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## ARTIFICIAL INTELLIGENCE IN EDUCATION - A BIBLIOMETRIC ANALYSIS STUDY USING BIBLIOSHINY

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### ABSTRACT

Artificial Intelligence (AI) has made significant contributions to various fields, including education, through its innovative applications. This research paper aims to assess the growth and impact of AI on education by conducting a bibliometric analysis of research studies conducted over a period of five years, from 2019 to 2024. The analysis was based on a literature review of studies published in journals and accessed through the SCOPUS database, using the keywords "Artificial Intelligence," "Education," and "Intelligence." A total of 432 documents were collected and analyzed, providing insights into the research developments in the field of AI in education. The data revealed that the United States was the leading contributor, with significant research output. Among the authors, Donia emerged as the most prominent with four documents and 208 citations. The analysis also highlighted the research trends and the progress of AI in education, shedding light on the potential benefits and opportunities it offers to students and teachers. The findings of this research contribute to mapping the landscape of AI in education and provide valuable insights for future studies and educational practices.

#### **Keywords:**

Artificial Intelligence, Education, Bibliometric Analysis, Research Studies, SCOPUS Database.

## INTRODUCTION

Artificial Intelligence (AI) is revolutionizing various industries, and one area where it holds great potential is education. The use of AI in education has gained significant attention in recent years due to its ability to enhance learning experiences, personalize education, and improve administrative tasks. To gain a comprehensive understanding of the research landscape in this field, a bibliometric analysis study was conducted using Biblioshiny. The aim of this study is to explore and analyze the existing body of literature on AI in education. By utilizing bibliometric analysis, we can identify key trends, influential authors, popular research topics, and the most relevant journals and conferences in the field. This analysis will provide valuable insights that can guide future research directions and inform policymakers and educators.

Biblioshiny, a powerful bibliometric analysis tool, was employed to collect and examine a wide range of scholarly articles related to AI in education. The selected articles were obtained from reputable and well-established academic databases. To ensure the reliability and credibility of the study, a rigorous screening process was conducted to include only high-quality and relevant articles. The analysis will involve various bibliometric indicators such as citation analysis, co-citation analysis, authorship patterns, and keyword co-occurrence analysis. These indicators will aid in identifying the most influential articles, the collaboration network among authors, and the emerging research themes in the field. The findings of this study will contribute to the existing knowledge and shed light on the current state of AI in education research. It is important to note that this study aims to provide an objective overview of the existing literature on AI in education without any plagiarism. The analysis will be conducted in a transparent and unbiased manner, adhering to best practices in bibliometric analysis. The insights gained from this study will be valuable for researchers, educators, and policymakers who are interested in exploring the potential of AI in education and its impact on teaching and learning processes.

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## **REVIEW OF LITERATURE:**

Xuesong Zha (2021) the challenges in education may be caused by AI with regard to inappropriate use of AI techniques, changing roles of teachers and students, as well as social and ethical issues. Su J and Yang W (2024) Early childhood AI literacy and effectiveness are more positively impacted by AI. Veletsianos (2024) Participantproduced classroom agreements between AI and learners covered social norms, boundaries, affordances, and educational components. A blended English teaching approach uses a speech recognition platform to achieve innovation and diversification in English teaching initiatives Wang C (2024).Ke Zhang (2021) highlights selected AIEd technologies and applications, reviews their proven and potential benefits for education, bridges the gaps between AI technological innovations and their educational applications. Bozkurt et al., (Bozkurt et al., 2021) note a sharp increase in AI in education-related publications around 2018 and 2019, attributing this rise to factors like increased technological capacity, computing infrastructure, investments in AI, and demands from sectors integrating Industry 4.0. Mustafa et al. (Mustafa et al., 2024) highlight the need for a comprehensive perspective that synthesizes scattered evidence on AIEd across time, disciplines, and educational levels. Lampou (Lampou, 2023) explores the current and potential role of AI in the educational sector, addressing its benefits and potential challenges, suggesting AI aims to supplement educators by making learning more engaging and efficient. Guan, Mou, and Jiang (Guan et al., 2020) offer a data-driven historical analysis of artificial intelligence innovation in education over a twenty-year period. Jiahong S (2023) The number of artificial intelligence (AI) literacy studies in K-12 education has recently increased, with most research focusing on primary and secondary education contexts. Little research focuses on AI literacy programs in early childhood education. Curriculum and Qualified Teachers, Kerimbayev et al., 2025 suggest that a well-structured curriculum and qualified teachers are essential for the successful integration of AI in education. Veletsianos, George (2024) this paper report on a thematic analysis of 92 participant responses to a story completion exercise which asked them to describe a classroom agreement between an AI instructor and a learner twenty years into the future. Chunyan Wang (2024) This paper first investigates English teaching using an AI speech recognition platform. In the feature value analysis module, using the hidden Markov model is beneficial to improve the accuracy of MFCC features for parameter speech recognition. This study proposes a blended English teaching strategy that utilizes a speech recognition platform to achieve innovation and diversification of English teaching efforts. Suresh Babu (2023) The chapter provides an extensive exploration of Generative AI in education. It investigates the evolution and significance of AI in educational settings while delving into contemporary issues such as ethics, privacy, fairness, and pedagogy. Furthermore, it examines the impact on traditional teaching methods, personalization, and accessibility, addressing educational disparities. The chapter also outlines the best practices and lessons learned from case studies and successful institutions, pointing toward future directions, including emerging technologies like GPT-4 and augmented reality. Papakostas, C (2024) This book concluding chapter encapsulates the essence of our extensive research, which explores the intricate intersection of artificial intelligence (AI) and augmented reality (AR). It offers a panoramic view of the intricate interplay between AI and AR, showcasing the boundless possibilities that await those who dare to traverse this dynamic landscape. By marrying human creativity with technological innovation, we aim to shape the course of future developments in the field of education. Zhang, S (2023) This paper reviews the relevant literature on the application of generative AI in higher education and proposes the application and implications of using generative AI tools to support student and instructors work in non-STEM higher education disciplines. Jaboob, M (2024) he integration of Artificial Intelligence (AI) in higher education has the power to revolutionize the learning experience by fostering engagement, personalization, efficiency, and innovation. AI offers a wide range of exciting possibilities where AI-powered tools enable students to receive tailored feedback and guidance, enabling them to learn at their own pace and excel academically. Results reveal that generative AI techniques and applications have positive and significant effects on students' cognitive achievement in Arab higher education institutions. Walter, Y (2024) The introduction of AI into education marks a significant departure from conventional teaching methods, offering personalized learning and support for diverse educational requirements, including students with special needs. There is detailed analysis of strategies for embedding these skills within educational curricula and pedagogical practices. This is discussed through a case-study based on a Swiss university and a narrative literature review, followed by practical suggestions of how to implement AI in the classroom. Kemelbekova, Z (2024) The article analyses the implementation and efficacy of artificial intelligence in teaching English to first-year students at the Abai Kazakh National Pedagogical University. The present study examined the effects of AI chatbots on students' speaking abilities and overall experiences in the English as a Foreign Language (EFL) classroom. Jain, K.K. (2024) This research delves into the multifaceted landscape of various factors that influence the adoption of Generation-

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Artificial Intelligence (Gen-AI) in Higher Education. By employing a comprehensive framework that includes perceived risk, perceived ease of use, usefulness, Technological Pedagogical Content Knowledge (TPACK), and trust, the study aims to reveal the crucial roles that these factors play in shaping the intention to embrace Gen-AI. Prather, J.(2023) Recent advancements in artificial intelligence (AI) and specifically generative AI (GenAI) are threatening to fundamentally reshape computing and society. Largely driven by large language models (LLMs), many tools are now able to interpret and generate both natural language instructions and source code. Gouvea, J.S (2024) The purpose of the Current Insights feature is to highlight recent research and scholarship from outside the LSE community. In this installment, I review a series of recently published articles which examine ethical dilemmas concerning the use of artificial intelligence (AI), more specifically machine learning, in science education. The articles in this set are intended to stimulate discussions about whether and how AI can and should be used in education research.Sundberg, (2024) This paper contributes to the literature on IS education by providing information for instructors on how to incorporate no-code AI in their courses and insights into the benefits and challenges of using no-code AI tools to support the ML workflow in educational settings.Awad, W.(2024) AI Chatbots are commonly used nowadays in different sectors such as real estate, marketing, healthcare, as well as education, in which both students and educators use these intelligent systems to gain personalized support and guidance to perform their tasks. Usage varies from solving assignments or setting the assignment questions, similarly, matters arising on whether these uses are acceptable, salutary, or ethical. Bansal, G (2024) the paper underscored that university leaders are placing a strong emphasis on human qualities in the human-AI dynamic. These qualities include adaptive skills for tackling unstructured problems, fostering collaboration, critical thinking, empathy, emotional intelligence, and a focus on ethical and social aspects. Memarian, B (2024) The contribution of this work is in presenting a blueprint for current research on embodied AI in education, identifying implications of research, and offering a classification that includes the environment-body-mind triad and three possible entities per triad, namely the human, technology/AI, or human + technology. Lee, S.J. (2024) AI education in enhancing students' AI literacy, problem-solving skills, and ethical reflections on AI's societal impact. Furthermore, it fostered motivation, positive attitudes toward AI, and an interest in technology while inspiring career aspirations. It is recommended to develop tailored AI curricula, instructional strategies, and appropriate tools and resources that seamlessly integrate into various subjects within the standard school curriculum. Kim, K (2024) This paper demonstrated the success of the curriculum among all students, with improved AI knowledge, perception, and behavioral intention after using tangible computing tools. Four themes about learning experiences were identified: (1) Augmentation of cognitive learning gains, (2) Augmentation of affective attributes, (3) Advantages of utilizing tangible computing tools for AI education, and (4) Obstacles encountered in the process of learning AI. Denny, P. (2023) Challenges and opportunities faced by computing educators and students adapting to LLMs capable of generating accurate source code from natural-language problem descriptions. Retrouvey, M (2024) this chapter discusses the integration of AI in radiology education both at the undergraduate and graduate levels. It offers concrete advice on how to overcome the most frequent challenges in the process and emphasizes the need to embrace AI and related technologies in the training of future radiologists in a collaborative, pragmatic, and continually improving manner. Labadze, L (2023) AI chatbots shook the world not long ago with their potential to revolutionize education systems in a myriad of ways. AI chatbots can provide immediate support by answering questions, offering explanations, and providing additional resources. Chatbots can also act as virtual teaching assistants, supporting educators through various means.Fütterer, T (2024) the average reaction on Twitter (e.g., using ChatGPT to cheat in exams) differs from discussions in which education and teaching-learning researchers are likely to be more interested (e.g., ChatGPT as an intelligent learning partner). These studies provides insights into people's reactions when new groundbreaking technology is released and implications for scientific and policy communication in rapidly changing circumstances. The reviewed literature highlights the transformative impact of artificial intelligence (AI) in education, offering both opportunities and challenges. AI enhances personalization, engagement, and accessibility, fostering student learning through generative AI, chatbots, and speech recognition tools. Studies emphasize AI's role in shaping AI literacy, problem-solving skills, and motivation, particularly in higher education and language learning. Ethical concerns, the evolving role of teachers, and the need for structured curricula and qualified educators are recurrent themes. Additionally, research underscores AI's growing presence in education, driven by technological advancements and industry demands. While AI supplements traditional teaching, addressing issues of fairness, privacy, and ethical use remains crucial. Additionally, AI's intersection with emerging technologies like augmented reality (AR) presents new opportunities for immersive and interactive learning. While AI supplements traditional teaching, a balanced approach that ensures equitable access, critical thinking, and human-AI

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collaboration is essential for its sustainable and ethical adoption in education. Ultimately, AI's successful integration in education requires a balanced approach that merges innovation with pedagogical considerations, ensuring equitable and effective learning experiences.

### FORMULATION OF RESEARCH QUESTIONS

To organize the research the aspects of Objectives, Research questions and outcomes was developed to accompany the research study to produce fruitful results for further research.

| Objective   | Research Questions   | Outcome  |  |
|---|--|--|--|
| To identify the mostly<br>contributed authors and<br>affiliation  | Which author has contributed<br>maximum articles in Artificial<br>Intelligence and the mostly cited<br>documents?  | To have a better understanding<br>of the concepts of Artificial<br>Intelligence and Education in the<br>articles contributed by the<br>authors                                     |  |
| The topics in which topics that<br>are concerned most by the<br>researcher and the countries<br>production overtime | Which are the main topics<br>considered for conducting<br>research?<br>What countries have produced<br>maximum articles on the topic<br>Artificial Intelligence? | To assess the countries that have<br>made maximum contribution to<br>the studies related to Artificial<br>Intelligence and the various<br>topics in which the research is<br>made. |  |
| Key words identified as the source for literature review  | What are the mostly used<br>keywords in the articles? What<br>are the number of times these<br>keywords are used?  | To understand the key words that<br>has been mostly used and the<br>application of the keywords at<br>various time periods.  |  |
| Trending topics in the field of<br>Artificial Intelligence and<br>Education   | What are the topics on which the research can be made in near future?  | To help the researchers to help them in further research.  |  |

### **METHODS**

The following search criteria was used to extract the database from the Scopus site. The search option included all the fields including abstract, keywords, titles, authors, ISSN number. The articles that were published during the period from 2019 - 2024 were extracted using the LIMIT - TO option in the years mentioned. The following selection parameter was used and the documents were downloaded as a .csv file and the further processing of the data was made.

TITLE (ai AND in AND education) AND PUBYEAR > 2018 AND PUBYEAR < 2025 AND (LIMIT-TO (SUBJAREA, "COMP") OR LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA, "DECI") OR LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "ARTS") OR LIMIT-TO (SUBJAREA, "ECON") OR LIMIT-TO (SUBJAREA, "MULT")) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp") OR LIMIT-TO (DOCTYPE, "ch") OR LIMIT-TO (DOCTYPE, "re")) AND (LIMIT-TO (LANGUAGE, "English"))

The data downloaded as a csv file served as a raw data from Scopus website and the analysis of the documents were made and the literature review study was conducted with the BIBLIOSHINY software and further detailed analysis were made on the source of information, mostly cited documents, affiliations, countries, keywords. A step-by-step plot diagram was introduced at each stage depicting clear picture on the concept.

### **Completeness of Metadata**

The completeness of the data was initially checked as soon as the Scopus data file is uploaded for analysis. From the bibliometric data the abstract, author, document type, journal, language, Publication year, title proved to be with completeness and excellent source of data. The data obtained is also evaluated for the Good, acceptable, poor and completely missing information. With the base of this preliminary information the next process of gathering the main information of the study was proceeded.

| Metadata | Description | Missing<br>Counts | Missing % | Status    |
|----------|-------------|-------------------|-----------|-----------|
| AB       | Abstract    | 0                 | 0         | Excellent |
| AU       | Author      | 0                 | 0         | Excellent |

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| DT | Document Type        | 0   | 0     | Excellent             |
|----|----------------------|-----|-------|-----------------------|
| SO | Journal              | 0   | 0     | Excellent             |
| LA | Language             | 0   | 0     | Excellent             |
| PY | Publication Year     | 0   | 0     | Excellent             |
| TI | Title                | 0   | 0     | Excellent             |
| TC | Total Citation       | 0   | 0     | Excellent             |
| C1 | Affiliation          | 2   | 0.47  | Good                  |
| CR | Cited References     | 4   | 0.93  | Good                  |
| DI | DOI                  | 45  | 10.51 | Acceptable            |
| DE | Keywords             | 84  | 19.63 | Acceptable            |
| RP | Corresponding Author | 152 | 35.51 | Poor                  |
| ID | Keywords Plus        | 207 | 48.36 | Poor                  |
| WC | Science Categories   | 428 | 100   | Completely<br>missing |

## **Main Information**

The main information portrays a detailed information on the database obtained through Scopus. The period of study was from 2019 - 2024 with 251 sources and 428 documents with a annual growth rate of 42.29%. The single author documents played a vital role in conducting research over the topics. The keywords were almost 1027 words which were considered as crucial for the study.



### Document per year

The contribution in the year 2023 was high with 209 documents and 1.39 years . Kim, K (2024) This paper demonstrated the success of the curriculum among all students, with improved AI knowledge, perception, and behavioral intention after using tangible computing tools. Four themes about learning experiences were identified: (1) Augmentation of cognitive learning gains, (2) Augmentation of affective attributes, (3) Advantages of utilizing tangible computing tools for AI education, and (4) Obstacles encountered in the process of learning AI.

| Year | Documents | Mean Total Citation Per Year | Citable Years |
|------|-----------|------------------------------|---------------|
| 2024 | 70        | 0.43                         | 1             |
| 2023 | 209       | 1.39                         | 2             |
| 2022 | 66        | 2.66                         | 3             |
| 2021 | 51        | 3.29                         | 4             |
| 2020 | 20        | 4.66                         | 5             |
| 2019 | 12        | 5.89                         | 6             |

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| Year | Documents |
|------|-----------|
| 2024 | 70        |
| 2023 | 209       |
| 2022 | 66        |
| 2021 | 51        |
| 2020 | 20        |
| 2019 | 12        |

#### **Document Sources:**

The sources of data as where the reviews were obtained through this analyses received from the SCOPUS database. The ACM international Conference Proceedings contributed much to the papers relating to the Artificial Intelligence in Education followed by Lecture notes in Network and Systems. This portrays that the various sources that contributed to the subject of the study were widely taken from different journals, books and proceedings for time periods.



← ACM International Conference Proceeding Series ← Lecture Notes In Networks And Systems

🖶 Education And Information Technologies 🛛 🛨 Computers And Education Artificial Intelligence

Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics

| Most Loca | Cited documents  |           |
|-----------|--|-----------|
| S.No      | Cited References   | Citations |
| 1.        | DESIGN AND IMPLEMENTATION OF A HIGHLY EFFICIENT THREE-LEVEL T-TYPE<br>CONVERTER FOR LOW-VOLTAGE APPLICATIONS, IEEE TRANSACTIONS ON<br>POWER ELECTRONICS, 28, 2, (2013) | 40        |
| 2.        | CHEN L., CHEN P., LIN Z., ARTIFICIAL INTELLIGENCE IN EDUCATION: A REVIEW, IEEE ACCESS, 8, PP. 75264-75278, (2020)  | 27        |

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|-----|---|----|
| 4.  | BRAUN V., CLARKE V., USING THEMATIC ANALYSIS IN PSYCHOLOGY,<br>QUALITATIVE RESEARCH IN PSYCHOLOGY, 3, 2, PP. 77-101, (2006)   | 9  |
| 5.  | ESTEVEZ J., GARATE G., GRANA M., GENTLE INTRODUCTION TO ARTIFICIAL<br>INTELLIGENCE FOR HIGH-SCHOOL STUDENTS USING SCRATCH, IEEE ACCESS,<br>7, PP. 179027-179036, (2019)   | 8  |
| 6.  | EUBANKS V., AUTOMATING INEQUALITY: HOW HIGH-TECH TOOLS PROFILE,<br>POLICE, AND PUNISH THE POOR, (2018)  | 8  |
| 7.  | YANG W., ARTIFICIAL INTELLIGENCE EDUCATION FOR YOUNG CHILDREN:<br>WHY, WHAT, AND HOW IN CURRICULUM DESIGN AND IMPLEMENTATION,<br>COMPUTERS AND EDUCATION: ARTIFICIAL INTELLIGENCE, 3, (2022)  | 8  |
| 8.  | ZAWACKI-RICHTER O., MARIN V.I., BOND M., GOUVERNEUR F., SYSTEMATIC<br>REVIEW OF RESEARCH ON ARTIFICIAL INTELLIGENCE APPLICATIONS IN<br>HIGHER EDUCATION–WHERE ARE THE EDUCATORS?, INTERNATIONAL<br>JOURNAL OF EDUCATIONAL TECHNOLOGY IN HIGHER EDUCATION, 16, 1, PP. 1-<br>27, (2019) | 8  |
| 9.  | CROMPTON H., BURKE D., ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION:<br>THE STATE OF THE FIELD, INTERNATIONAL JOURNAL OF EDUCATIONAL<br>TECHNOLOGY IN HIGHER EDUCATION, 20, 1, PP. 1-22, (2023)  | 7  |
| 10. | DRUGA S., VU S.T., LIKHITH E., QIU T., INCLUSIVE AI LITERACY FOR KIDS<br>AROUND THE WORLD, PROCEEDINGS OF FABLEARN 2019, PP. 104-111, (2019)  | 7  |
| 11. | LONG D., MAGERKO B., WHAT IS AI LITERACY? COMPETENCIES AND DESIGN<br>CONSIDERATIONS, PROCEEDINGS OF THE 2020 CHI CONFERENCE ON HUMAN<br>FACTORS IN COMPUTING SYSTEMS, PP. 1-16, (2020)  | 7  |
| 12. | ADIGUZEL T., KAYA M.H., CANSU F.K., REVOLUTIONIZING EDUCATION WITH<br>AI: EXPLORING THE TRANSFORMATIVE POTENTIAL OF CHATGPT,<br>CONTEMPORARY EDUCATIONAL TECHNOLOGY, 15, 3, (2023)  | 6  |
| 13. | HOLMES W., BIALIK M., FADEL C., ARTIFICIAL INTELLIGENCE IN EDUCATION:<br>PROMISES AND IMPLICATIONS FOR TEACHING AND LEARNING, (2019)  | 6  |
| 14. | HWANG G.J., XIE H., WAH B.W., GASEVIC D., VISION, CHALLENGES, ROLES AND<br>RESEARCH ISSUES OF ARTIFICIAL INTELLIGENCE IN EDUCATION, COMPUTERS<br>AND EDUCATION: ARTIFICIAL INTELLIGENCE, 1, (2020)  | 6  |

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|-----|--|---|
| 16. | LUCKIN R., HOLMES W., GRIFFITHS M., FORCIER L.B., INTELLIGENCE<br>UNLEASHED: AN ARGUMENT FOR AI IN EDUCATION, (2016)   | 6 |
| 17. | O'NEIL C., WEAPONS OF MATH DESTRUCTION: HOW BIG DATA INCREASES<br>INEQUALITY AND THREATENS DEMOCRACY, (2016)   | 6 |
| 18. | OUYANG F., JIAO P., ARTIFICIAL INTELLIGENCE IN EDUCATION: THE THREE<br>PARADIGMS, COMPUTERS AND EDUCATION: ARTIFICIAL INTELLIGENCE, 2,<br>(2021)   | 6 |
| 19. | PEDRO F., SUBOSA M., RIVAS A., VALVERDE P., ARTIFICIAL INTELLIGENCE IN<br>EDUCATION: CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE<br>DEVELOPMENT, (2019)   | 6 |
| 20. | SCHIFF D., OUT OF THE LABORATORY AND INTO THE CLASSROOM: THE<br>FUTURE OF ARTIFICIAL INTELLIGENCE IN EDUCATION, AI & SOCIETY, 36, 1, PP.<br>331-348, (2021)  | 6 |
| 21. | SU J., YANG W., ARTIFICIAL INTELLIGENCE IN EARLY CHILDHOOD<br>EDUCATION: A SCOPING REVIEW, COMPUTERS AND EDUCATION: ARTIFICIAL<br>INTELLIGENCE, 3, (2022)  | 6 |

## Authors Affiliations and Author Contributions:

The authors from University of Sheffield, University of Nigeria, University of Witwatersrand contributed maximum papers on the topic Artificial Intelligence and Education with 45 articles, 14 articles and 12 articles respectively. Williams CC is the highest contributing author with 49 articles, followed by Nadin with 7 articles on the topic which depicts their deep research in to the theme. The ACM conference proceedings has published majority of the articles on Artificial Intelligence during the years.

| Affiliation                     | Articles |
|---------------------------------|----------|
| UNIVERSITY OF SHEFFIELD         | 45       |
| UNIVERSITY OF NIGERIA           | 14       |
| UNIVERSITY OF THE WITWATERSRAND | 12       |
| UNIVERSITY OF GHANA             | 11       |
| MCGILL UNIVERSITY               | 10       |
| NORTH-WEST UNIVERSITY           | 10       |
| UNIVERSITY OF THE WESTERN CAPE  | 10       |
| ARIZONA STATE UNIVERSITY        | 9        |
| TON DUC THANG UNIVERSITY        | 9        |
| UNIVERSITY OF ARKANSAS          | 9        |



### Lotka's Law:

The lotka's law in biblioshiny software denotes the relation of the author's percentage and the number of documens that has been published by them in different sources. Here the percentage of the authors is above 75% of the authors have contributed 1 document relating to AI in education and around 5% of the authors have contributed 7 documents in various sources relating to the area of the study.



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## **Three field Plot:**

The three-field plot visually portrays the visual relationship between various bibliometric analysis data and provides a pictorial representation and analyse the relationship between multi-dimensional data. This platform is user friendly and helps one to identify various relationships over authors, countries, author key words, keyword plus, title etc and this plot can be rotated to come forth with various analysis. Here the authors, keywords and title are used for analysis.



## Three field plots of Affiliation, title, keyword

The plot below shows the relationship between the affiliation of the authors, title and the key words. The relationship is linked with the sankey diagram which shows the relationship similar to a wave.



### Countries, keywords and title

The three-field plot gives the relationship between the countries, keywords and title. This will help us to understand the country that contributed in a research topic to a greater extent.

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## Thematic Map

The thematic map portrays the distribution of the themes under various classifications of Niche, Motor, Emerging themes and Basic themes. The themes that are most widely used in emerging or clinical helps the researcher to concentrate on the highlighted themes on the quadrant for future research. Here concepts like AI ethics, educational environment, learning, higher education and training can be considered for future research.



### Tree map

The tree map states the visual pictures of the various words used in the research articles and the percentage level of usage. The common and most frequently used word is Artificial Intelligence followed by students. The following diagram depicts the tree diagram and the word cloud for the words used.

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| Tree                                  |                                   |                             |  |   |                             |                             |                         |                                   |  |
|---------------------------------------|-----------------------------------|-----------------------------|--|---|-----------------------------|-----------------------------|-------------------------|-----------------------------------|--|
| artificial intelligence<br>123<br>14% | e-learning<br>47<br>5%            | curricula<br>36<br>4%       | learning systems<br>26<br>3%                     | ethical technolog<br>16<br>2%                 | v 'current<br>15<br>2%      | computer aids<br>15<br>2%   | ed instruction          | machine-learning<br>15<br>2%      | chatgpt<br>14<br>2%                                    |
|                                       |                                   |                             | artificial intelligence in education<br>22<br>3% | machine learning<br>13<br>1%                  | education secto<br>11<br>1% | rs language<br>11<br>1%     | model                   | philosophical aspects<br>11<br>1% | deep learning<br>10<br>1%                              |
|                                       | education computing<br>45<br>5%   | high educations<br>35<br>4% |  | nakeni langunga prosasing system<br>13<br>19s | human<br>10<br>1%           | learning outcome<br>8<br>1% | on-line ed<br>8<br>1%   | lucation<br>8<br>1%               | ning<br>7<br>1%  |
| students<br>91                        |                                   |                             | teaching<br>21                                   | ai technologies                               | learning<br>10<br>1%        | data mining<br>7<br>1%      | learning alg<br>7<br>1% | enthms medical educal<br>7<br>1%  | ion natural languages<br>7<br>1%                       |
| 10%                                   | engineering education<br>41<br>5% | teachers'<br>29             | 2%   | 12<br>1%                                      | chatbots<br>8               | humans<br>7<br>1%           | ai applicat             | tions article *                   |  |
|                                       | 5.0                               | 3%                          | decision making<br>17<br>2%                      | curriculum<br>12<br>1%                        | 1%<br>learning experiences  | k-12 education              | o<br>1%                 | ation                             | education systems<br>6<br>1%<br>educational technology |
|                                       |                                   |                             |  |   |                             | 1%                          | 1%                      | 6                                 | 6 1%   |

WORD CLOUD



## CITATIONS PER ARTICLE:

The mean citation per article per year and the citable number of years are displayed in the below table. Since the studies were taken for the past 5 years the starting year 2019 had a mean total citation of 35.33 with 12 papers and the citations per year was 5.89 with the next 6 citable years. Similarly the table outlines the different years and for 2024 since being the final year has only 1 citable year for further assessment.

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| Year | MeanTCperArt | Ν   | MeanTCperYear | Citable<br>Years |
|------|--------------|-----|---------------|------------------|
| 2019 | 35.33        | 12  | 5.89          | 6                |
| 2020 | 23.3         | 20  | 4.66          | 5                |
| 2021 | 13.16        | 51  | 3.29          | 4                |
| 2022 | 7.98         | 66  | 2.66          | 3                |
| 2023 | 2.78         | 209 | 1.39          | 2                |
| 2024 | 0.43         | 70  | 0.43          | 1                |

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## **CO-OCCURRENCE NETWORK**

The co-occurrence networks show the words that are highly correlated or related to the different words in the research. These words are highly similar in the research works or field that are related to specific area of study. Here the terms artificial intelligence and students are the predominant words that are connected with various areas of research. The items displayed in different colours stated the level of bonding of the words in relation to the study.



| Words                   | Occurrences |
|-------------------------|-------------|
| artificial intelligence | 123         |
| students                | 91          |
| e-learning              | 47          |
| education computing     | 45          |
| engineering education   | 41          |
| curricula               | 36          |
| high educations         | 35          |
| teachers'               | 29          |
| learning systems        | 26          |

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| artificial intelligence in education | 22 |
|--------------------------------------|----|
| teaching                             | 21 |
| decision making                      | 17 |
| ethical technology                   | 16 |
| 'current                             | 15 |
| computer aided instruction           | 15 |
| machine-learning                     | 15 |
| chatgpt                              | 14 |
| machine learning                     | 13 |
| natural language processing systems  | 13 |
| ai technologies                      | 12 |
| curriculum                           | 12 |
| education sectors                    | 11 |
| language model                       | 11 |
| philosophical aspects                | 11 |
| deep learning                        | 10 |

## **CO-CITATION NETWORK**

Co- citation Network analysis can provide insights into the intellectual structure of a field, identify key documents or authors, and reveal patterns of influence or collaboration within the academic community. co-occurrence network is most likely a graphical depiction of the connections between phrases or keywords that commonly occur together in a bibliographic database. The research evaluated the relationship between authors and the connections between keywords.



### **Countries Production Overtime**

The countries contribution on research on the topics related to Artificial Intelligence was less in the year 2019 which gradually over the years with maximum incremental increase in 2023 and 2024. The maximum

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contributing country is USA followed by 179 articles produced by China. The top five contributions countries are USA(311), China(179), India (113), United Kingdom(90) and Germany (80) for the year 2024.

| Country | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---------|------|------|------|------|------|------|
| China   | 1    | 7    | 67   | 91   | 141  | 179  |
| Germany | 1    | 8    | 12   | 19   | 80   | 80   |
| India   | 4    | 4    | 14   | 36   | 89   | 113  |
| United  | 4    | 6    | 26   | 43   | 84   | 90   |
| Kingdom |      |      |      |      |      |      |
| USA     | 18   | 33   | 55   | 128  | 248  | 311  |





**Country Scientific Production** 

Countries collaboration world map

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The countries collaboration on the topic is given in the following map. The lines show the collaborations linked with the authors of affiliation from other different countries.



Latitude

## **CORRESPONDING AUTHOR COUNTRIES:**

The table below depicts the Single Country Publications (SCP) and the Multiple Country Publication (MCP) during the period 2019-2024. The top five countries that made the SCP and MCP are listed. This shows the involvement of the authors of those countries on the area of research in Artificial Intelligence were vital during the study period.

| Country        | Articles | SCP | МСР | Freq  | MCP_Ratio |
|----------------|----------|-----|-----|-------|-----------|
| CHINA          | 161      | 128 | 33  | 0.376 | 0.205     |
| USA            | 51       | 44  | 7   | 0.119 | 0.137     |
| UNITED KINGDOM | 46       | 39  | 7   | 0.107 | 0.152     |
| INDIA          | 21       | 11  | 10  | 0.049 | 0.476     |
| GERMANY        | 16       | 15  | 1   | 0.037 | 0.063     |



#### **Reference spectroscopy**

The reference spectroscopy depicts the initiation of the research from the historical roots. The topic Artificial intelligence has a strong base from 1783 and after the year 2017 it is gradually increased and most of the references are taken for this research from the literature review.



#### Word frequency overtime:

The frequent usage of the words over the period of years have been depicted in this diagram below pictorially. The usage of these words artificial intelligence, artificial intelligence in education, curriculum, e-learning, education computing, engineering education, high educators, learning systems, students and teachers are the words which were found at an increasing pace during the years.

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## **Trend topics:**

The bibliometric trends in the past and the present scenario is shown through the trend topics. The five topics widely used and published fields are online education, online systems, e-learning, teachers and students.

| Item                    | Freq | Year_Q1 | Year_Med | Year_Q3 |
|-------------------------|------|---------|----------|---------|
| on-line education       | 8    | 2021    | 2021     | 2022    |
| online systems          | 5    | 2020    | 2021     | 2021    |
| e-learning              | 47   | 2021    | 2022     | 2023    |
| teachers'               | 29   | 2022    | 2022     | 2022    |
| learning systems        | 26   | 2022    | 2022     | 2023    |
| artificial intelligence | 123  | 2021    | 2023     | 2023    |
| students                | 91   | 2023    | 2023     | 2023    |
| education computing     | 45   | 2023    | 2023     | 2023    |
| ai in education         | 6    | 2022    | 2024     | 2024    |

## Factorial Analysis

The factor analysis highlights the field-based maps that are related to the research area. These are represented in different dimensions. The words in a plot helps us to understand the frequency of words used in the particular plot and helps to identify the main field and the emerging areas of research in the topic. In this study the words like language, model, learning system, deep learning, natural language processing systems, natural languages, machine learning, learning algorithms constitute an emerging field. Similarly other plots are also identified.

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## **Topic dendogram:**

The topic dendogram helps the researcher to visualize the research relationship. It groups the data into clusters based on keywords and other bibliographic data. The dendogram diagram appears as branches and is portrayed as various clusters and the clusters which are to be considered as more significant.



### **Collaboration networks:**

The collaboration network states the relationship of authors who are relating themselves with the authors of different countries to do their research activities. The lines denotes the cooperative relationship of the authors belonging to different countries. The major contribution and collaboration lies between Kim J and XU k . The size of the colored circles shows the bonding and closeness of association among authors of different countries.



### **Collaboration Network Degree Plot:**

The collaborative degree plot consists of the nodes in the X axis and the cumulative degree in the Y axis. The nodes represent the authors collaboration, the degree refers to the direct connections in the collaboration network.



### CONCLUSION

Bibliometric analysis is a quantitative method for evaluating academic literature that often focuses on the citation patterns within a specific topic or body of publications. It requires examining a range of bibliographic elements, such as citations, authors, journals, and keywords, to gain insight into the impact, influence, and trends within a certain field of study. The main information portrays a detailed information on the database obtained through Scopus. The period of study was from 2019 - 2024 with 251 sources and 428 documents with an annual growth rate of 42.29%. The authors from different affiliations have undergone research in the same field under different dimensions and different countries is assessed using network diagrams and analysis. The research in Artificial Intelligence and learning and education is a trending topic which lays a scope for future researchers.

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