INTERNATIONAL JOURNAL OF MODERN EDUCATION STUDIES

| Volume 9 - No 2 - December 2025 - ISSN 2618-6209 |

Research

Artificial Intelligence in Education: Insights from a Bibliometric Study (2010–2025) Based on Scopus and Web of Science"

Güler SHAIKH [1] **Semra KIRANLI GÜNGÖR** [2]

Article Type
Original Research
International Journal of Modern Education Studies
2025
Volume 9, No 2
Pages: 526-555
http://www.ijonmes.net

Article Info:

Received 04.08.2025
Revision 30.09.2025
Accepted 07.10.2025

Abstract:

This bibliometric study examined articles on artificial intelligence (AI) in education from 2010 to 2025, using data from Scopus and Web of Science. The results indicate a sharp rise in AI-related educational research, particularly in 2024. In the Scopus database, the term "artificial intelligence" emerged as the most prevalent keyword, appearing 44 times. It was followed by "higher education" and "ChatGPT." In contrast, the Web of Science database exhibited a different trend, with "ChatGPT" and "artificial intelligence" appearing equally at four instances each. Additionally, it highlighted emerging terms such as "LLM" and "GPT-4." The United States demonstrated a leading position in terms of publication output in both datasets, with countries such as China, Spain, the UK, and Türkiye following closely behind, exhibiting only minor variations in document counts. Notable authors in this field include Chai Ching Sing and Mishra, with the latter contributing 13 publications. These findings reflect the expanding role of AI in transforming educational practices and emphasise the growing interest in this field.

Keywords: Artificial Intelligence, Bibliometric analysis, Scopus index, Web of Science, VOSviewer

Citation:

Shaikh, G. & Kıranlı, Güngör S. (2025). Artificial Intelligence in Education: Insights from a Bibliometric Study (2010–2025) Based on Scopus and Web of Science. *International Journal of Modern Education Studies, 9*(2), 526-555. https://doi.org/10.51383/ijonmes.2025.428

[1] English Language Teacher, Ministry of National Education, Kocaeli, Türkiye. gulershaikh@gmail.com
https://0000-0002-1094-6110
[2] Prof. Dr. Eskişehir Osmangazi University, Faculty of Educational Sciences, Eskişehir, Türkiye. semk2009@gmail.com
https://0000-0001-5785-8137

INTRODUCTION

In recent years, significant advancements in technology have paved the way for the development of systems that exhibit functional similarities to human intelligence. These developments include enhanced information processing capabilities and substantial progress in big data analytics. In this context, artificial intelligence (AI) has emerged as a multidisciplinary research field that aims to enable machines and software to perform human-like cognitive skills such as thinking, learning, decision-making, and problem-solving. The field of AI encompasses not only the development of algorithms but also the continuous learning and self-renewal of these systems through data they acquire from their environments (Benko & Lányi, 2009; Crevier, 1993).

Artificial Intelligence is regarded as a strategic instrument that has evolved in parallel with information technologies. It facilitates innovative applications in numerous fields, including education, healthcare, engineering, economics, and public administration. In this regard, AI is not merely a technical innovation; it has become a pivotal component of a comprehensive transformation process that profoundly impacts how individuals, institutions, and societies access information, reshapes decision-making processes, and sparks new research debates (Haenlein & Kaplan, 2019).

In today's rapidly digitalising world, artificial intelligence (AI) has emerged as a significant phenomenon in education, with the potential to reshape learning and teaching practices on a global scale. AI-driven applications are now widely used to personalise instruction, reduce teachers' administrative workload, monitor student performance, and enhance feedback mechanisms. When integrated with big data analytics, these systems can effectively analyse learners' needs and progress, enabling more targeted and efficient teaching strategies (Chen et al., 2020; Ng et al., 2024). Beyond offering technological convenience, AI has contributed to the restructuring of instructional design, the expansion of learner-centred approaches, and the promotion of equity in education. Accelerated feedback systems have further enabled educators to follow students' development in a systematic and data-informed manner, thereby making the learning process more adaptive and dynamic (Chan, 2023; Chang et al., 2023).

Recent studies in the field of AI in education have focused on the potential of intelligent systems to support and optimise pedagogical processes. Researchers have investigated how AI algorithms can interpret learning data, predict academic performance, and guide educators in designing more effective and individualised learning experiences. The integration of AI into learning analytics and assessment platforms allows for continuous progress monitoring and data-driven decision-making, making educational practices more responsive and evidence-based. As digital transformation continues to advance, AI has evolved from a supportive technological tool into a fundamental element of innovative and sustainable educational ecosystems. Therefore, outlining AI's major applications and recent research developments is essential to contextualise this study and underscore its

contribution to the expanding literature in this domain (Hwang et al., 2020; Qadir, 2023; Su & Yang, 2023).

In this respect, artificial intelligence is considered a strategic element in the digital transformation process of education systems, both pedagogically and administratively.

This article aims to review articles written in the past fourteen years to answer these questions.

Purpose of the Study

This study aims to examine the evolution and growing significance of artificial intelligence (AI) in the field of education. In recent years, AI has increasingly shaped fundamental educational parameters such as teaching methods, learning personalisation, assessment systems, and administrative decision-making. As AI technologies have become more integrated into educational settings, the academic interest in understanding their pedagogical and institutional implications has expanded considerably. Using data from the Scopus and Web of Science databases, this study analyses publication trends, frequently used keywords, citation dynamics, and the contributions of countries, institutions, and authors. Analytical tools such as VOSviewer are employed to identify emerging topics—including ChatGPT, large language models (LLMs), and GPT-4- revealing how the field has diversified and deepened over time. By mapping the Global Research landscape, the study aims to highlight how AI has transformed educational research priorities and to provide insights that may guide future scholarly and practical developments in this evolving domain.

In this respect, artificial intelligence is considered a strategic element in the digital transformation process of education systems, both pedagogically and administratively.

This article aims to review articles written in the past fourteen years to answer these questions.

1. What are the most common keywords in Artificial Intelligence research?
2. Who has been the most cited author in the field of Artificial Intelligence?
3. Which publications are the most cited in the field of Artificial Intelligence?
4. What is the most cited year in the field of Artificial Intelligence?
5. Who are the most active authors and what are their demographics?
6. What is the year with the most Artificial Intelligence studies in education?
7. Which universities lead the most research in the field of Artificial Intelligence?
8. Which Universities are cited the most in the field of Artificial Intelligence?
9. Which countries lead in the production of Artificial Intelligence studies in education?
10. Which countries are cited the most in the field of Artificial Intelligence?

To answer these questions, a bibliometric analysis of the last fifteen years' corpus, as accessed on the Web of Science, will be conducted using both Scopus Analytics and Web of Science for comparison.

METHOD

This section presents the nature of the study, data collection process, inclusion criteria, and the tools used for analysis. A bibliometric approach was applied using data from Scopus and Web of Science. VOSviewer software was used to analyze keyword frequencies, citation patterns, and author collaborations to ensure systematic and reliable findings.

Research Design

In this research, a bibliometric analysis, a quantitative approach for evaluating scholarly output, was employed to examine academic publications systematically. This method focuses on measurable indicators such as citation counts, download frequencies, and appearances in other academic works, encompassing sources like journal articles, books, and conference proceedings (Ellegaard & Wallin, 2015). Bibliometric analysis serves as an objective tool to assess the research productivity and academic influence of individuals or institutions, using metrics such as publication volume, citation impact, and the quality of published work (Donthu et al., 2012). Moreover, it plays a vital role in uncovering patterns and shifts within a specific field by identifying trending topics, expanding research domains, and emerging scholarly interests. These insights not only reflect the evolving landscape of academic inquiry but also inform strategic research planning and policy-making by providing evidence-based guidance (Öztürk et al., 2024).

Data Collection Tools and Procedures

This study utilised the Scopus database, a comprehensive and interdisciplinary platform for citation analysis, to carry out data evaluation. Scopus offers a built-in feature known as Scopus Analyse, which enables users to perform bibliometric assessments by filtering and examining data based on variables such as authorship, institutional affiliation, journal titles, keywords, publication dates, citation metrics, and country of origin. Additionally, the platform provides indexing and abstracting services linked to full-text sources (Falagas et al., 2007).

In this research, the "Analyze Results" function available in the Web of Science platform was also employed to facilitate data interpretation. This feature offers a range of graphical tools—such as bar graphs and treemap visualisations, that enable users to gain clearer insights into patterns within scientific publications. Bar graphs are commonly used to display bibliometric indicators, including citation frequencies, publication years, and subject categories, making it easier to observe changes or distributions over time (Mongeon & Paul-Hus, 2015).

This study also incorporated the use of VOSviewer, a specialised software designed for constructing and analysing bibliometric networks, to compare data across the two databases. VOSviewer allows researchers to visualize and investigate the connections among publications, authors, journals, and thematic research domains. By employing co-citation analysis, the software identifies key publications and prominent contributors based on the frequency with which they are cited together in the literature (Van Eck & Waltman, 2009).

Data Analysis

The research process began with the formulation of clear research objectives and the central research question. The study focuses on publications from 2010 onwards to capture the most recent developments and trends in artificial intelligence applications in education, reflecting the rapid growth and evolving nature of the field over the past decade. Moreover, to gather relevant academic sources, a comprehensive literature search was carried out across multiple databases. The keyword "*artificial intelligence*" was used as the primary search term to focus the inquiry, and the discipline filter was set to *"education"* to exclude unrelated fields and refine the dataset.

An extensive keyword search for "Artificial Intelligence" initially retrieved 441,103 records from Scopus and 279,684 records from the Web of Science. For Scopus, the search was refined to include publications from 2010 to 2026, within the Social Sciences subject area, limited to articles, and filtered for the exact keyword "Education". In Web of Science, the query incorporated Keyword Plus® terms "artificial intelligence" and "education," spanning the years 2011–2025, restricted to Open Access articles within relevant education categories. After applying these selection criteria, 798 documents from Scopus and 72 documents from Web of Science were retained for analysis. The datasets were meticulously cleaned and organised, encompassing metadata such as authors, institutional affiliations, journals, publication years, and citation metrics. This curated collection provided a robust foundation for bibliometric analysis, with visualisations—including charts, graphs, and network maps— used to reveal research trends, thematic patterns, and collaboration networks in the field of Artificial Intelligence in Education.

Ensuring the reliability and validity of data in bibliometric analyses is essential for maintaining the scientific accuracy and reproducibility of research. In this study, data were retrieved from Web of Science and Scopus, both of which are internationally recognized databases that index peer-reviewed and high-quality publications. A transparent search strategy was implemented using predefined keywords, filters, and document types, while duplicate and irrelevant records were systematically removed to enhance data consistency. To ensure reliability, the datasets from both databases were compared across indicators such as publication year, author, country, and citation count (Donthu et al., 2021; Van Eck & Waltman, 2009).

The validity of the dataset was maintained by aligning keyword selection and time frames with the research objectives and including only studies directly relevant to the topic. Bibliometric indicators, including citation counts, h-index, and co-authorship networks, were used to reflect the study's scope. Through careful data cleaning and cross-validation, the findings were ensured to be both methodologically sound and content-valid, providing a robust foundation for the bibliometric analysis.

RESULTS

This part of the study presents an analysis of the data retrieved from the Scopus and Web of Science databases concerning the subject of Artificial Intelligence between the years 2010 and 2025. VOSviewer was utilised to map and visualise the bibliometric data gathered during the search process. A comparative evaluation was conducted based on the results extracted from both databases, along with the network visualisations generated through VOSviewer, to highlight similarities and differences in publication trends and scholarly patterns.

Results About Year Analysis

The increasing focus on artificial intelligence in education is largely driven by the rapid advancements in technology that are reshaping the landscape of education, both in terms of pedagogy and learning methodologies. A significant factor contributing to this surge of interest is the worldwide transition towards digital learning, which was particularly accelerated by the global Coronavirus pandemic (Singh et al., 2024). This shift has brought to the forefront the necessity for education systems that are more adaptable and robust. AI-based tools have been shown to facilitate learning, provide real-time support, and enable more personalised learning experiences. These capabilities are often challenging for traditional classroom models to achieve (Solanki et al., 2021; Roll & Wylie, 2016).

Overall, the rise of AI in education isn't just about embracing new technology—it reflects a deeper change in how we think about teaching, learning, and the role of data in shaping educational experiences. As this field continues to grow, it holds the promise of making education more inclusive, responsive, and aligned with the needs of a rapidly evolving world (Rospigliosi, 2023).

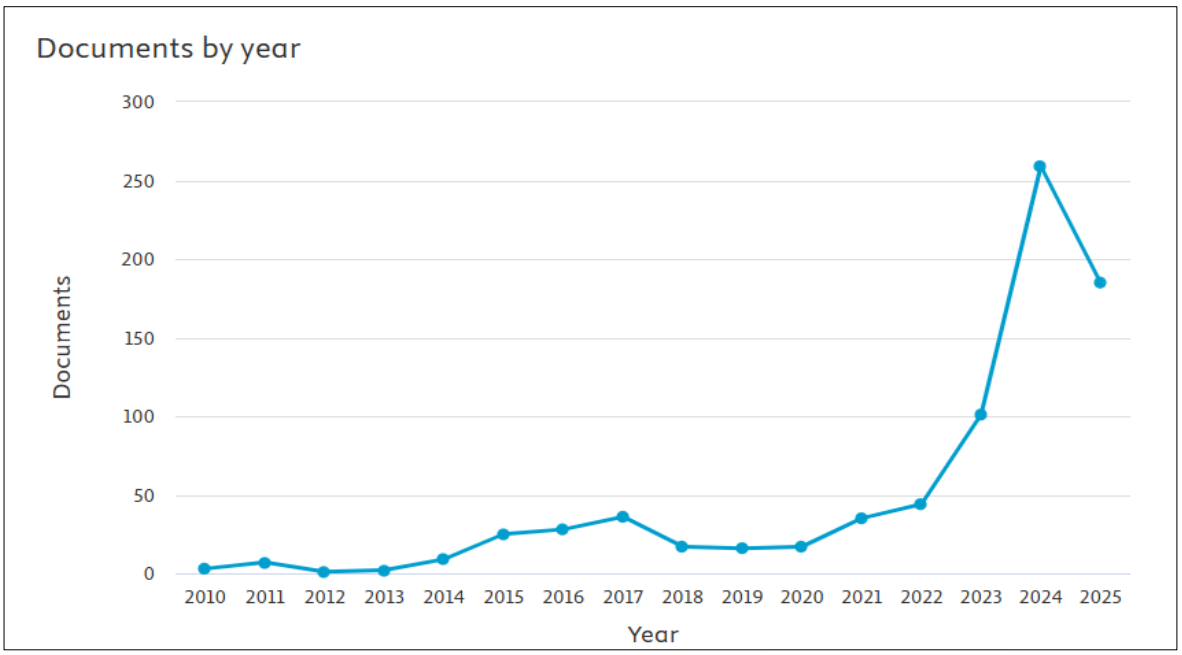

Figure 1. Annual publication distribution according to the Scopus database

(retrieved July 12, 2025).

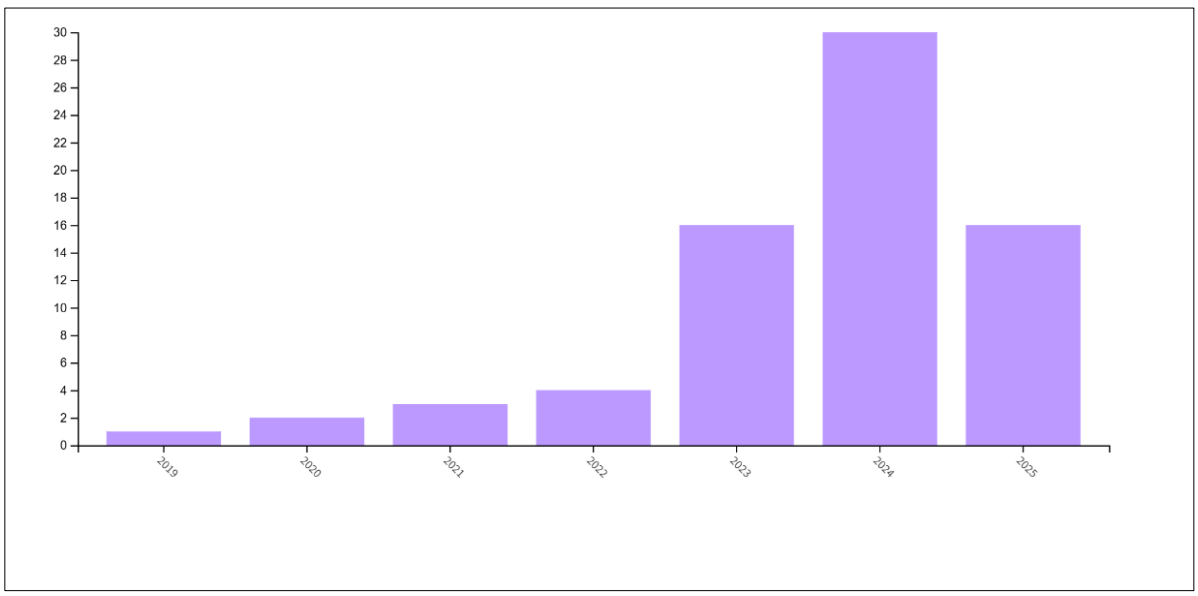

Figure 2. Annual publication distribution according to the Web of Science database

(retrieved July 12, 2025).

The research included 798 articles from the Scopus database and 72 articles from the Web of Science database, published between 2010 and 2025. While the years between 2010 and 2025 were selected as the research year, it was observed that the Web of Science database began documenting Artificial Intelligence data in education in 2019, initially with a single document. While 30 data records were documented in 2024, the number decreased to 17 in 2025. Similarly, a close examination of the data obtained from Scopus reveals a marked increase in the number of documents, which rose from 3 in 2010 to 259 in 2024 and further decreasing to 197 in the first half of 2025.

Furthermore, an analysis of both databases reveals that the highest number of publications appeared in 2024. The upward trend in research focusing on artificial intelligence in education over the years is consistent with the findings reported in prior studies (Gan & Yusof, 2020; Shrivastava et al., 2022). Figures 1 and 2 provide a detailed overview of the annual distribution of articles published between 2010 and 2025, as indexed in both the Scopus and Web of Science databases.

Result About Keywords Analysis

Keywords play a vital role in helping researchers narrow down their searches and access literature that closely aligns with their areas of inquiry. In the context of academic research, this level of precision is especially important given the overwhelming amount of information available in digital databases and scholarly archives. During the literature review process, selecting appropriate keywords allows researchers to locate studies, articles, and academic publications that are directly relevant to their specific research focus (Liu et al., 2006).

The data presented in this figure were retrieved from the Scopus Database (2025) and analysed using the VOSviewer software to identify the most frequently occurring keywords in the field of Artificial Intelligence in Education between 2010-2025 (see Figure 3).

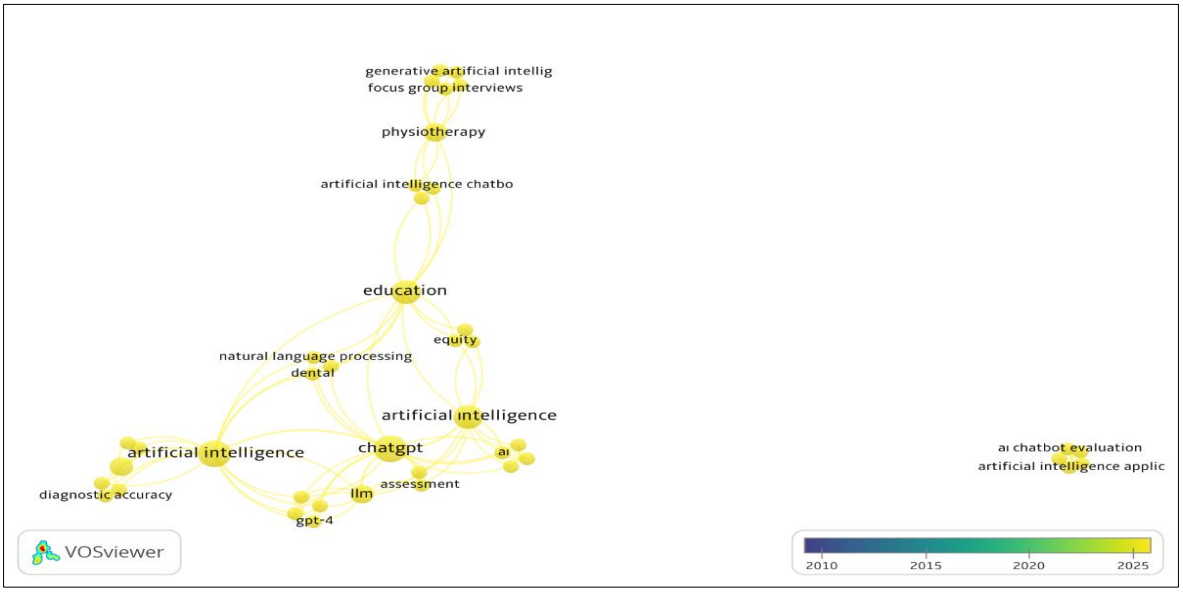

Figure 3. Most frequently used keywords on Artificial Intelligence in Education on Scopus

The data presented in this figure were retrieved from the Web of Science Core Collection (2010- 2025) and analyzed using the VOSviewer software to identify the most frequently occurring keywords in the field of Artificial Intelligence in Education between 2010-2025 (see Figure 4).

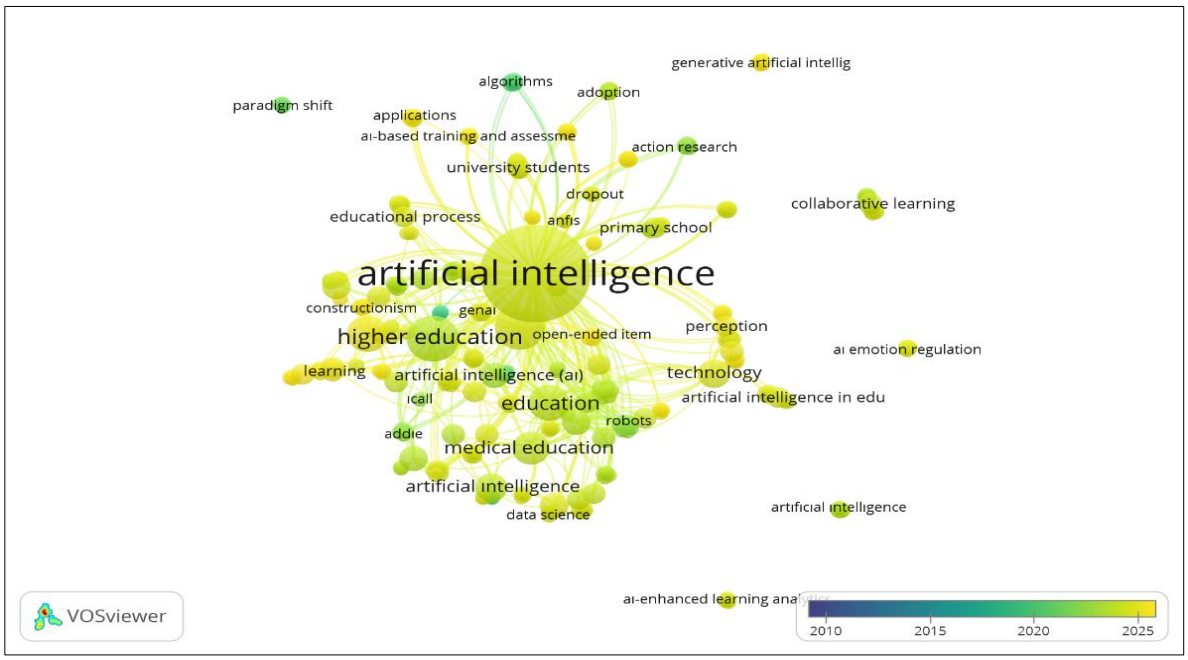

Figure 4. Most frequently used keywords on Artificial Intelligence in Education according Web of Science

Figures 3 and 4 indicate the most commonly occurring keywords in academic articles published between 2010 and 2025 in both the Scopus and Web of Science databases. The

Scopus data showed *"artificial intelligence"* as the most dominant keyword, appearing 44 times across the examined publications. The next most frequent term was *"higher education,"* which occurred 10 times. Additional frequently used keywords, in descending order, included *"ChatGPT," "education," "generative artificial intelligence," "medical education,"* and *"technology."*

In contrast, analysis of the Web of Science dataset revealed that the terms *"ChatGPT"* and *"artificial intelligence"* were among the most frequently used keywords, each appearing four times. These were followed by the term *"education"* and the phrase *"large language model (LLM)"*, both of which appeared twice. Other notable keywords—listed in decreasing order of frequency—included *"physiotherapy," "medical education," "answer rationales," "clinical vignettes,"* and *"GPT-4."*

Result About Citation Analysis

References are a foundational element of academic research, fulfilling multiple essential functions within scholarly work. They allow authors to properly attribute ideas, findings, and data to their original sources, recognizing the contributions of previous researchers. By clearly identifying the origins of specific information, citations help maintain academic honesty and protect against plagiarism—a serious breach of ethical standards that can compromise the credibility of research. Additionally, referencing authoritative sources strengthens the validity of an author's arguments, providing evidence that supports their claims. This practice not only reflects a comprehensive review of the existing literature but also situates the new research within the ongoing academic conversation. Through citations, researchers connect their work to a wider body of knowledge, highlighting its relevance and contribution to the field (Balaban, 1996; Garfield, 1972).

The data presented in this figure were retrieved from the Scopus database (2010-2025) and analyzed using VOSviewer software to identify the most cited authors in the field of Artificial Intelligence in Education (see Figure 5).

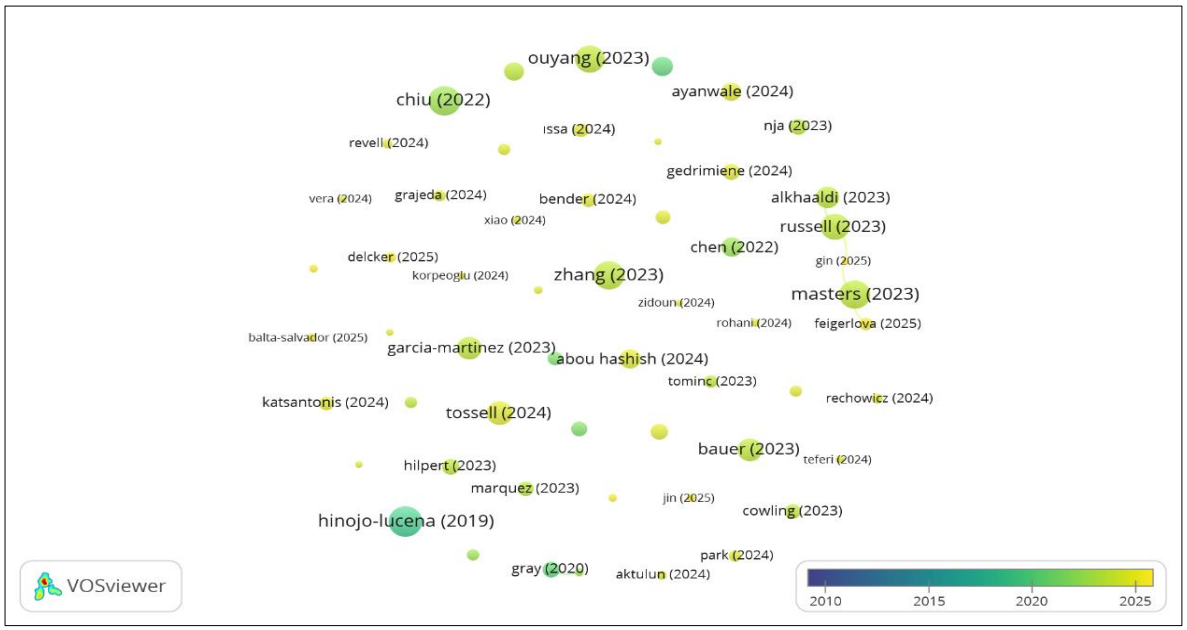

Figure 5. The Most Cited Authors on Artificial Intelligence in Education According to Scopus

The data presented in this figure were retrieved from the Web of Science Core Collection (2010- 2025) and analysed using VOSviewer software to identify the most cited authors in the field of Artificial Intelligence in Education (see Figure 6).

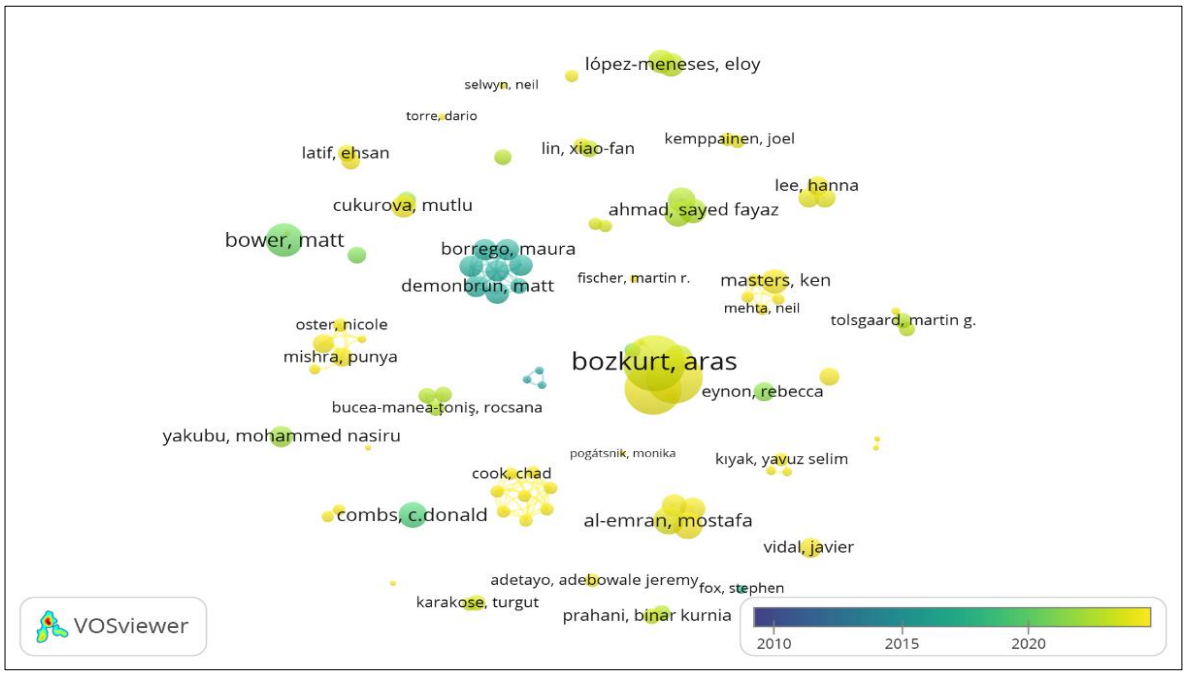

Figure 6. The Most Cited Authors on Artificial Intelligence in Education According to Web of Science

Table 1.

Most cited publications on Artificial Intelligence according to Scopus Database

Rank	*From 2010 to 2015*		*From 2016 to 2025*	
	Documents	*Citations*	*Documents*	*Citations*
1.	(Bower et al., 2015)	353	(Tlili et al., 2023)	985
2.	(Mok, 2014)	272	(Lim et al., 2023)	736
3.	(Zhu et al., 2015)	215	(Roll & Wylie, 2016)	576
4.	(Velegol et al., 2015)	131	(Sima et al., 2020)	465
5.	(Hu et al., 2015)	84	(Kamalov et al., 2020)	393
6.	(Yelamarthi &Drake, 2015)	74	(Kurdi et al.,2020)	378
7.	(Shekbar et al., 2015)	73	(Kooli,2023)	353
8.	(Singleton et al., 2011)	55	(Halaweh, 2023)	314
9.	(Haudek et al., 2011)	48	(Timms,2016	281
10.	(Kang & Landry, 2014)	46	(Chui & Chai., 2020)	228

Table 1 presents the most cited researchers in the field of Artificial Intelligence, based on data extracted from the Scopus database. Applying a threshold of at least one publication and a minimum of six citations, we analyzed the citation patterns of authors in this domain. From 2010 to 2015, the most cited publication is by Bower et al. (2015), with 353 citations, followed by Mok (2014) with 272 citations, and Zhu et al. (2015) with 215 citations. These authors made significant early contributions to the field of Artificial Intelligence, and their work has continued to influence subsequent research.

Moreover, from the full dataset, the most cited author up to 2023 is Tlili et al. (2023), with 985 citations, followed by Lim et al. (2023), with 736 citations, and Roll & Wylie (2016) with 576 citations, ranking third. These findings indicate a significant concentration of influence among a select group of researchers within the last decade.

Table 2.

Most cited publications on Ethical leadership according to Web of Science Database

Rank	*From 2019 to 2025*	
	Documents	*Citations*
1.	(Hinojo-Lucena et al., 2019)	136
2.	Chiu et al., 2022)	118
3.	(Masters, 2023)	103
4.	(Zhang et al., 2023)	97
5.	(Ouyang et al., 2023)	90
6.	(Russell et al.,2023)	83
7.	(Tossell et al., 2024)	55
8.	(Bauer et al., 2023)	53
9.	(Garcia- Martinez et al., 2023)	47
10.	(Alkhaaldi et al., 2023)	40

Given the temporal limitation of the records in the Web of Science, which commences in 2019, notably, the top ten records have been incorporated into the table. This approach excludes the records that span the period from 2010 to 2018.

Between 2019 and 2025, the landscape of highly cited leadership research shifted, with Hinojo-Lucena et al. (2019) emerging as the most cited study, accumulating 136 citations. This was closely followed by Chiu et al. (2022) with 118 citations and Masters (2023) with 103 citations, highlighting a growing scholarly interest in recent studies. The presence of several 2023 publications, such as those by Zhang, Ouyang, Russell, and Bauer, among the top ten, further reflects the rapid acceleration in research and citation impact, in just a short span. Notably, even 2024 publications, like Tossell et al., already appear with considerable citation counts, demonstrating the immediacy with which impactful work is recognised in the field. These data illustrate a dynamic and fast-evolving body of literature where recent studies are rapidly shaping the discourse around Artificial Intelligence in Education (Chen et al., 2022; Lim et al., 2023).

The data presented in this figure were retrieved from the Scopus Database (2010–2025) and analysed using VOSviewer software to show the most cited years on Artificial Intelligence in Education (see Figure 7).

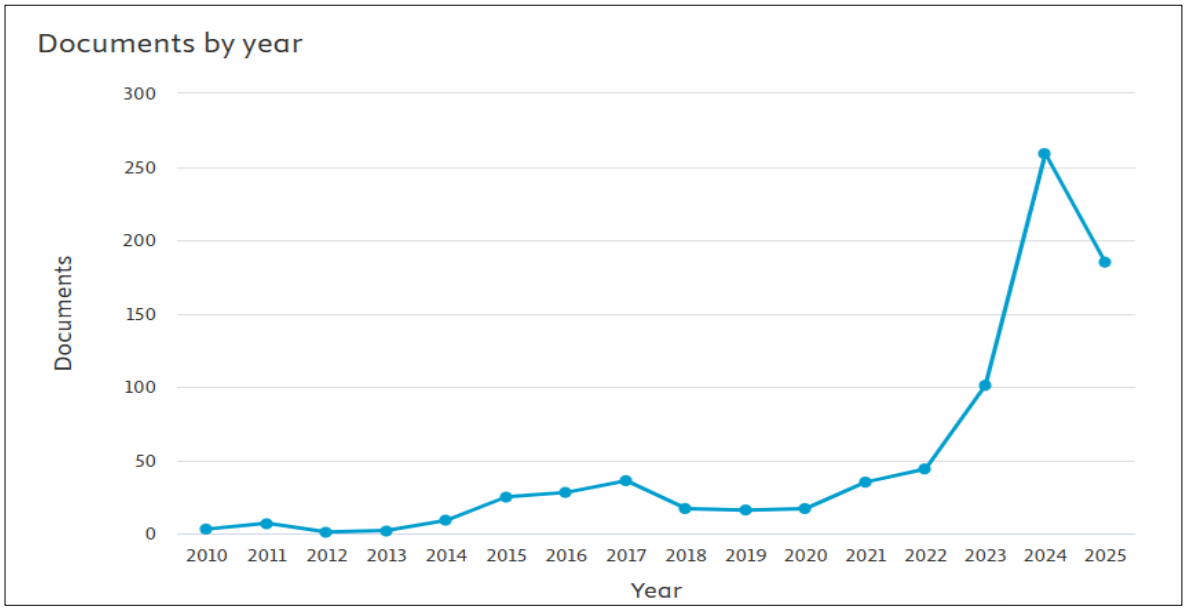

Figure 7. Most cited years on Artificial Intelligence in Education according to Scopus

The data presented in this figure were retrieved from the Web of Science Core Collection (2010-2025) and analysed using VOSviewer software to show the most cited years in Artificial Intelligence in Education (see Figure 8).

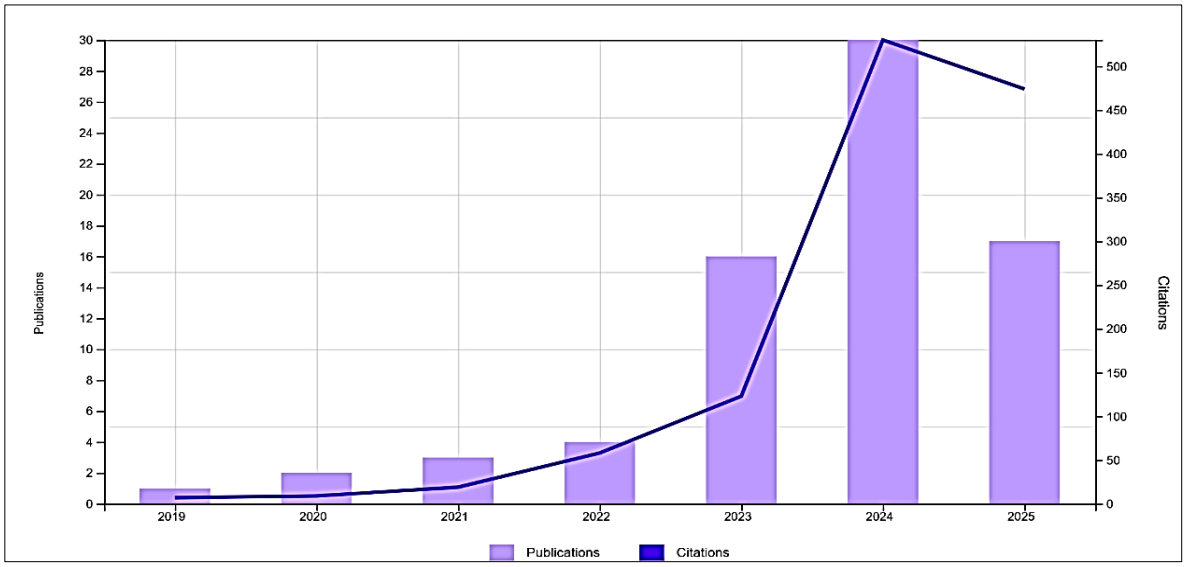

Figure 8. Most cited years on Artificial Intelligence in Education according to Web of Science

Figures 7 and 8 illustrate the annual distribution of documents on artificial intelligence in education from 2010 to 2025. For much of the early period, from 2010 to 2020, publication numbers remained relatively modest, fluctuating between 5 and 40 documents per year. There were only slight increases in certain years, such as in 2015 and 2017. However, a noticeable upward trend began in 2021, gaining momentum in 2022 and reaching a significant peak in 2024 with over 250 publications. Though there was a slight decline in 2025, the number of publications remained substantially higher than in previous years. This sharp rise from 2021 onward indicates growing interest and intensified research activity in artificial intelligence in education, likely influenced by evolving global educational challenges and a post-pandemic focus on effective practices ((Singh et al., 2024; Solanki et al., 2021).

The data presented in this figure were retrieved from the Scopus database (2025) and analyzed using VOSviewer software to identify the most active authors in the field of Artificial Intelligence in Education (see Figure 9).

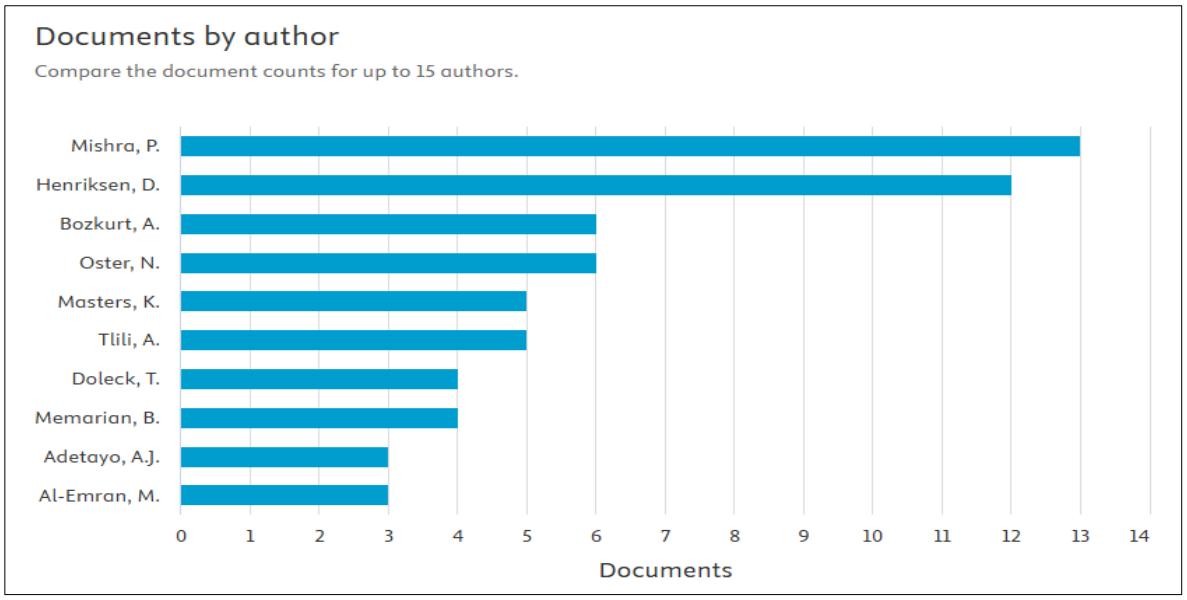

Figure 9. Most Active Authors on Artificial Intelligence according to Scopus Database

Figure 9 illustrates the authors who have contributed most significantly to the field of *Artificial Intelligence*, based on data filtered from the Scopus database. Leading the list is *P. Mishra*, who has authored 13 publications on the topic. His 2024 article, *"Generative AI, Teacher Knowledge and Educational Research: Bridging Short- and Long-Term Perspectives,"* currently holds the highest citation count among his works, with 23 citations. *D. Henriksen* follows closely, having written 12 articles in the field. Her 2023 publication, *"Can We Just Please Slow It All Down? School Leaders Take on ChatGPT,"* has received notable attention as well, accumulating 18 citations.

The data presented in this figure were retrieved from the Web of Science Core Collection (2025) and analyzed using VOSviewer software to identify the most active authors in the field of Artificial Intelligence in Education (see Figure 10).

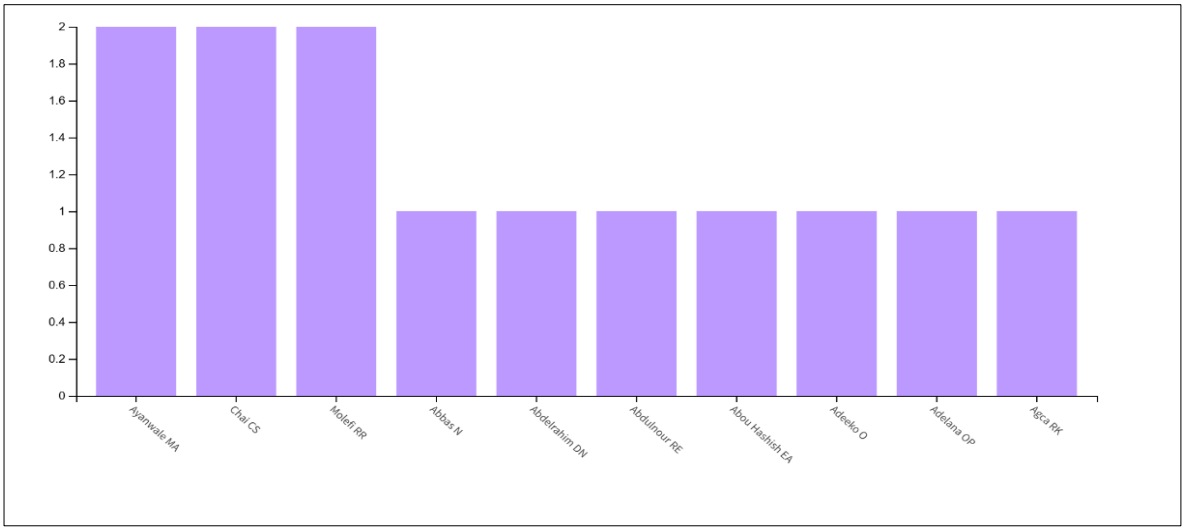

Figure 10. Most Active Authors on Artificial Intelligence according to the Web of Science Database

A review of the literature reveals that Chai Ching Sing: "Creation and Evaluation of a Pretertiary Artificial Intelligence (AI) Curriculum", Ayanwale Musa Adekunle: "Examining artificial intelligence literacy among pre-service teachers for future classrooms", and Molefi Rethabile Rosemary: "Do in-service teachers accept artificial intelligence-driven technology? The mediating role of school support and resources" were the most prolific authors in the field, with 128, 23, and 9 citations, respectively. Each of these authors has authored two articles in the field.

Countries and Affiliations

Countries increasingly recognize that research and development (R&D) serves as a critical engine for both societal advancement and economic prosperity. A key area emerging within this landscape is artificial intelligence (AI), particularly its integration into education. As research in AI continues to evolve, it is transforming traditional learning environments through personalized instruction, intelligent tutoring systems, and data-driven decision-making. These innovations not only enhance student engagement and learning outcomes but also support educators in curriculum planning and classroom management (Chen et al., 2020). A strong commitment to research in AI and education is, therefore, essential not just for academic progress, but for building future-ready societies. Moreover, investments in health, science, and technology, including AI applications, are contributing to public well-being, job creation, and sustainable growth (Devedzic, 2004; Zawacki-Richter et al., 2019).

Universities serve as key engines of research, often leading initiatives that aim to enhance societal well-being. Research on AI in education provides valuable insights that can inform curriculum development, instructional design, and institutional policy. By incorporating AI-driven tools and methods into academic programs, universities equip students and educators with innovative resources that enhance learning outcomes, promote

personalized education, and support data-informed decision-making (Lameras & Arnab, 2021).

The data presented in this figure were retrieved from the Scopus database (2010-2025) and analyzed using VOSviewer software to identify the most active universities in the field of Artificial Intelligence (see Figure 11).

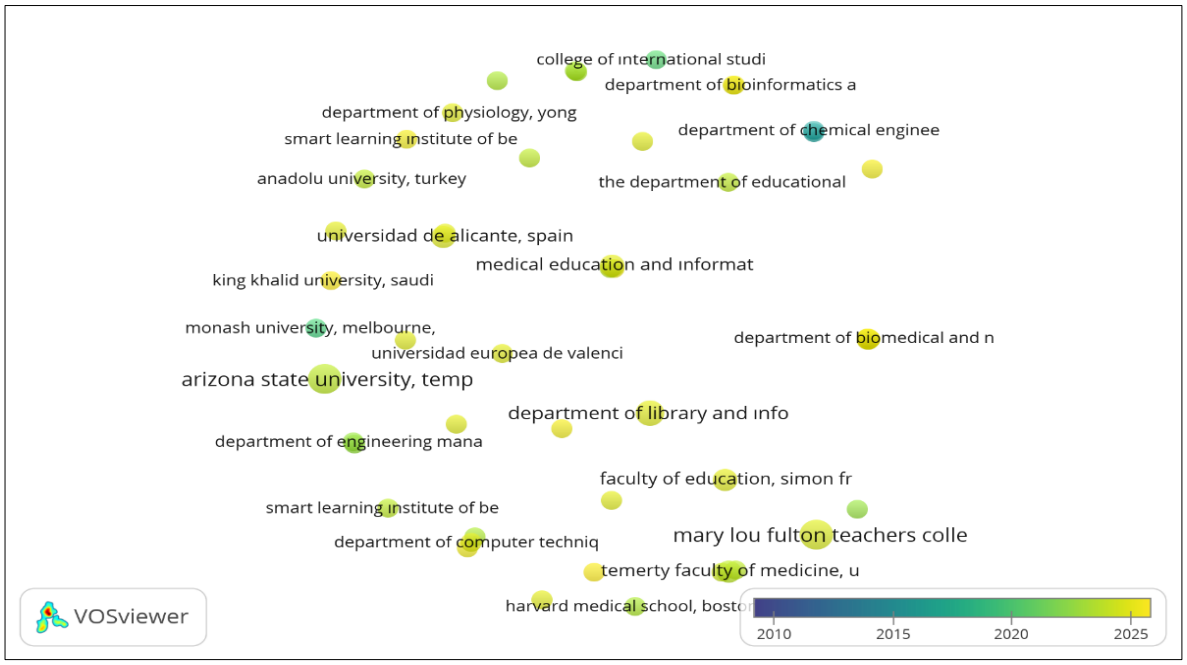

Figure 11. The most active universities on Artificial Intelligence, according to VOSviewer, based on Scopus Data

The data presented in this figure were retrieved from the Scopus database (2025) and analysed using VOSviewer software to identify the most active universities in the field of Artificial Intelligence (see Figure 12).

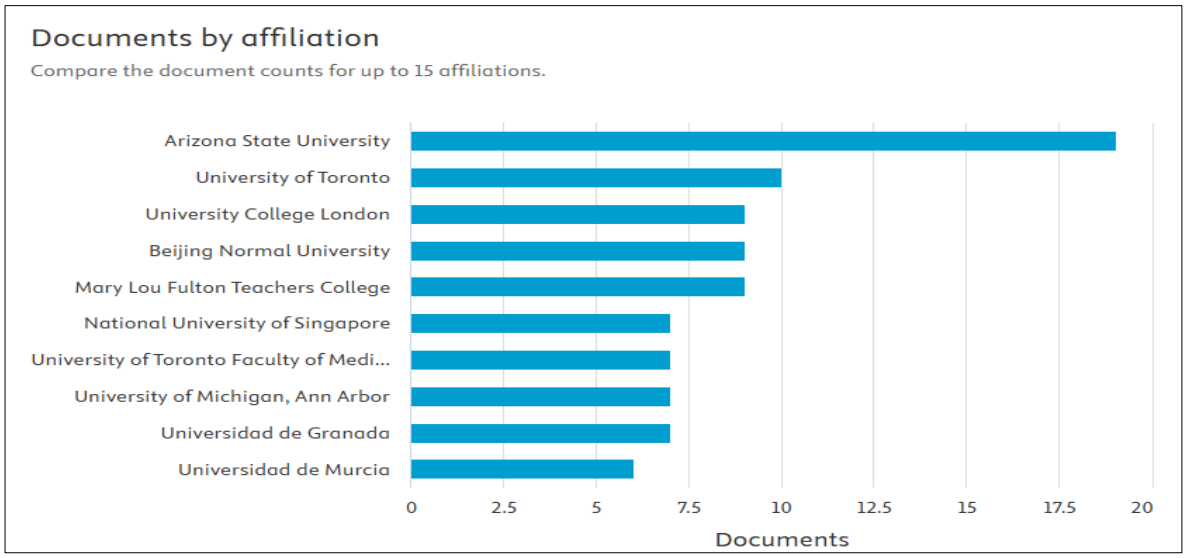

Figure 12. The most active universities in Artificial Intelligence according to the Scopus Database

It is evident that Arizona State University leads in the field, contributing nearly 19 documents, with the highest number of publications, followed closely by the University of Toronto with 10 publications. Other prominent institutions include University College London, Beijing Normal University, and Mary Lou Fulton Teachers College, each with 9 documents. Additional contributors with 8 publications include the National University of Singapore, University of Toronto Faculty of Medicine, University of Michigan at Ann Arbor, Universidad de Granada, and Universidad de Murcia. This analysis reflects a broader engagement from global institutions in ethical leadership research. These figures revise earlier conclusions which highlighted institutions such as the Rotterdam School of Management, Erasmus University, and the University of Leuven based on Scopus and VOSviewer data. While those universities showed significant influence in terms of citations, the latest document count positions Arizona State University and The University of Toronto as current leaders in publication volume.

In contrast, a comparison of figures 11 and 12 reveals a striking discrepancy in the number of documents attributed to specific universities, as evidenced by a notable variation between the VOSviewer map and the bar chart. For instance, Arizona State University appears to have only around 2–3 documents in the VOSviewer illustration, yet the bar chart reveals it has 19 publications, indicating a significant underrepresentation in the network map. Similarly, Mary Lou Fulton Teachers College displays approximately 2–3 documents in VOSviewer, but is credited with 9 publications in the bar chart. On the other hand, institutions such as Monash University and Universidad de Alicante are visible in the VOSviewer map with two documents each, but they do not appear in the top 10 institutions in the bar chart. Meanwhile, universities like Universidad de Granada, Universidad de Murcia, and the University of Michigan, Ann Arbor, are featured prominently in the bar chart with 7–8 documents each, yet they are not visible in the VOSviewer map. These discrepancies likely stem from differences in visualisation thresholds, co-authorship connections, or inclusion criteria between the two data presentations.

The data presented in this figure were retrieved from the Web of Science Core Collection (2010-2025) and analysed using VOSviewer software to identify the most active universities in the field of Artificial Intelligence (see Figure 13).

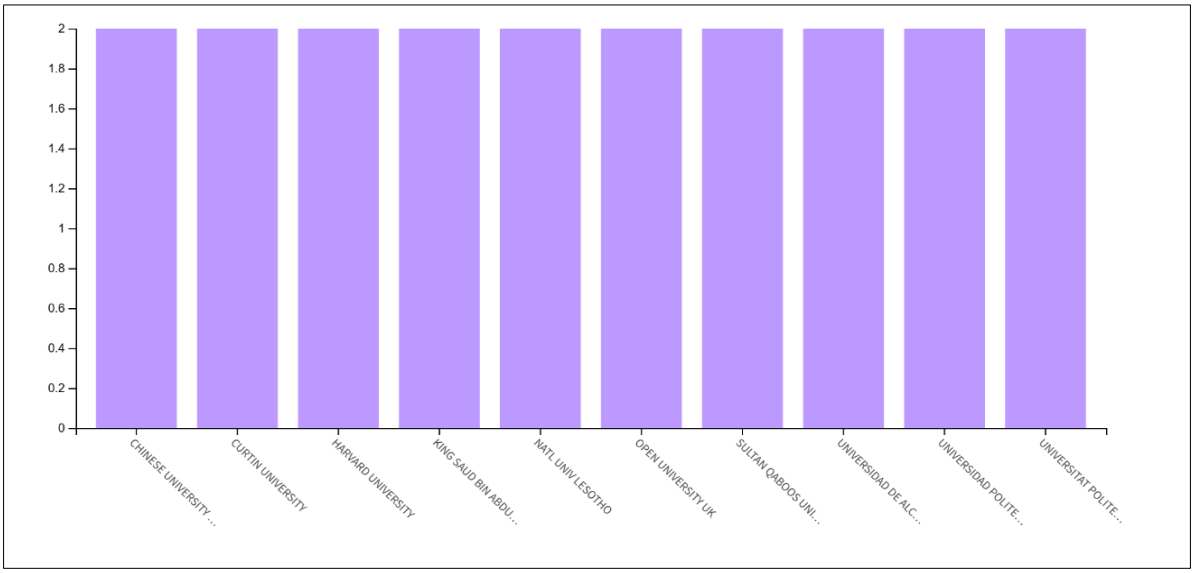

Figure 13. The most active universities in Artificial Intelligence, according to the Web of Science database

The data presented in this figure were retrieved from the Web of Science Core Collection (2010-2025) and analyzed with VOSviewer software to identify the most active universities in the field of Artificial Intelligence (see Figure 14).

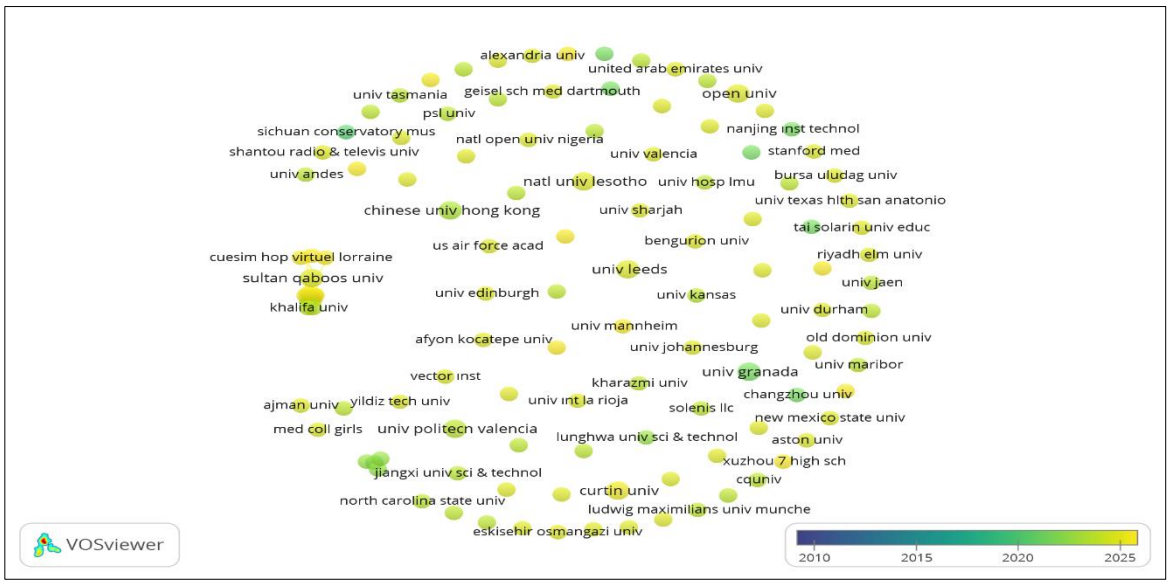

Figure 14. The most active universities on Artificial Intelligence according to VOSviewer based on Web of Science database

A comparative analysis of figures 13 and 14 reveals both clear overlaps and notable differences in the institutions listed. The data indicates that universities such as the Chinese

University of Hong Kong; Curtin University; Sultan Qaboos University; National University of Lesotho; Open University UK; and Universidad Politécnica de Valencia each contributed two publications. This consistency suggests that the core data are reliable across both sources. However, the second figure includes some institutions not seen in the first, such as Harvard University, King Saud Bin Abdulaziz University for Health Sciences, Universidad de Alcalá, and Universidad Politécnica de Madrid. The initial figure enumerates universities such as the University of Granada and the University of Leeds with two publications, while also including several organizations with a single document, which are absent from the subsequent list. These differences may be attributable to the method of grouping of affiliations, the manner in which the data was extracted, or the specific criteria employed in each analysis. While the primary contributors are similar, the figures offer slightly divergent perspectives on the data (Mongeon & Paul-Hus, 2015).

The data presented in this figure were retrieved from the Scopus database (2010-2025) and analysed using VOSviewer software to identify the most active countries in the field of Artificial Intelligence (see Figure 15).

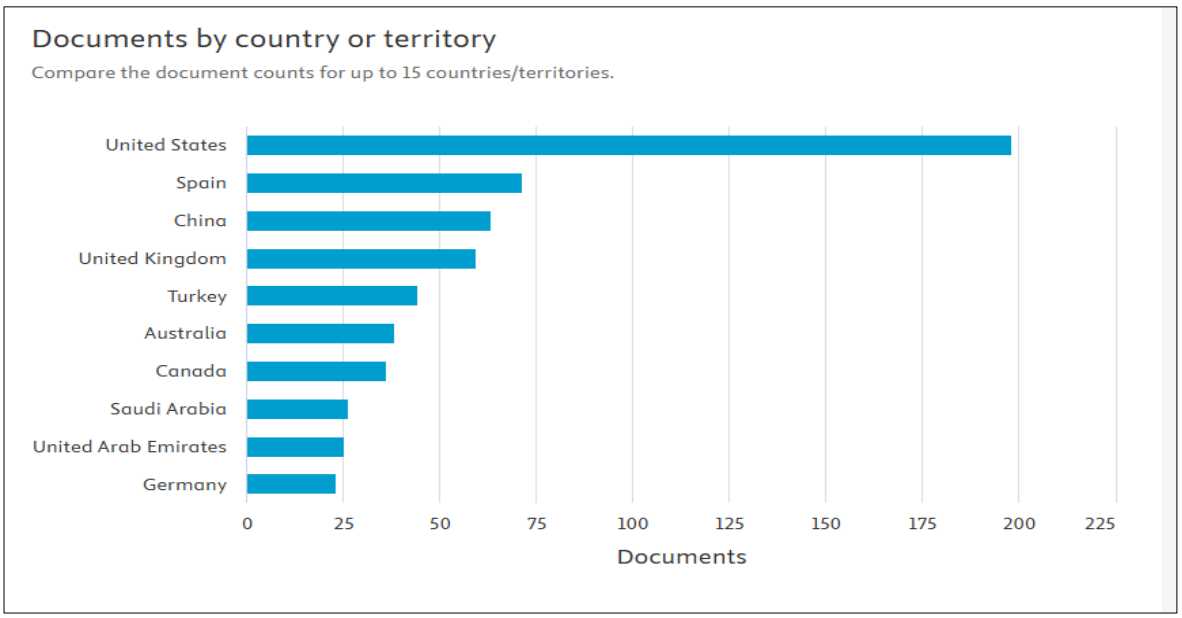

Figure 15. The most active countries in Artificial Intelligence, according to the Scopus Database

The data presented in this figure were retrieved from the Scopus database (2010-2025) and analysed using VOSviewer software to identify the most active countries in the field of Artificial Intelligence (see Figure 16).

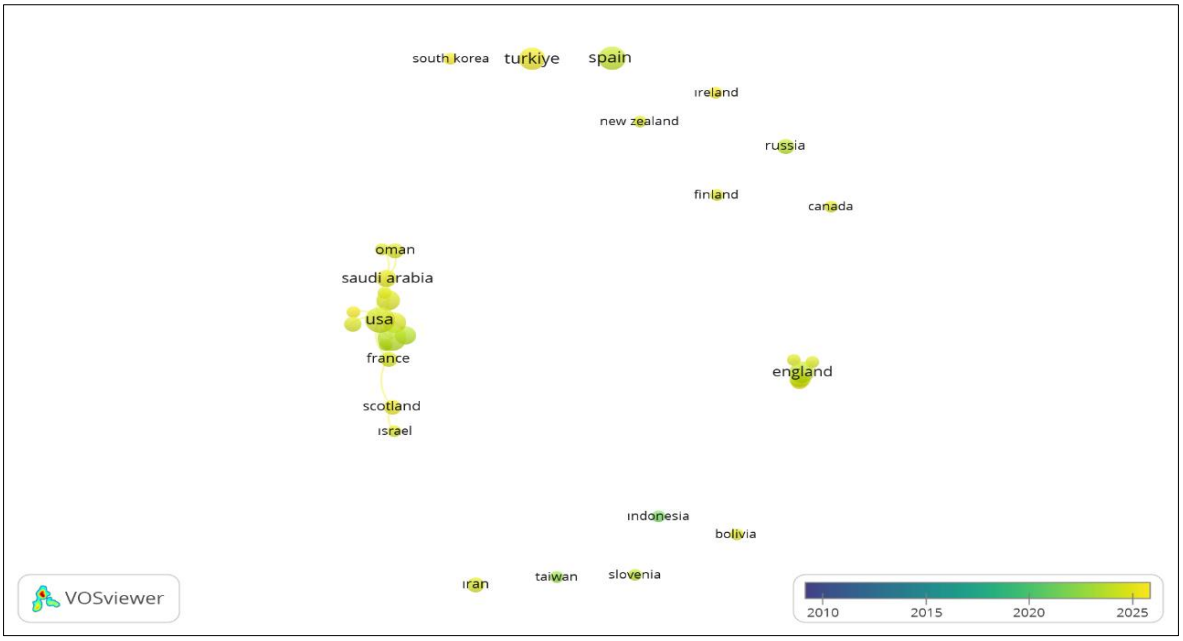

Figure 16. The most active countries in Artificial Intelligence, according to VOSviewer, based on the Scopus Database

A comparison of figures 15 and 16 reveals a high degree of consistency in the ranking of the top publishing countries. However, there are minor discrepancies in the exact document counts. A close examination of the data reveals that the United States has published the highest number of articles, with 197 publications identified in the VOSviewer data, and approximately 215 publications as indicated by the bar chart. This finding substantiates the claim that the United States is the most active contributor in the field. Spain, China, the United Kingdom, Türkiye, Australia, Canada, Saudi Arabia, the United Arab Emirates, and Germany appear in the same order across both visuals, with slightly varying publication numbers. For instance, China has 64 documents in the VOSviewer table, but shows a slightly higher count in the bar chart. These minor variations may be attributable to rounding or time-based modifications in data retrieval processes.

Furthermore, the VOSviewer table incorporates countries not displayed in the bar chart, including India, Malaysia, Brazil, South Korea, and Italy. This observation suggests that the bar chart focuses exclusively on the top ten countries. The VOSviewer data offer a more comprehensive perspective by incorporating citation counts and total link strength, providing a more detailed view of each country's research impact and collaboration. A comparative analysis of the two figures reveals a substantial degree of agreement regarding the identification of the most prolific countries. However, minor discrepancies may emerge from variations in the scope of the data sets or limitations inherent in the visualisation techniques employed.

The data presented in this figure were retrieved from the Web of Science Core Collection (2010-2025) and analysed using VOSviewer software to identify the most active countries in the field of Artificial Intelligence (see Figure 17).

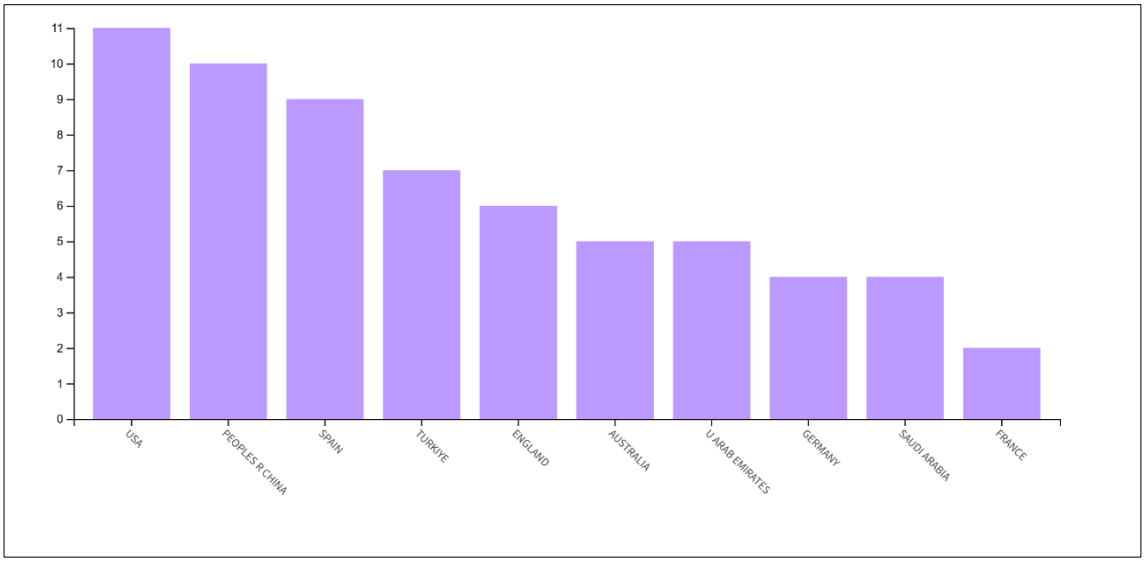

Figure 17. The most active countries in Artificial Intelligence, according to the Web of Science Database

The data presented in this figure were retrieved from the Web of Science Core Collection (2010-2025) and analysed using VOSviewer, software used to identify the most active countries in the field of Artificial Intelligence (see Figure 18).

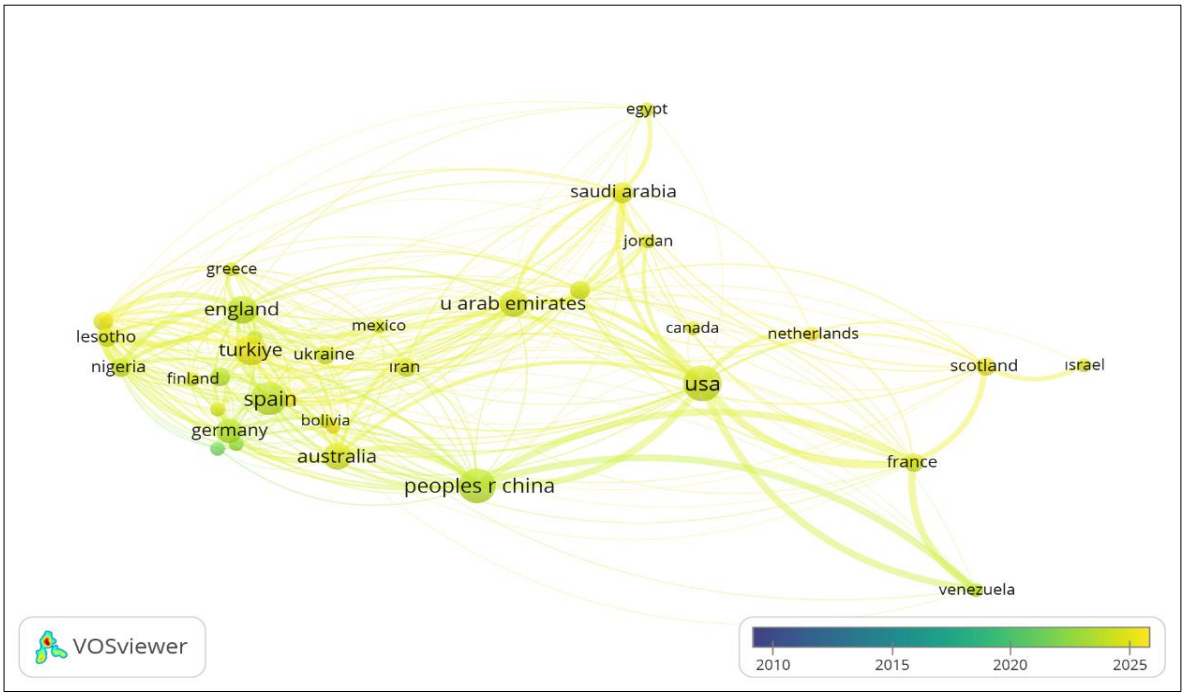

Figure 18. The most active countries in Artificial Intelligence, according to VOSviewer, based on the Web of Science Database

A comparative analysis of these figures reveals a notable similarity in the overall rankings and publication numbers for both countries, despite the differing data presentation methods used. The analysis reveals that the United States is the predominant contributor, with a total of 11 publications. It is closely followed by China, which published 10 publications, and Spain, with 9 publications. The list continues with Türkiye, England, Australia, the United Arab Emirates, Germany, Saudi Arabia, and France, each with 2 to 7 publications. The uniformity observed in both visual representations serves to substantiate the veracity of the data presented.

However, the first figure goes a step further by including citations and total link strength, offering insight into not just how many documents a country produced, but also how well-connected and cited those works are. For instance, the United States and China demonstrate leadership in both publication count and measures of link strength and citation frequency. This finding suggests that these nations exhibit robust international collaboration and significant impact. In contrast, the second figure is more focused and simpler, counting documents without offering any details on influence or network strength. Therefore, while both visual representations concur on the leading contributing nations, the initial visual depiction offers a more comprehensive and detailed analysis of each nation's academic influence (Mongeon & Paul-Hus, 2015).

CONCLUSION & DISCUSSION

Bibliometric analysis is a quantitative research technique used to explore the patterns, trends, and impact of scientific studies through the analysis of publication and citation data (Van Eck & Waltman, 2009). In this study, an overview of articles on artificial intelligence in education published between 2010 and 2025 was conducted using data from Scopus and Web of Science. By employing tools such as VOSviewer, publication trends, commonly used keywords, and citation distributions were examined, providing an objective picture of research activity in this field.

The analysis also highlighted the most influential researchers, leading institutions, and active countries, indicating where knowledge production is concentrated. The results reveal a marked increase in scholarly attention to AI in education, suggesting that the topic has gained momentum over time. This surge reflects not only growing interest among researchers but also the expanding role of AI in shaping teaching methods, learning environments, and educational policies. The identified patterns suggest that AI has become a central focus within educational research, pointing to both its practical relevance and its potential to guide future studies and institutional strategies (Mishra et al., 2024; Ouyang & Jiao, 2021).

The keywords obtained from the Scopus dataset reveal that "artificial intelligence" is the most frequently used term, appearing 44 times. "Higher education" is the second most frequent term, appearing 10 times. Other notable keywords include "ChatGPT,"

"education," "generative artificial intelligence," "medical education," and "technology," indicating a focus on general educational contexts and emerging AI tools. In contrast, the Web of Science dataset has a more balanced distribution of keywords. "ChatGPT" and "artificial intelligence" are each mentioned four times. Terms such as "education," "large language model (LLM)," "physiotherapy," "medical education," "answer rationales," "clinical vignettes," and "GPT-4" appear less frequently. Moreover, these patterns suggest that Scopus captures broader, more established topics, while Web of Science highlights emerging, specialized areas within AI applications in education. The differences reflect the field's development, showing both the advancement of foundational themes and the exploration of new, innovative directions. This points to the evolving focus and growing diversity of research interests in AI-enhanced educational practices (Kamble et al., 2018; Knox, 2020; Mongeon & Paul-Hus, 2015; Rospigliosi, 2023; Tlili et al., 2023).

Data from Scopus, Web of Science, and VOSviewer show a clear pattern regarding the most active countries in AI research within education. The United States leads in all datasets, with 197 publications in VOSviewer and approximately 215 in the bar chart, highlighting its dominant role in the field. Other countries such as Spain, China, the United Kingdom, Türkiye, Australia, Canada, Saudi Arabia, the UAE, and Germany also appear consistently, though the exact number of publications varies slightly between sources. For example, China has 64 documents in VOSviewer but a slightly higher count in the bar chart, likely due to updates or rounding differences. VOSviewer additionally identifies countries not included in the bar chart, such as India, Malaysia, Brazil, South Korea, and Italy, demonstrating a broader scope of global participation.

Beyond publication counts, citation numbers, and link strength in VOSviewer provide insight into research influence and collaboration networks. Notably, projections suggest that 2024 will emerge as the peak year for both publications and citations in Scopus and Web of Science, reflecting increasing scholarly interest in AI's applications in education. Therefore, these patterns indicate that AI research is expanding globally, with certain countries leading in output while others contribute through growing collaboration and influence, suggesting a dynamic and internationally connected research landscape (Arrieta et al., 2019; Gocen & Aydemir, 2020; Pedro et al., 2019).

Chai Ching Sing, Ayanwale Musa Adekunle, and Molefi Rethabile Rosemary are among the most productive authors in the field of artificial intelligence in education. Each of these authors has published two articles, receiving 128, 23, and 9 citations , which reflects both their output and the impact of their work. Mishra stands out with 13 publications, including a 2024 study, cited 23 times, indicating consistent contribution and recognition in the field. Similarly, D. Henriksen has produced 12 articles, with a 2023 study receiving 18 citations, highlighting his influence. The results suggest that while some authors have a smaller number of highly cited works, others like Mishra and Henriksen demonstrate both

productivity and sustained impact, revealing different ways researchers contribute to the development of AI in education.

The United States holds the highest number of publications in both datasets, indicating its leading role in AI research in education. Similar patterns are observed for Spain, China, the United Kingdom, Türkiye, and Australia, although minor differences exist in the exact number of documents. Notably, VOSviewer includes additional countries such as India, Brazil, and South Korea, which do not appear in the bar chart limited to the top ten, offering a broader perspective on global participation. On the other hand, VOSviewer provides supplementary information on citation counts and collaboration strength, enabling a deeper understanding of research influence and international networks. Overall, a comparative analysis of both datasets shows substantial overlap in the most productive countries, suggesting that the global distribution of AI research in education is consistent across different bibliometric sources, while also highlighting emerging contributors beyond the top-ranked nations (Abad-Segura et al., 2020; Hwang et al., 2020).

LIMITATIONS AND RECOMONDATIONS

While this bibliometric analysis provides valuable insights into the development of artificial intelligence research in education, several limitations should be noted. The study is based solely on data from Scopus and Web of Science, which, although extensive, may not capture all relevant publications, particularly from regional journals or emerging databases. Differences in author-defined keywords and indexing practices can create inconsistencies in thematic categorization, potentially affecting the accuracy of keyword and trend analyses. Moreover, the study primarily relies on quantitative measures such as publication counts, citation metrics, and co-authorship networks, which may not fully reflect the qualitative depth or practical impact of the research. Finally, the focus on publications from 2010 to 2025 may overlook earlier foundational works or very recent studies not yet indexed, influencing longitudinal interpretations.

Based on the findings of this study, several recommendations emerge for researchers, educators, and practitioners. Researchers are encouraged to investigate underrepresented regions, institutions, and emerging educational contexts to achieve a more globally inclusive perspective on AI in education. Integrating bibliometric analyses with content or systematic reviews can provide richer qualitative and quantitative insights. Given the rapid rise of tools such as ChatGPT, large language models (LLMs), and GPT-4, longitudinal studies are recommended to track their evolving effects on teaching and learning. Expanding the scope of data sources to include regional or specialized repositories may enhance comprehensiveness in future analyses. Moreover, it is important for educators to develop training programs that enable effective use of AI tools in the classroom and to leverage AI-powered analytics to identify student learning needs for more targeted lesson planning. School administrators can use AI data to monitor teacher performance and

student achievement, while also informing intra-institutional collaboration and resource allocation decisions.

Finally, it is recommended that policymakers support international collaboration in AI-related education research and consider the development of policies that address ethical aspects and equitable access to AI technologies. Implementing such measures may help the educational community utilize AI tools more effectively while mitigating potential challenges.

REFERENCES

Abad-Segura, E., González-Zamar, M., Infante-Moro, J. C., & García, G. R. (2020). Sustainable Management of Digital Transformation in Higher Education: Global Research Trends. *Sustainability*, *12*(5), 2107. https://doi.org/10.3390/su12052107

Arrieta, A. B., Díaz-Rodríguez, N., Del Ser, J., Bennetot, A., Tabik, S., Barbado, A., Garcia, S., Gil-Lopez, S., Molina, D., Benjamins, R., Chatila, R., & Herrera, F. (2019). Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities and challenges toward responsible AI. *Information Fusion*, *58*, 82–115. https://doi.org/10.1016/j.inffus.2019.12.012

Balaban, A. T. (1996). How should citations to articles in high- and low-impact journals be evaluated, or what is a citation worth? *Scientometrics*, *37*(3), 495–498. https://doi.org/10.1007/bf02019260

Bnko, A., & Lányi, C. S. (2009). History of artificial intelligence. In *IGI Global eBooks* (pp. 1759–1762). https://doi.org/10.4018/978-1-60566-026-4.ch276

Chen, X., Xie, H., Zou, D., & Hwang, G. (2020). Application and theory gaps during the rise of Artificial Intelligence in Education. *Computers and Education Artificial Intelligence*, *1*, 100002. https://doi.org/10.1016/j.caeai.2020.100002

Chan, C. K. Y. (2023). A comprehensive AI policy education framework for university teaching and learning. *International Journal of Educational Technology in Higher Education*, *20*(1). https://doi.org/10.1186/s41239-023-00408-3

Chen, X., Zou, D., Xie, H., Cheng, G., & Liu, C. (2022). Two decades of Artificial Intelligence in Education: contributors, collaborations, research topics, challenges, and future directions. *DOAJ (DOAJ: Directory of Open Access Journals)*. https://doaj.org/article/f8b4d7534bfc42a4818ca1d6bf7e4d4b

Crevier, D. (1993). AI: the tumultuous history of the search for artificial intelligence. *Choice Reviews Online*, *31*(03), 31–1555. https://doi.org/10.5860/choice.31-1555

Devedzic, V. (2004). Web intelligence and artificial intelligence in education. *Educational Technology & Society*, *7*(4), 29–39. http://www.ifets.info/journals/7_4/6.pdf

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, *133*, 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070

Falagas, M. E., Pitsouni, E. I., Malietzis, G. A., & Pappas, G. (2007). Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses. *The FASEB Journal*, *22*(2), 338–342. https://doi.org/10.1096/fj.07-9492lsf

Garfield, E. (1972). Citation analysis as a tool in journal evaluation. *Science*, *178*(4060), 471–479. https://doi.org/10.1126/science.178.4060.471

Gocen, A., & Aydemir, F. (2020). Artificial intelligence in education and schools. *Research on Education and Media*, *12*(1), 13–21. https://doi.org/10.2478/rem-2020-0003

Haenlein, M., & Kaplan, A. (2019). A Brief History of artificial intelligence: on the past, present, and future of artificial intelligence. *California Management Review*, *61*(4), 5–14. https://doi.org/10.1177/0008125619864925

Hwang, G., Xie, H., Wah, B. W., & Gašević, D. (2020). Vision, challenges, roles and research issues of Artificial Intelligence in Education. *Computers and Education Artificial Intelligence*, *1*, 100001. https://doi.org/10.1016/j.caeai.2020.100001

Kamalov, F., Calonge, D. S., & Gurrib, I. (2023). New era of Artificial intelligence in Education: Towards a sustainable Multifaceted Revolution. *Sustainability*, *15*(16), 12451. https://doi.org/10.3390/su151612451

Knox, J. (2020). Artificial intelligence and education in China. *Learning Media and Technology*, *45*(3), 298–311. https://doi.org/10.1080/17439884.2020.1754236

Lameras, P., & Arnab, S. (2021). Power to the Teachers: An Exploratory review on Artificial intelligence in education. *Information*, *13*(1), 14. https://doi.org/10.3390/info13010014

Lim, W. M., Gunasekara, A., Pallant, J. L., Pallant, J. I., & Pechenkina, E. (2023). Generative AI and the future of education: Ragnarök or reformation? A paradoxical perspective from management educators. *The International Journal of Management Education*, *21*(2), 100790. https://doi.org/10.1016/j.ijme.2023.100790

Liu, F., Yu, C., Meng, W., & Chowdhury, A. (2006). Effective keyword search in relational databases. *Proceedings of the 2006 ACM SIGMOD International Conference on Management of Data*, 563–574. https://doi.org/10.1145/1142473.1142536

Mishra, P., Oster, N., & Henriksen, D. (2024). Generative AI, Teacher Knowledge and Educational Research: bridging Short- and Long-Term Perspectives. *TechTrends*, *68*(2), 205–210. https://doi.org/10.1007/s11528-024-00938-1

Mongeon, P., & Paul-Hus, A. (2015). The journal coverage of Web of Science and Scopus: a comparative analysis. *Scientometrics*, *106*(1), 213–228. https://doi.org/10.1007/s11192-015-1765-5

Ng, D. T. K., Tan, C. W., & Leung, J. K. L. (2024). Empowering student self-regulated learning and science education through ChatGPT: A pioneering pilot study. *British Journal of Educational Technology*, *55*(4), 1328–1353. https://doi.org/10.1111/bjet.13454

Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers and Education Artificial Intelligence*, *2*, 100020. https://doi.org/10.1016/j.caeai.2021.100020

Öztürk, O., Kocaman, R., & Kanbach, D. K. (2024). How to design bibliometric research: an overview and a framework proposal. *Review of Managerial Science*, *18*(11), 3333–3361. https://doi.org/10.1007/s11846-024-00738-0

Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). Artificial intelligence in education : challenges and opportunities for sustainable development. *MINISTERIO DE EDUCACIÓN*. http://repositorio.minedu.gob.pe/handle/20.500.12799/6533

Qadir, J. (2023). Engineering Education in the Era of ChatGPT: Promise and Pitfalls of Generative AI for Education. *2022 IEEE Global Engineering Education Conference (EDUCON)*, 1–9. https://doi.org/10.1109/educon54358.2023.10125121

Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. *International Journal of Artificial Intelligence in Education*, *26*(2), 582–599. https://doi.org/10.1007/s40593-016-0110-3

Rospigliosi, P. '. (2023). Artificial intelligence in teaching and learning: what questions should we ask of ChatGPT? *Interactive Learning Environments*, *31*(1), 1–3. https://doi.org/10.1080/10494820.2023.2180191

Singh, K., Kaur, N., & Prabhu, A. (2024). Combating COVID-19 Crisis using Artificial Intelligence (AI) Based Approach: Systematic Review. *Current Topics in Medicinal Chemistry*, *24*(8), 737–753. https://doi.org/10.2174/0115680266282179240124072121

Solanki, V., Solanki, U., Baliyan, A., Kukreja, V., Lamba, V., & Sahoo, B. K. (2021). Importance of Artificial Intelligence and Machine Learning in fighting with COVID-19 Epidemic. *2021 5th International Conference on Information Systems and Computer Networks (ISCON)*, 1–8. https://doi.org/10.1109/iscon52037.2021.9702316

Su, J., & Yang, W. (2023). Unlocking the power of ChatGPT: a framework for applying generative AI in education. *ECNU Review of Education*, *6*(3), 355–366. https://doi.org/10.1177/20965311231168423

Tlili, A., Shehata, B., Adarkwah, M. A., Bozkurt, A., Hickey, D. T., Huang, R., & Agyemang, B. (2023). What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. *Smart Learning Environments*, *10*(1). https://doi.org/10.1186/s40561-023-00237-x

Van Eck, N. J., & Waltman, L. (2009). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal of Educational Technology in Higher Education*, *16*(1). https://doi.org/10.1186/s41239-019-0171-0

Data Availability Declaration

Data Availability Upon Formal Request: While the primary datasets utilized in this study are not publicly accessible due to certain constraints, they are available to researchers upon a formal request. The authors have emphasized maintaining the integrity of the data and its analytical rigor. To access the datasets or seek further clarifications, kindly reach out to the corresponding author. Our aim is to foster collaborative academic efforts while upholding the highest standards of research integrity

Author Contributions

All authors, Güler SHAIKH and Semra KIRANLI GÜNGÖR, contributed equally to this work. They collaboratively handled the conceptualization, methodology design, data acquisition, and analysis. Each author played a significant role in drafting and revising the manuscript, ensuring its intellectual depth and coherence. All authors have thoroughly reviewed, provided critical feedback, and approved the final version of the manuscript. They jointly take responsibility for the accuracy and integrity of the research.

Author(s)' statements on ethics and conflict of interest

Ethics statement: We hereby declare that research/publication ethics and citing principles have been considered in all the stages of the study. We take full responsibility for the content of the paper in case of dispute.

Statement of interest: The authors have a scholarly interest in the intersection of educational technologies and data-driven research methodologies. This study was conducted with the aim of contributing to the academic understanding of how artificial intelligence is shaping educational practices globally. The authors affirm that the research was carried out independently and with academic integrity.

Acknowledgements: The authors express their sincere gratitude to the institutions and academic databases that made this research possible, particularly Scopus and Web of Science for providing access to comprehensive bibliographic data. Special thanks are also extended to the developers of VOSviewer for offering valuable tools that facilitated the analysis and visualization of bibliometric networks. The authors also appreciate the constructive feedback and encouragement received from colleagues during the preparation of this study.

Biographical notes:

Güler SHAIKH[1] *:* She holds a Master's degree from Mardin Artuklu University and is currently pursuing a doctorate at Osmangazi University. She has previously completed a degree in English Language Teaching at Dokuz Eylül University. She is currently employed as the principal at the Provincial Directorate of National Education.

[1] Corresponding Author

Scopus Author Identifier Number: 57222097462

Web of Science Researcher ID: AED-6244-2022

Google Scholar Researcher ID: 6lQ-RlYAAAAJ&hl

Semra KIRANLI GÜNGÖR [2]*:* She holds a Master of Arts in Educational Administration from Eskişehir Osmangazi University's Social Sciences Institute, with a specialisation in supervision and planning. She also holds a Bachelor of Arts in Foreign Language Education from Anadolu University's Faculty of Education. She currently serves as a Professor at Eskişehir Osmangazi University.

Scopus Author Identifier Number: 57204102316

Web of Science Researcher ID: CTN- 763-2018

Google Scholar Researcher ID: ImKVSV0AAAAJ

Appendix 1 : Scopus

KEY ((artificial intelligence) AND PUBYEAR > 2009 AND PUBYEAR < 2027 AND PUBYEAR > 2009 AND PUBYEAR < 2026 AND (LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (EXACTKEYWORD , "Education"))

Appendix 2 (Web of Science)

Refine results for artificial intelligence (Keyword Plus ®) AND education (Keyword Plus ®) and 2011 or 2014 Key (artificial intelligence (Title) and education (KeywordPlus®) and 2011 or 2014 or 2017 or 2018 or 2019 or 2025 or 2024 or 2023 or 2022 or 2021 or 2020 or 2019 or 2018 or 2017 or 2014 or 2011 (Publication Years) and Open Access and Article (Document Types) and Education Educational Research or Education Scientific Disciplines (Web of Science Categories) and All Open Access (Open Access)017 or 2018 or 2019 or 2025 or 2024 or 2023 or 2022 or 2021 or 2020 or 2019 or 2018 or 2017 or 2014 or 2011 (Publication Years) and Open Access and Article (Document Types) and Education Educational Research or Education Scientific Disciplines