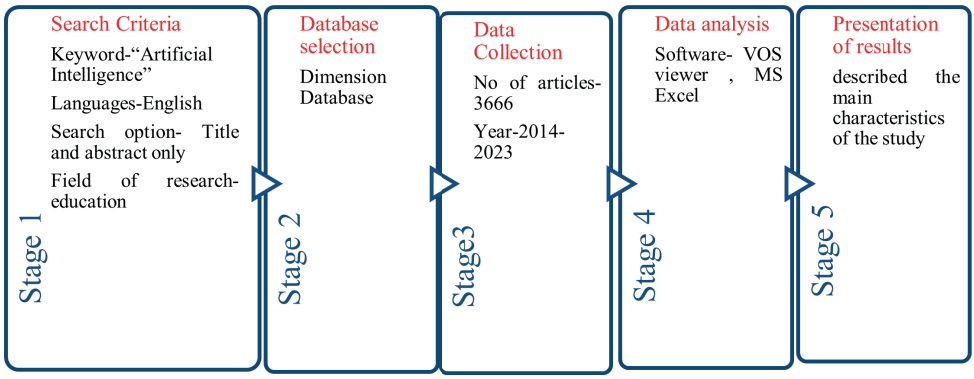
- How can digitally empowered teachers use the latest publication and citation trends in educational research on artificial intelligence to enhance their professional outcomes?
- Which authors in "artificial intelligence" are the most influential, according to co-citation analysis, and how can digitally empowered teachers benefit from this?
- Which countries have gained the most citations for their research contributions in "artificial intelligence," and how can digitally empowered teachers use insights from these leading nations?
- Which journals have the most influence in publishing research on "artificial intelligence" in education, and how can digitally empowered teachers use these journals to stay informed and enhance their teaching practices?

Method

Here the researchers used the quantitative method as it involves the systematic measurement and analysis of scientific literature using numerical and statistical techniques. Bibliometric analysis relies on numerical data such as the number of publications, citations, and various metrics (e.g., h-index, impact factor). The method uses statistical tools and techniques to analyze patterns, trends, and relationships within the data. This includes co-citation analysis, citation analysis, and network analysis. Bibliometric analysis was done on "artificial intelligence" in the field of education

Research design: Descriptive Bibliometric- This design focuses on summarizing and describing patterns within a specific set of publications. It includes analyzing publication trends, citation patterns, co-citation patterns and bibliographic coupling. Fig 1 explains the research design.

Figure-1: Research design



Search strategy

Data of journal articles published in the field of artificial intelligence in education during the period 2014-2023 were collected from the Dimension database. To obtain clean data, we searched the key terms in the title and abstract only, and the research was limited to articles written in English alone. Without substantial research in artificial intelligence, our nation cannot prepare our digitally empowered teachers for the current scenario. The significance of Dimension lies in its ability to aggregate scholarly publications across diverse disciplines, offering a wealth of information that enhances the depth and breadth of our investigation. By leveraging the extensive and up-to-date resources within the Dimension database, we ensure the reliability and relevance of our findings. Table 1 shows the search strategy.

Table-1: Search strategy

No. of Documents	**3666**
Search Term	"Artificial Intelligence"
Languages	English
Publication Years	2014-2023
Document Types	Article
Field of research	Education
Search option	Title and abstract only

Exclusion Strategy

To maintain the precision of the results, some documents were excluded from the study. The exclusion was determined by specific criteria to ensure the accuracy and integrity of the analysis.

1. The papers that are written in any other language than English.
2. Excluded research other than the field of education like robotics, machine learning, programming, etc.

Co-citation and bibliographic coupling are two Bibliometric measures that reveal different aspects of scholarly relationships. Co-citation indicates thematic similarity by identifying documents frequently cited together by third parties, showcasing shared intellectual themes. In contrast, bibliographic coupling identifies content similarity between two documents when they independently cite the same source, reflecting a direct intellectual affinity. While co-citation emphasizes shared influence, bibliographic coupling highlights common foundational references, providing nuanced insights into the intellectual connections within the scholarly literature.

Analysis and Interpretation

Publication and citation trend

Figure-2: Publication and citation trend

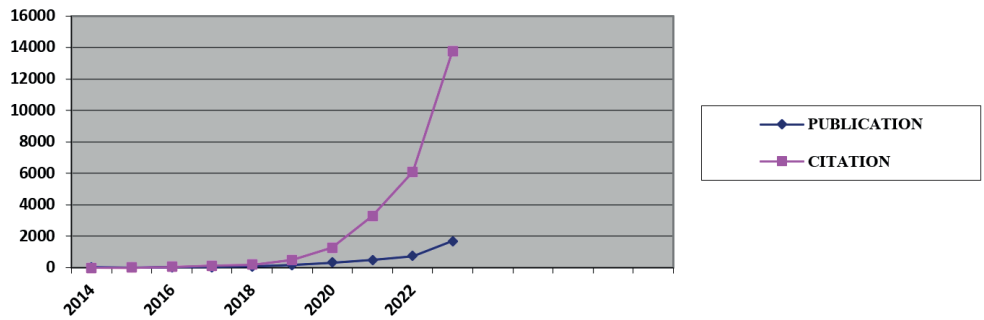


Fig 2 shows the publication and citation trends. The data reveals a consistent upward trend in both the number of publications and citations related to Artificial Intelligence in the field of education from 2014 to 2023, indicating a sustained and growing interest in this field. This surge in scholarly output and recognition through citations underscores the significance and evolving prominence of AI in shaping educational practices.

Figure-3: Co-citation pattern

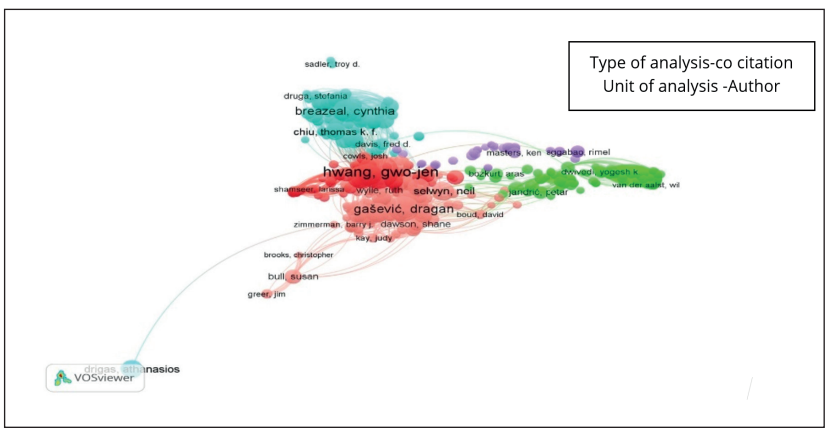


Figure-4: Citation pattern

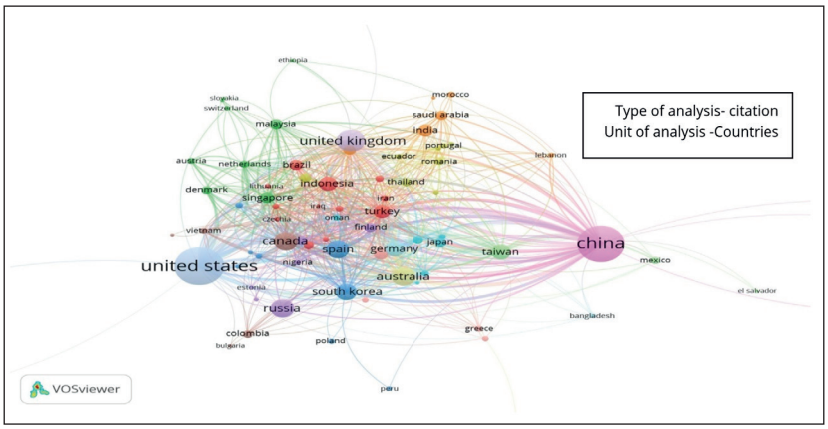


Fig 3 & Fig 4 shows the co-citation and citation patterns. The highly influential authors have been selected based on this pattern. The results are given in table 2.

Table-2: Highly influential authors based on total link strength in co-citation analysis

Author	Affiliation	H index
Gwo-jen Hwang	National Taiwan University of Science and Technology	101
Dragan Gasevic	Monash University	83
Cynthia Breazeal	Massachusetts Institute of Technology	92
Haoran Xie	Lingnan university Hong Kong	47
Simon J. Buckingham Shum	University of Technology Sydney	62

All authors being discussed have a highly impactful scholarly output, as indicated by their H-index exceeding 40. This implies a substantial and sustained contribution to their respective fields, reflecting a significant level of influence and recognition within the academic community.

Table 3 shows the leading countries that gained more citations for their research contributions.

Table-3: Leading countries that gained more citations for their research contributions

Country	*Citations Received*
US	*3544*
China	*3090*
Australia	*1984*
UK	*1891*
Canada	*1202*

India has received a comparatively lower number of citations, 443, suggesting a lower level of global academic recognition in comparison to the United States. This discrepancy may reflect differences in research output, international collaboration, or the impact of Indian research on the global academic community.

Figure- 5: Bibliographic coupling map

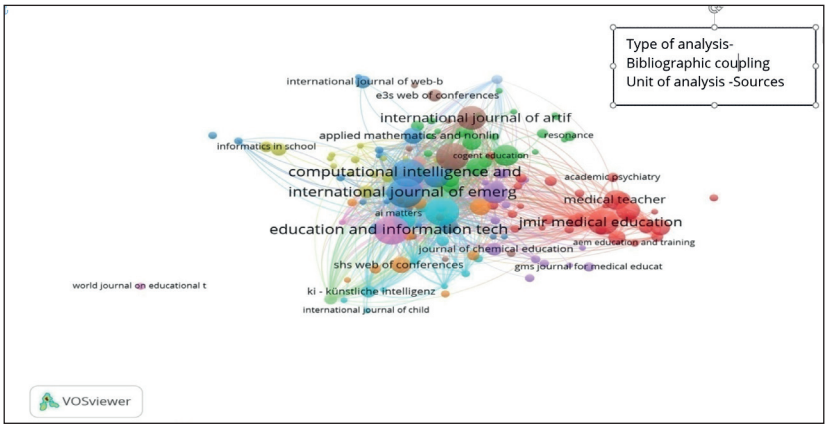


Fig 5 shows the bibliographic coupling map, and the overall performance of each journal was calculated and tabled in table 4.

Table-4: A journal's overall influence in its field based on their citations in bibliographic coupling map

Source	Impact factor	Citations
Computers and education artificial intelligence	13.62	1597
international journal of educational technology in higher education	9.4	1174
international journal of artificial intelligence in education	4.9	1173
JMIR medical education	3.6	898
Sustainability	3.8	621

Computers and Education Artificial Intelligence" has the highest impact factor among the listed journals. The "Impact Factor" is a measure of the average number of citations that articles in a journal receive over a specific period.

Findings

- There is a consistent upward trend in both the number of publications and citations related to Artificial Intelligence in the field of education from 2014 to 2023
- Leading authors in the field of Artificial Intelligence in Education are Gwo-jen Hwang (National Taiwan University of Science and Technology), Dragan Gasevic (Australia), Cynthia Breazeal (Massachusetts Institute of Technology), Haoran Xie (Hong Kong), and Simon J. Buckingham Shum (Australia). Authors from India do not find a place on this list. This suggests a need for international collaboration to enhance the professional development of digitally empowered teachers in the current scenario.
- The observed citation count of 443 for India implies a relatively lower degree of global academic recognition compared to the United States. This difference in citation metrics may be indicative of variations in research output, international collaboration, or the impact of Indian research within the global academic community.
- The prominence of "Computers and Education Artificial Intelligence" with the highest impact factor and the most citations underscores its significant influence in the field.

Conclusion

The application of Bibliometric analysis in the realm of artificial intelligence (AI) in pedagogy provides invaluable benefits for educators and researchers alike. Publications and citations related to Artificial Intelligence in education, spanning from 2014 to 2023, showed an ongoing upward trend, which underscores the growing significance of this field in the present educational landscape. This finding agrees with the study of Bozkurt et al. (2021) which suggests a rise in artificial intelligence studies in the field of education on themes like adaptive learning, personalization, AI in higher education, etc. The prevalent influence of non-Indian leading authors and the lower citation count for India in comparison to the United States highlight the need for international collaboration in shaping educational practices. Digitally empowered teachers should recognize the pivotal role played by influential journals like "Computers and Education Artificial Intelligence" to stay updated with the research trends. In the present landscape, a proactive approach to balancing awareness of impactful journals and fostering global collaborations emerges as a valuable strategy for digitally empowered teachers, enabling them to effectively enhance their professional development within the dynamic realm of AI in education. By understanding where India stands in AI research, teachers can identify specific areas where knowledge and resources are lacking. This can help them focus on those gaps and seek out the best international resources, tools, and research to integrate into their teaching practices. Digitally empowered teachers can study the successful AI-enhanced pedagogical practices of these leaders and adapt them to fit the Indian educational context, bringing proven methods into their classrooms. Knowing that India is behind can make teachers aware of the need to collaborate with international researchers and institutions. Teachers can use the analysis to design curricula that incorporate AI concepts, ensuring that students are learning current and relevant information. This can help prepare students for future careers in AI and technology, bridging the knowledge gap from the ground up. By using bibliometric analysis in these

ways, Digitally empowered teachers in India can turn the current challenges into opportunities for growth and innovation, significantly enhancing the quality of education through AI.

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