# Artificial Intelligence in Education: A Bibliometric Mapping of Research Trends and Future Directions


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## Abstract:

*Artificial Intelligence in Education refers to the use of AI technologies and systems to enhance teaching, learning, and administrative processes in educational settings. The study examines the evolution of AI research in education through bibliometric analysis of 542 articles from the Scopus Database, using VOS Viewer for visualization. It reveals a significant increase in the frequency of publications after the COVID-19 pandemic with a notable shift towards machine learning, Generative AI, Intelligent tutoring, personalized learning, and behavioral intention. The study finds that the "International Journal of Artificial Intelligence in Education" is a prominent journal, and the United States is the most influential country in this area. Future research will likely focus on fostering interdisciplinary collaborations and exploring how AI can be leveraged to reduce educational inequalities.*


**Keywords:** *Artificial Intelligence in Education, bibliometric analysis, network visualization, Scopus, VOS viewer.*

## 1. Introduction:

Artificial intelligence (AI) is rapidly evolving in the field of technology. It can able to change human life drastically. AI is the future, a double-edged sword, and should be treated carefully. AI has wide applications in different sectors such as the military, industry, automobiles, engineering, marketing, agriculture, banking, health care, etc. (Wakchaure, Patle, & Mahindrakar, 2023). Education is the sector that is most affected by AI (Gardner, O'Leary, & Yuan, 2021). According to the latest definition, "AI is an applied discipline that aims to enable systems to identify, interpret, make inferences, and learn from data to achieve predetermined organizational and societal goals" (Enholm, Papagiannidis, & Krogstie, 2022). AI can be defined as the simulation of human intelligent processes with the help of technology. Artificial Intelligence in Education (AIED) refers to the integration or application of Artificial Intelligence in the field of Education. It includes the use of smart technologies to improve how teachers teach and how students learn. AIED includes students-centered AIED, Teacher-centered AIED, and Institution-Centered AIED. These AI tools can automate repetitive tasks, like grading or

scheduling, freeing up time for teachers to focus on teaching. They can also personalize learning by adapting lessons to each student's needs, helping them learn at their own pace. For example, AI systems can analyze a student's progress and suggest areas where they might need more practice. Moreover, AI can assist in identifying patterns in how students learn, making it easier for teachers to understand which teaching methods work best. As AI continues to develop, its potential in education is growing, offering new ways to support students, reduce the workload on teachers, and make education more accessible and effective for everyone. AIED can provide individualized learning and guidance based on their current status, needs, preferences, or personal characteristics.

## 2. Review of Related Literature:

With the advancement of AIEd, teaching and learning methods, curriculum, administration, etc. have all changed from the traditional setting. AIED helps in administration, instruction, and learning. The use of AI tools, particularly ChatGPT, in education helps teachers reduce administrative tasks while ensuring academic integrity is maintained (Dhamija & Dhamija, 2024). Teachers can easily undergo assessment, evaluation, and grading, which helps to analyze the student's learning progress and to develop new instructional methods (Chen, Chen, & Lin, 2020). AI has the potential to enhance student engagement, improve learning outcomes, support personalized learning paths, and reduce the administrative burden on educators and institutions (Alqahtani, et al., 2023). AI-based teaching methods have the potential to revolutionize traditional educational approaches, making them more adaptable to the varied needs and preferences of modern students (Liu, 2024). Without the proper awareness; students, teachers, and educators aren't able to utilize the AIED application effectively (Hwang, Xie, Wah, & Gašević, 2020). AIED awareness helps students to engage with new technologies. Studies show that AIED has a significant influence on individual development, creativity, curiosity, enthusiasm, critical thinking, and scholastic performance among learners (Altememy, et al., 2023).

From the review of related literature, the investigator noted that, while AI has been increasingly integrated into educational practices, there is a lack of detailed and systematic mapping of research trends, key authors, and influential journals. This study aims to address this gap by offering an in-depth bibliometric analysis of the current landscape, highlighting emerging trends, and providing insights into potential future directions for AI in education.

The significance of this study lies in its potential to help educators, researchers, and policymakers identify key areas for further exploration and advancement. Moreover, it offers valuable insights into the effective integration of AI in educational practices, optimizing learning outcomes, personalizing teaching methods, and streamlining administrative tasks.

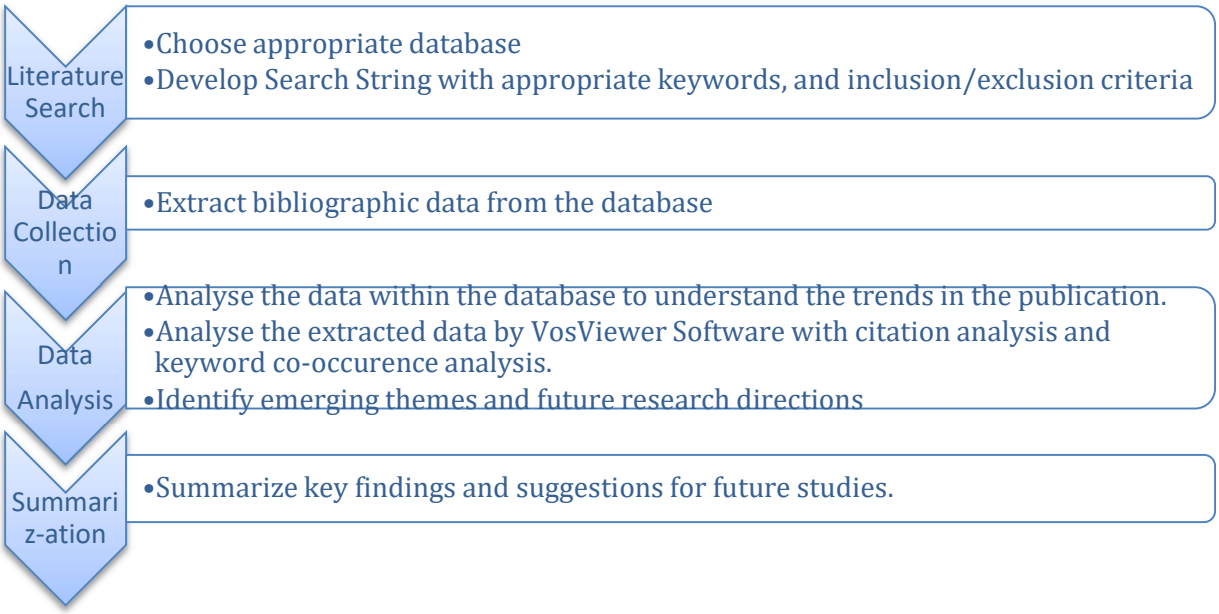
## 3. Aims/ Objectives of the Study:

This study aims to explore the research landscape of AI in education by conducting a bibliometric analysis to map key research trends, authors, institutions, and areas of focus within the academic literature. For that following research questions are set.

(i) What are the trends in the volume of publications on Artificial Intelligence in Education across countries and over the years?
(ii) Which is the most influential journal and country in the relevant field?
(iii) What are the current research areas in Artificial Intelligence in Education?
(iv) What future research directions can be identified from the analysis of current research trends?

## 4. Methodology:

This study examines the recent trends in Artificial Intelligence in Education using a Bibliometric Analysis. It adopts a Quantitative Research Design, employing a Bibliometric Approach to analyze the relevant data. Bibliometric analysis is an effective tool for visualizing and mapping the structure of scientific knowledge (Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021). Bibliometric techniques such as citation analysis, and keyword co-occurrence are used to assess research impact and emerging trends. Visualization tools like VOS Viewer are used to map these research networks and themes. The planning of the methodology is depicted in Figure 2.




## 5. Data Collection and Data Extraction:

The data collection of articles took place in November 2024, following the three-phase search strategy such as Defining the topic, scope, and eligibility criteria; screening the articles; and

including them, as depicted in Figure 1 (Zakaria, Ahmi, Ahmad, & Othman, 2021). The data are extracted by phrases such as “AIED”, “AIEd”, “Artificial Intelligence in Education” and “AI in Education”. The search string is limited to Social Science journal articles published in English only. Finally, a total of 542 documents were included in this study. The selected data were extracted in CSV format, including citation details, bibliographic information, abstracts, keywords, and other relevant data. The extracted data set is analyzed using Vos Viewer 1.6.20 software.

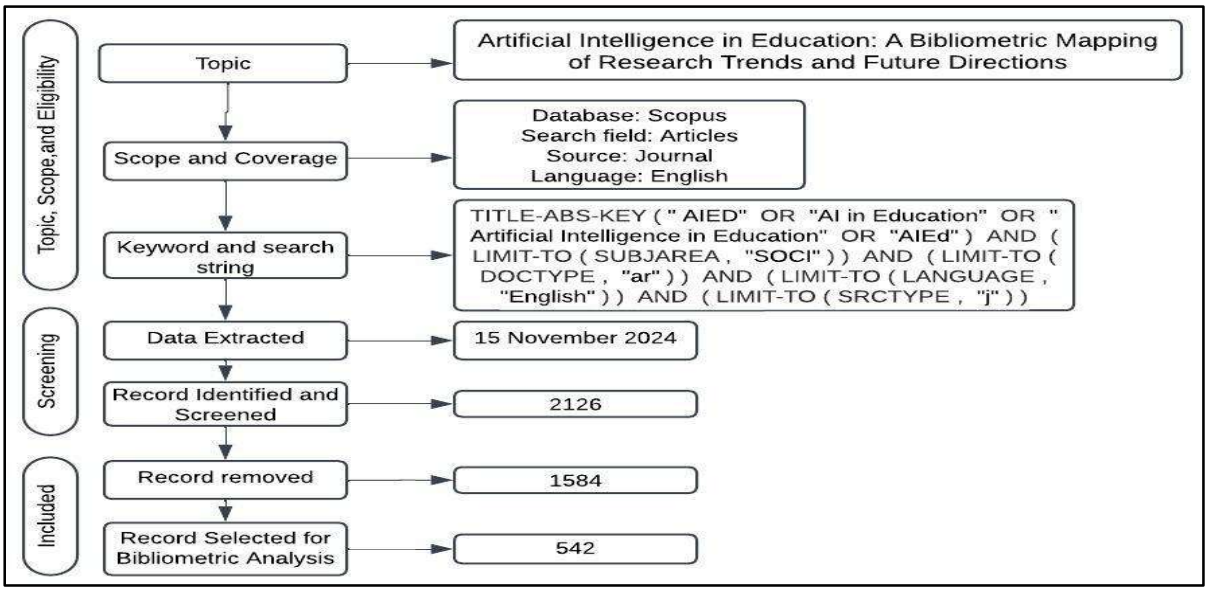



Figure 1: The Search Strategy Flow Diagram

*Note.* Adapted from (Zakaria, Ahmi, Ahmad, & Othman, 2021)

## 6. Data Analysis:

The research trends are first examined using the results from the Scopus database, including publication distribution across various years and countries. Next, a co-citation analysis is conducted to identify the most influential authors, documents, and journals. Additionally, a co-occurrence keyword analysis is performed to highlight the current trends in the literature on Artificial Intelligence in Education.

## 7. Results and Discussion:

### 7.1 Publication Trends Over the Years:

The researcher analyzed the publications over the years across all the extracted articles from the Scopus database without any time gaps, and the findings are presented in Figure 2.

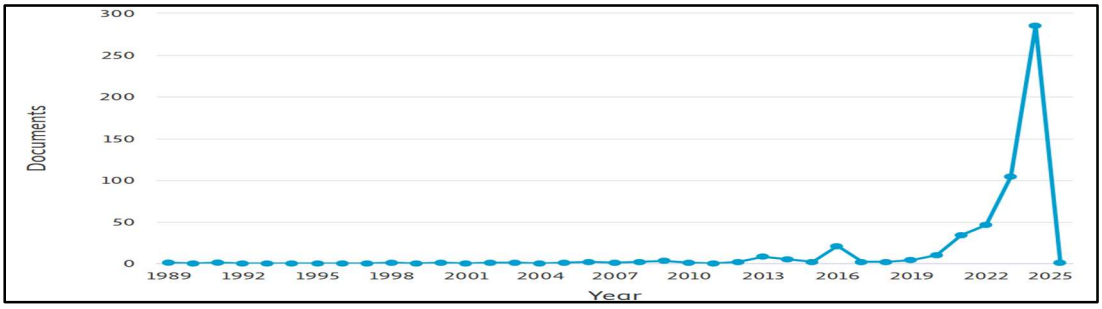



Figure 2: Publication Over the Years

The graph revealed a sudden increase in the publications on AIED in recent years. In 2023, 104 documents were published, accounting for 19% of the total documents analyzed, while in 2024, the number increased to 285, making up 52.6% of the total, reflecting a rising interest in this field.

### 7.2 Publication Trends Across the Country:

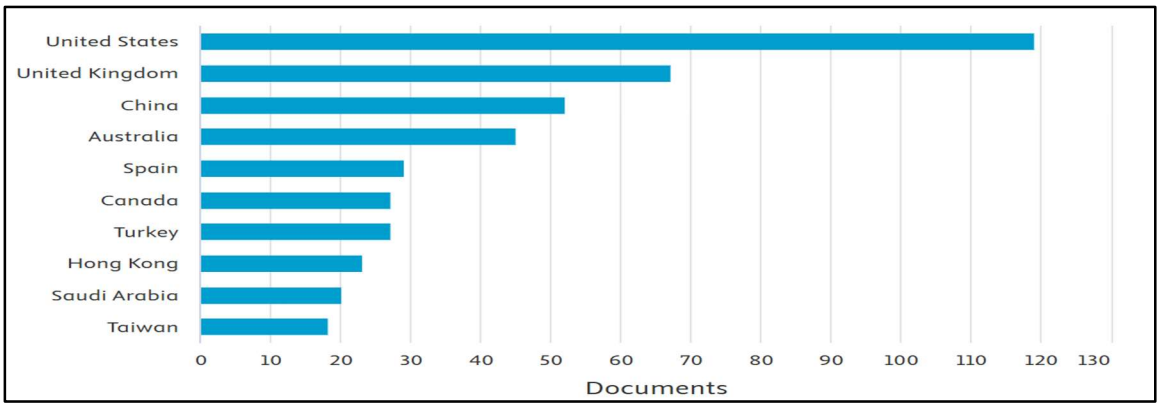



Figure 3: Publication Across the Country

From Figure 3, the United States emerged as the most influential country in terms of publications on AIED, contributing (119) 22.7% of the total articles. The United Kingdom followed closely with 67 publications and China with 52 publications. India is in 13$^{th}$ position with 13 documents.

### 7.3 Journal Citation Analysis:

Table 1: Journal Citation Count

| Journal | Number of Documents | Citations |
|---|---|---|
| International Journal of Artificial Intelligence in Education | 74 | 3508 |
| Education and Information Technologies | 34 | 988 |
| Computers And Education Artificial Intelligence | 32 | 1702 |
| Journal of Applied Learning and Teaching | 13 | 925 |
| Educational Technology and Society | 13 | 494 |

From Table 1, the “International Journal of Artificial Intelligence in Education" emerged as the most influential journal in the field, publishing 13.7% of the analyzed publications and receiving the highest number of citations. Other prominent journals include “Education and Information Technologies”, and “Computers and Education Artificial Intelligence”.

### 7.4 Co-Occurrence Keyword Analysis:

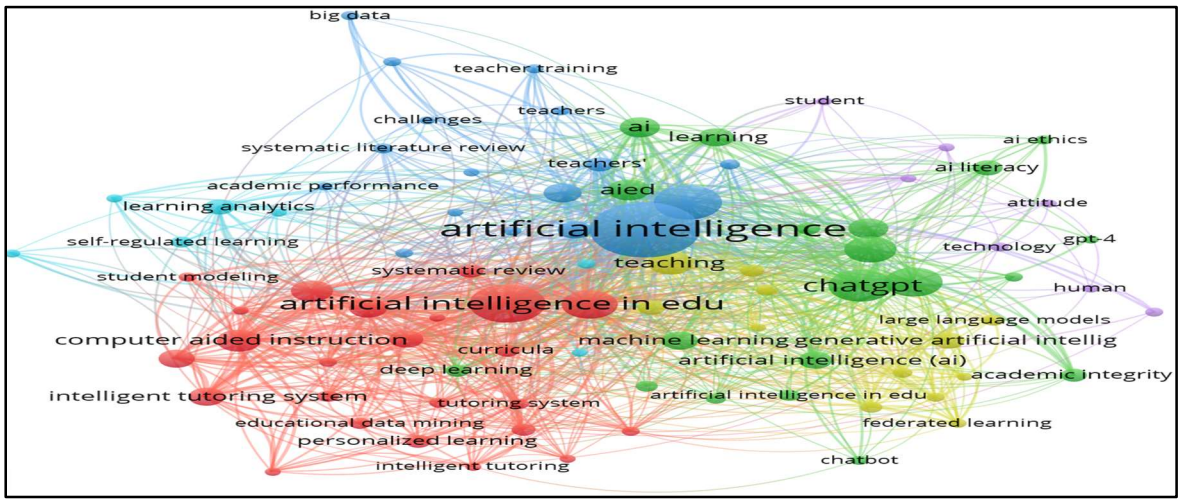



Figure 4: Network Visualization of Co-Occurrence Keyword Analysis

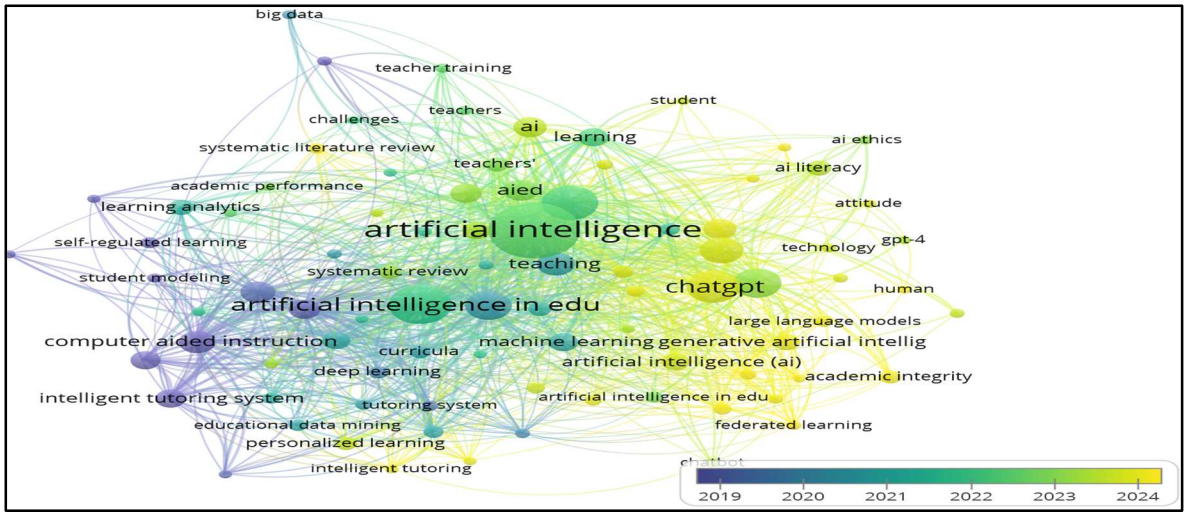



Figure 5: Overlay Visualization of Co-Occurrence Keyword Analysis

Figure 4 shows the network visualization of the keyword co-occurrence analysis with six clusters in different colours which refer to groups of related keywords or terms that frequently appear together in academic research, signifying interconnected concepts or themes. The six research areas focus on exploring innovative applications of artificial intelligence (AI) to enhance education across various disciplines. The first area emphasizes the design and evaluation of

personalized, adaptive learning systems tailored to individual student needs. The second area examines the intersection of AI, ethics, and educational innovation in higher education. The third and fourth areas delve into AI-driven educational technologies, focusing on enhancing teaching and learning in general and specifically within engineering education. The fifth area highlights the integration of digital technologies in transforming medical education. Lastly, the sixth area investigates how intelligent systems, such as learning analytics and AI-powered tools, can support self-regulated learning and motivation in online environments.

The Overlay Visualization of the keyword co-occurrence shows that generative AI, Large Language Model, Academic Integrity, Federated Learning, Machine Learning, and Contrastive Learning are the emerging trends in the field of Artificial Intelligence in Education.

## 8. Future Directions:

Future research areas identified through bibliometric analysis include developing ethical frameworks for AI that prioritize privacy, diversity, data security, and inclusivity. Another focus is using AI to bridge educational gaps, offering tailored support for individuals with disabilities and reducing inequalities. Collaboration with policymakers is crucial to creating guidelines for ethical AI deployment in education. Additionally, fostering interdisciplinary collaboration among researchers, educators, and technology developers will be key to the effective application of AI. These efforts aim to ensure responsible, impactful use of AI in education.

## 9. Conclusion and Recommendations:

The study highlights the growing importance of Artificial Intelligence in Education, with a focus on Generative AI, Large Language Models, Academic Integrity, Federated Learning, Machine Learning, and Contrastive Learning. The findings provide valuable insights for future research and publications in this field. The study recommends further exploration of bibliometric mapping using additional databases and software, as well as expanding the scope of analysis to include other languages and publication types.

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