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ORIGINAL ARTICLE

Global Trends on Artificial Intelligence in Science Research: A Scientometric Observation

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ABSTRACT

This scientometric analysis deals with global research trends on artificial intelligence (AI) in science education through scientific literature output to assist readers, policy-makers, academicians, and stockholders, understand the state of the field's research in time and future perspective. The main purpose is to provide bibliometric data on AI in science education publications which were listed in the Scopus database between 2004 and 2023. The results showed that the year 2023 leads the chart with 1,021 papers, constituting 22.20% of the total output, more than doubling the production of 2021 (512 papers). The highest citation density appears in 2013, with an ACPP of 37.83, and in 2015, where 138 papers generated 7,234 citations, yielding an ACPP of 52.42—the highest in the dataset. It found conference papers are the backbone of AI scholarship, with 2,256 papers (49.05%) and followed by the second-largest category is journal articles, accounts for 1,387 publications (30.16%). It noted that Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics, which account for 497 publications. Koedinger, K.R. ranked first with 13 publications in terms of author productivity and followed by Russell, I. secures the second rank with 12 publications. The United States leads with 1,515 publications by far the largest contribution. The United Kingdom emerges as the most cited country, with approximately 6,854 citations, indicating its leading role in producing highly influential research.

KEYWORDS

• Artificial Intelligence • AI • Science • Education • Scientometric Analysis • Bibliometrics

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INTRODUCTION

AI technology is currently applied in numerous sectors, including science education, medicine, transportation, manufacturing, finance, health care, and urban planning. It shows a clear picture of AI through scientometric analysis from 2004 to 2023, showing that the number of publications in the Scopus database was increased from 53 to 1021. Therefore, the present study has been undertaken to know the growth and development of publications in the field of Artificial intelligence of science research. Thus, the goal of the current study is to understand the expansion and evolution of publications in the field of Artificial intelligence in science.

LITERATURE REVIEW

Dikmen and Elmalı (2026) analysed 40 years of AI in nursing research trends, collaborations, and research hotspots in global level. The purpose of the study was to map global trends, intellectual structures, and thematic evolution of AI in nursing research from 1984 to 2025 and to identify key authors, institutions, and research foci within AI-related nursing scholarship. The results showed that the research publication output significantly increased post-2018, with the US, China, and UK as leading contributors. The key research themes were elder care robotics, clinical decision support, and AI-enhanced nursing education. Velmurugan and Indrani (2024) did a bibliometric analysis on artificial intelligence (AI) in science education literature which will help readers, policy-makers, academicians, and stockholders, understand the state of the field's research at the time. The primary aim was to provide bibliometric data on AI in science education publications listed in the Scopus database between 2004 and 2023. They described the research publications in terms of year-wise contribution, growth of authorship pattern, citation analysis, document types, document by affiliation, subject coverage, individual author's research productivity, h-index, geographical collaboration of authors, core journal activity, and national and international collaboration. Srinivasulu and Velmurugan (2023) analyzed the urology open access journals which are available in DOAJ (Directory of Open Access Journals) database. The results showed that DOAJ indexes 12 open access journals published by Elsevier and followed by 8 journals are published by Wolters Kluwer Medknow. The other publishers such as Hindawi Limited 5 journals, Karger Publishers 4 journals. They found that there are 37 blind peer review journals followed by 32 double blind peer review journals and 11 peer-reviews journals respectively indexed in DOAJ database. They also discovered in the study that maximum Urology journals (74) were without DOAJ seal and only 8 journals have got the desired DOAJ seal, which represents as a symbol of certification and high publishing standards.

Mustak, M. et al. (2021) analysed the research trends on Artificial intelligence in marketing. They examined applying scientometric tools in terms of dominant topics, diversity, and evolution over time, and dynamics to map the existing knowledge base. The study focussed on key concepts, keyword co-occurrences, authorship networks, top research themes, landmark publications, and the evolution of the research field over time. It found that the insights as a foundation and this research also close with a proposed agenda for further research. Darko, A. et al., (2020) demonstrated the science mapping method using quantitative analysis with 41,827 bibliographic records which were retrieved from Scopus. The results indicated that genetic algorithms, neural networks, fuzzy logic, fuzzy sets, and machine learning have been the most widely used AI methods in AEC. The findings brought the deficiencies in the current research and provide paths for future research, where they indicated that future research opportunities lie in applying robotic automation and convolution neural networks to AEC problems. Yuh-Shan Ho and Ming-Huang Wang (2020) measured the characteristics literature output in the domain of artificial intelligence using the Science Citation Index Expanded from 1991 to 2018. They focussed on the distribution of annual publications, citations per publication, leading journals, Web of Science categories, productive countries and institutions with 13,251 artificial intelligence literatures.

Zhong, B., et al., (2019) conducted the study on ontology publications published in the Scopus database from 2007 to 2017. The results revealed that a large network of co-authors in this field and half of the literature (53%) were published by the three countries such as the United States, the United Kingdom, and Canada. They identified that the top co-occurring keywords were "project management" and "knowledge management", "building information modelling", and "compliance control". They also noted the four research themes were "Domain ontology", "Industry foundation classes", "Automated compliance checking", and "Building information modelling". Gupta and Dhawan (2018) explored the global literature in artificial intelligence with a total of 1,52,655 publications retrieved from Scopus database between 2007 and 2016. They found 74.32% of global publication shared among top10 countries of the world in artificial intelligence research. They found that China had 19.46% global share, followed by the United States (17.96 %), India (6.37 %), and the United Kingdom (6.33 %), etc. they registered an annual average growth rate of 27.45%, and the average citation impact was 2.76 citations per paper. Shrivastava and Mahajan (2016) examined the Indian literature output in the field of artificial intelligence applying scientometric techniques during 1968-2014. They identified that a total of 6,529 articles were published in the field of artificial intelligence in India and the research papers had grown considerably since 2004. They noted the average citation per paper was 3.06 and the average number of authors per paper was three. They found the most popular keyword was "Artificial Intelligence" followed by "Algorithm" and the Anna University was the leading institution producing research articles.

OBJECTIVES

The main objective of this study was to evaluate the literature output of Artificial Intelligence in Science Literature. The other objectives are:

Publications by Years and Citations

Publications' Relative Growth Rate (RGR) and Doubling Time

Type of Documents in Artificial Intelligence in Science

Source-wise Publications in AI Research

Publications by Authors in AI and Science Output

Publications by Affiliations of AI in Science Literature

Publications by Country in AI and Science Education

Most cited countries

Publications by Funding Sponsor in AI and Science Education

METHODOLOGY

The study shows the scientific publications associated with AI in science education. The required bibliographic data of 88 years was retrieved from the Scopus database to identify research productivity trends on AI in science education published between 1935 and 2023. The search keywords were "artificial intelligence," "AI," "science education," and "STEM education," applying Boolean operators such as "AND," "OR," and "NOT." A total of 6717 scientific literature records were found between 1935 and 2025 for the first search. Then, after limiting the search to the most recent twenty years, specifically from 2004 to 2023, it found a total of 4599 pieces of literature related to AI in science education. Further, the VOSviewer mapping technique is used to visualize the data through various networks. Publication data has been obtained through Scopus after filtering the data and checking how the number of citations and publication titles correspond to the research topic. PoP, MS Excel, and VOSviewer software are used to analyze and measure the literature output to create online publications, country or journal mapping, and create links between keyword maps and existing records.

RESULTS AND ANALYSIS

1. Publications by Years and Citations

The distribution of research publications published in the journals indexed in the Scopus database by year was analyzed over two decades. Analysis of Table 1 revealed that there were a huge number of publications published between 2012 and 2023, and this indicates that there was an increasing trend in the number of publications. It found that the most publications were produced in the year 2023 (=1021), followed by 622 in 2022.

Table 1: Publications by Year

Year	Papers	Percent	Citations	ACPP
2023	1021	22.20	8820	8.64
2022	622	13.52	6223	10.01
2021	512	11.13	10097	19.72
2020	406	8.83	7387	18.19
2019	294	6.39	6424	21.85

Year	Papers	Percent	Citations	ACPP
2018	231	5.02	5694	24.65
2017	220	4.78	4075	18.52
2016	160	3.48	2168	13.55
2015	138	3.00	7234	52.42
2014	151	3.28	1627	10.77
2013	125	2.72	4729	37.83
2012	74	1.61	979	13.22
2011	140	3.04	977	6.98
2010	82	1.78	1504	18.34
2009	113	2.46	1959	17.33
2008	93	2.02	1196	12.86
2007	59	1.28	729	12.35
2006	66	1.44	1114	16.88
2005	39	0.85	264	6.77
2004	53	1.15	876	16.53
Total	**4599**	**100**	**25140**	**5.47**

When we analyze the temporal distribution of research publications, a fascinating trajectory of scholarly growth and impact emerges. The data, spanning from 2004 to 2023, reveals both the quantitative productivity of papers published and the qualitative dimension measured through citations and Average Citations Per Paper (ACPP).

1.1. Rising Volume of Publications

The publication output has demonstrated a substantial escalation in recent years. The year 2023 leads the chart with 1,021 papers, constituting 22.20% of the total output, more than doubling the production of 2021 (512 papers). This reflects not merely an increase in scholarly participation but also the maturation of the field with broader institutional and international engagement. By comparison, the early years, such as 2004 and 2005, registered only 53 and 39 papers, respectively, indicating the humble beginnings of this research trajectory. This progression clearly depicts a paradigm shift towards accelerated research dissemination, particularly after 2015, with a sharp surge in annual contributions.

1.2. Citations as a Measure of Influence

The impact dimension, captured through citations, narrates a slightly different story. The highest citation density appears in 2013, with an ACPP of 37.83, and in 2015, where 138 papers generated 7,234 citations, yielding an ACPP of 52.42—the highest in the dataset. This demonstrates that while fewer papers were produced during that time, their scholarly influence and relevance was profound, indicating a concentration of seminal or foundational works. In contrast, more recent years, such as 2022 and 2023, though voluminous, exhibit lower ACPP values of 10.01 and 8.64, respectively, reflecting the natural citation lag effect-recent publications have not yet had sufficient time to accrue long-term recognition.

1.3. Patterns of Scholarly Maturity

The data reveals three distinct phases:

Formative Phase (2004–2010): Characterized by modest annual outputs ranging from 39 to 140 papers. However, some years, notably 2009 and 2010, already demonstrate respectable citation averages (17.33 and 18.34, respectively), suggesting the emergence of influential early contributions.

Growth Phase (2011–2017): Marked by steady increases in both publications and citations, with annual outputs rising from 140 in 2011 to 220 in 2017. The ACPP values during this phase oscillated between 6.98 and 18.52, denoting consolidation and diversification of themes.

Acceleration Phase (2018–2023): An era of exponential expansion, with outputs leaping from 231 papers in 2018 to over 1,000 in 2023. Yet, citation averages remain relatively lower in the immediate term, as recent research is still under evaluation by the wider academic community.

In total, across two decades, the field has produced 4,599 papers, attracting 25,140 citations, with an overall ACPP of 5.47. This synthesis of productivity and impact illustrates a healthy, evolving research ecosystem-one that has matured from its modest beginnings into a vibrant, globally impactful domain. Looking ahead, the challenge will be to balance quantity with quality, ensuring that the accelerating publication pace is matched by intellectual depth, methodological rigor, and long-term citation impact.

2. Publications' Relative Growth Rate (RGR) and Doubling Time

The Relative Growth Rate (RGR) is the increase in the number of articles or pages per unit of time. This definition is derived from the definition of relative growth rates in the study of growth analysis in the field of air pollution.

The mean relative growth rate (R) over the specific period of interval can be calculated from the following equation.

Relative Growth Rate (RGR)

1 - 2R=Log W2 – Log W1/ T2-T1

Where 1-2 R- mean relative growth rate over the specific period of interval

Loge W1 - log of initial number of articles

Loge W2 - log of the final number of articles after a specific period of interval

T2-T1- the unit difference between the initial time and the final time

The year can be taken here as the unit of time.

Doubling Time (DT) = 0.693/R

Table 2: Relative growth rate (RGR) and Doubling time (DT) of publications

Year	Papers	Cumulative	W1	W2	RGR	DT
2023	1021	1021	6.93	6.93	-	-
2022	622	1643	6.43	7.40	0.97	0.71
2021	512	2155	6.24	7.68	1.44	0.48
2020	406	2561	6.01	7.85	1.84	0.38
2019	294	2855	5.68	7.96	2.27	0.30
2018	231	3086	5.44	8.03	2.59	0.27
2017	220	3306	5.39	8.10	2.71	0.26
2016	160	3466	5.08	8.15	3.08	0.23
2015	138	3604	4.93	8.19	3.26	0.21
2014	151	3755	5.02	8.23	3.21	0.22
2013	125	3880	4.83	8.26	3.44	0.20
2012	74	3954	4.30	8.28	3.98	0.17
2011	140	4094	4.94	8.32	3.38	0.21
2010	82	4176	4.41	8.34	3.93	0.18
2009	113	4289	4.73	8.36	3.64	0.19
2008	93	4382	4.53	8.39	3.85	0.18
2007	59	4441	4.08	8.40	4.32	0.16
2006	66	4507	4.19	8.41	4.22	0.16
2005	39	4546	3.66	8.42	4.76	0.15
2004	53	4599	3.97	8.43	4.46	0.16

Measuring the RGR and doubling time with 4599 literature outputs which were published during 2004-2023. The average number of publications per year was 229.95. There were only 39 publications in 2005, and a fluctuating growth of publications was observed during the study period. The highest publications (1021) were in 2023. It was also noted that there was a steady growth of publications during 2016-2023. The year-wise RGR is found to be in the range of 0.97 to 4.46. It has been observed from Table 2 that RGR is a downward trend from 2013 (0.73) to 2016 (0.28) and increased from 2017 (0.30) to 2020 (0.52). The doubling time (DT) was upward trend from 2013 (0.95) to 2016 (2.47) and decreased from 2017 (2.31) to 2020 (1.33).

3. Type of Documents in Artificial Intelligence in Science

When we examine the landscape of Artificial Intelligence (AI) in Science scholarship, the variety of document types provides a profound insight into the modes of knowledge production, dissemination, and validation. The dataset, encompassing 4,599 documents, highlights both the dominant forms of publication and the supplementary contributions that together shape the intellectual ecosystem of AI.

The data reveals that conference papers are the backbone of AI scholarship, with 2,256 papers (49.05%). This dominance reflects the fast-paced, rapidly evolving nature of AI research, where conferences act as the primary venues for presenting cutting-edge findings, algorithms, and applications. Unlike many other fields that privilege journal articles, AI thrives in conference-driven dissemination, offering quicker peer engagement, networking opportunities, and immediate feedback. This culture is particularly evident in flagship conferences such as NeurIPS, ICML, ICLR, and AAAI, which are globally recognized as the crucibles of innovation.

The second-largest category, journal articles, accounts for 1,387 publications (30.16%). Articles serve as the archival record of AI research, where findings presented initially at conferences often evolve into more comprehensive, peer-reviewed journal versions.These journal papers ensure the rigor, stability, and permanence of knowledge, balancing the rapid dissemination of conferences with deeper theoretical and empirical exploration. Together, conference papers and journal articles make up nearly 80% of the total output, underscoring their dual role in shaping AI discourse. An essential dimension of the literature is provided by review papers, numbering 302 (6.57%). Reviews act as knowledge synthesizers, integrating disparate findings, mapping emerging trends, and identifying future research frontiers. In a field as dynamic as AI, reviews are invaluable for early-stage scholars and interdisciplinary researchers, offering navigational clarity in an otherwise fragmented knowledge landscape.

The presence of 207 book chapters (4.50%) and 117 full-length books (2.55%) indicates the pedagogical and conceptual maturation of AI.Books serve as reference works and teaching resources, consolidating theories, methodologies, and applications for a broader audience.They signify a shift from research as an exclusive academic discourse toward knowledge democratization, influencing industry practitioners, educators, and policymakers. Several document types, though numerically smaller, hold distinctive roles: Conference Reviews (207; 4.50%) and Editorials (41; 0.89%) provide evaluative, reflective, and directional perspectives on ongoing research. Notes (38; 0.83%) and Short Surveys (14; 0.31%) offer concise, focused insights, often pointing to technical novelties or early-stage experimental findings. Letters (8; 0.17%) provide brief communicationsoften urgent or narrowly scoped contributions to ongoing debates. The presence of 13 errata (0.28%) and 9 retracted papers (0.19%) highlights the self-correcting nature of science. Retractions, though few, emphasize the importance of academic integrity, transparency, and reliability in AI Science literature. In a field influencing critical domains such as medicine, autonomous systems, and ethics, the correction of the scientific record is not merely procedural but essential for societal trust.

4. Source-wise Publications in AI Research

One of the most revealing dimensions of a scientometric analysis lies in source-wise distributionthat is, identifying the publication outlets where scholarly contributions are most frequently disseminated. By examining these sources, we not only understand the preferred venues for AI in Science research communication but also appreciate the disciplinary networks and academic communities that sustain this field.

At the forefront, we observe the Lecture Notes in Computer Science (LNCS) series, including its specialized subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics, which account for 497 publications. This series alone represents a significant concentration of AI output, affirming its reputation as a prestigious, globally recognized conference proceedings platform. LNCS is widely indexed, rapidly disseminated, and highly visible, making it a natural choice for AI researchers seeking timely dissemination and scholarly recognition. The inclusion of subseries further highlights the interdisciplinary integration of AI with bioinformatics, computer vision, and other computational sciences.

The ACM International Conference Proceeding Series, with 147 records, stands as the second most prominent outlet. ACM's brand equity in computer science provides credibility and global reach. Many AI subdomains, particularly machine learning, natural language processing, and computational theory, find their primary stage of discourse through ACM-hosted conferences. The ASEE Annual Conference and Exposition Proceedings contribute 115 publications, signifying the pedagogical and applied orientation of AI research. Here, AI intersects with engineering education, curriculum development, and pedagogy. The presence of AI papers in ASEE reflects its dual role as both a technical discipline and an educational innovation driver. Similarly, the Frontiers in Education Conference (FIE) accounts for 82 publications. This reveals AI's strong integration into the educational technology ecosystem, demonstrating how machine learning and intelligent tutoring systems are being leveraged to transform teaching and learning environments.

Finally, the Annual Conference on Innovation and Technology in Computer Science Education (ITiCSE) contributed 32 publications. These contributions underscore the growing efforts to institutionalize AI into computer science curricula, ensuring that the next generation of engineers and scientists are AI-literate. We conclude that the source-wise analysis reveals that AI scholarship is anchored in highly visible, conference-driven outlets such as LNCS and ACM proceedings, while also expanding into educational and interdisciplinary platforms. This duality of technological innovation and educational transformation positions AI not only as a technical discipline but also as a catalyst of change across the entire academic ecosystem.

5. Publications by Authors in AI and Science Output

When we analyze the authorship patterns in Artificial Intelligence research within science education, we gain valuable insights into the intellectual leadership and scholarly networks that shape the field. Figure 1 offers a clear representation of the most prolific contributors, highlighting both individual productivity and collaborative dynamics.

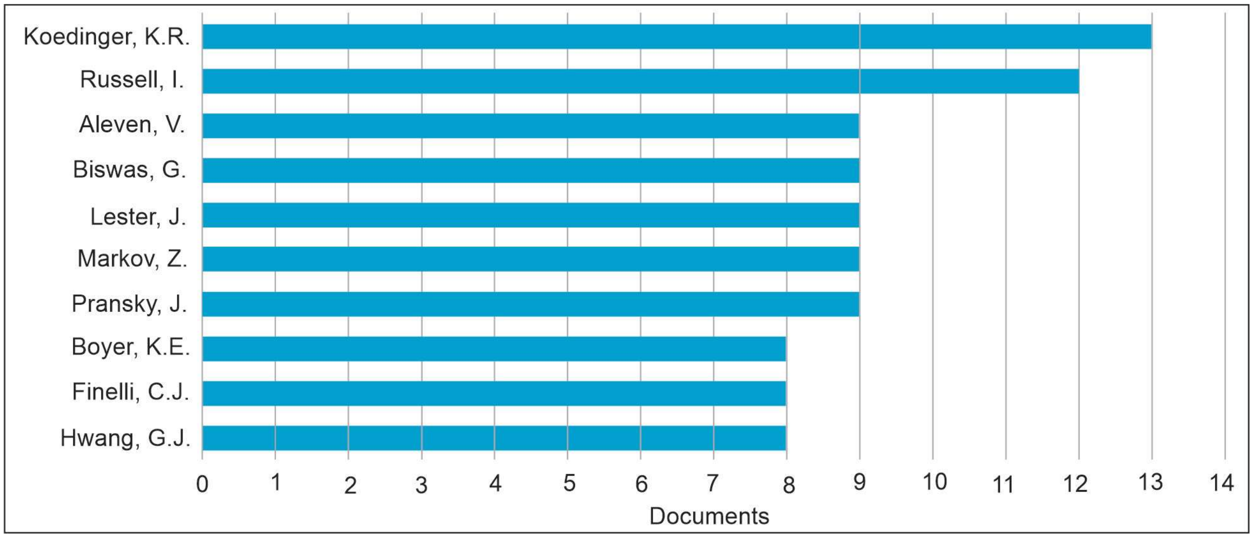

Figure 1: Number of publications by author (***Source:*** Authors)

5.1. Leading Contributor: Koedinger, K.R.

At the forefront of this scholarly landscape stands Koedinger, K.R., with 13 publications. His consistent output not only places him at the top rank but also reflects his pioneering contributions to intelligent tutoring systems and AI-driven educational technologies. Koedinger's work has been instrumental in bridging cognitive science, AI, and classroom practice, making his leadership a cornerstone of this domain.

5.2. Second Position: Russell, I.

In close succession, Russell, I. secures the second rank with 12 publications. Russell's scholarship emphasizes computing education and AI integration in pedagogy, underscoring the role of AI not only as a tool of automation but also as a pedagogical enabler.The narrow margin between Koedinger and Russell demonstrates the competitive yet collaborative nature of contributions in this growing research area.

5.3. Third Rank: Cluster of Prolific Scholars

The third rank is collectively shared by six scholars, such as Aleven, V., Biswas, G., Lester, J., Markov, Z., and Pransky, J., each contributing nine publications. This cluster of researchers demonstrates the distributed leadership model in AI and science education research. Their works span a variety of themes, including:

Aleven, V.: adaptive learning systems and cognitive modeling,

Biswas, G.: student learning analytics and AI-based assessment,

Lester, J.: Intelligent Agents and Affective Computing in Education,

Markov, Z.: computational pedagogy and learning frameworks,

Pransky, J.: Practical integration of AI tools in science classrooms.

Together, these scholars represent a core intellectual cohort advancing the methodological, technological, and applied dimensions of AI in education.

6. Publications by Affiliations of AI in Science Literature

The analysis of institutional affiliations provides an important perspective on the geography of knowledge production and the institutional ecosystems driving AI research in science education. Figure 2 highlights the leading contributors by university affiliation, showcasing how academic centres of excellence act as hubs of innovation, collaboration, and dissemination.

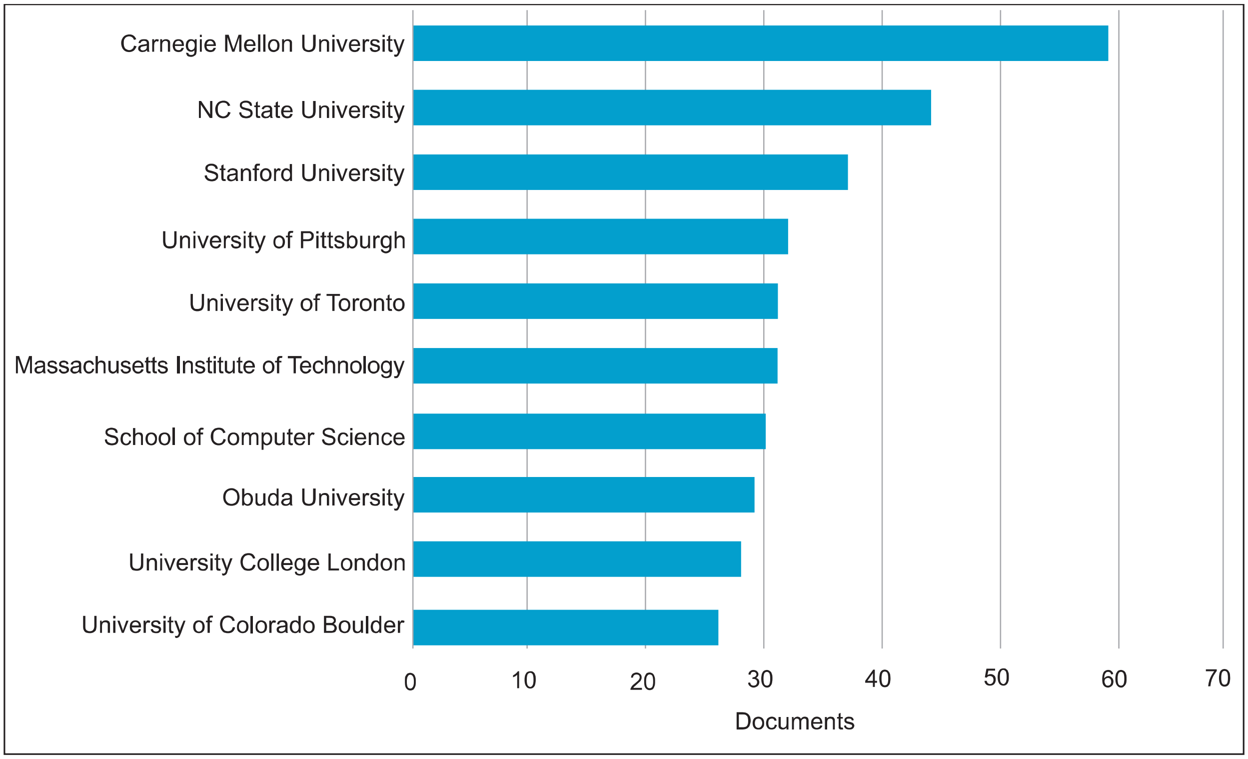

Figure 2: Number of publications by affiliation (***Source:*** Authors)

6.1. Carnegie Mellon University – Leading Contributor

At the forefront stands Carnegie Mellon University (CMU), with 59 publications, making it the single largest contributor. CMU's leadership is not surprising, given its longstanding global reputation in artificial intelligence, cognitive psychology, and computer science.The university has nurtured pioneers in intelligent tutoring systems, human-computer interaction, and adaptive learning technologies, which directly influence AI-driven science education.CMU's interdisciplinary ecosystemwhere computer science intersects with learning scienceshas positioned it as a global leader in educational AI innovation.

6.2. NC State University – A Strong Second

The second-highest contributor is North Carolina State University (NC State), with 49 publications. NC State is recognized for its practical and applied orientation, integrating AI into STEM education, learning analytics, and instructional design.Its contributions signify how public universities with strong engineering traditions play a crucial role in expanding the impact of AI beyond theoretical innovation into classroom practices and teacher training.

6.3. Stanford University – A Prestigious Third

In third position is Stanford University, with 37 publications.Stanford has been a historic hub for AI research, home to some of the earliest AI laboratories and thought leaders.Its contributions to AI in science education reflect both technical advancements and policy-driven initiatives, reinforcing Stanford's role as a bridge between research, practice, and broader educational reform. We can conclude that while AI in science education is a global movement, its intellectual leadership is concentrated in a few elite research universities. These institutions-Carnegie Mellon, NC State, and Stanford serve as epicentres of innovation, nurturing ideas, technologies, and practices that influence not only local educational systems but also global trajectories of AI integration in learning.

7. Publications by Country in AI and Science Education

When we analyze Figure 3, which represents the country-wise distribution of research publications in AI and science education, we gain critical insight into the global landscape of knowledge production and collaboration. This distribution highlights not only the volume of research activity but also the regional strengths and priorities shaping the field.

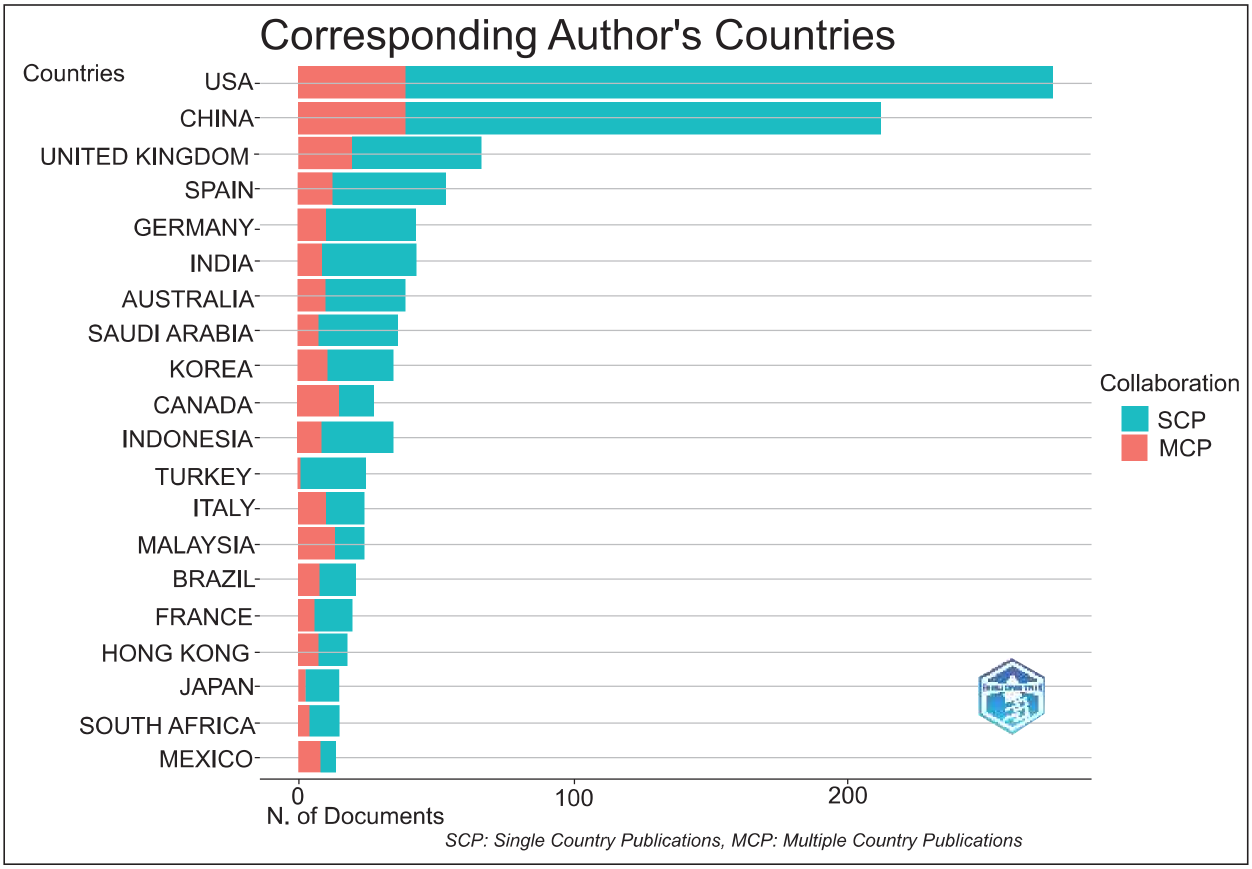

Figure 3: Number of publications by countries (***Source:*** Authors)

7.1. United States – The Global Leader

The United States leads with 1,515 publications by far the largest contribution. This dominance is not surprising, given the country's longstanding investment in AI research, cutting-edge technology infrastructure, and strong academic–industry partnerships. Institutions such as Carnegie Mellon University, Stanford, and MIT have pioneered AI applications in Scienceeducation, ensuring the U.S. remains the epicentre of innovation and experimentation in this domain.

7.2. China – Rapidly Emerging Power

The second rank is held by China, with 627 publications. China's strong performance reflects its massive national investment in AI research and digital education initiatives. ith large-scale pilot projects in AI-driven classrooms, adaptive learning systems, and STEM education, China has positioned itself as a global competitor and a hub for applied AI in education.This trajectory signals rapid growth and long-term strategic emphasis on AI as a driver of educational modernization.

7.3. United Kingdom – A Strong European Contributor

In third place is the United Kingdom, contributing 300 publications. The UK has made significant advances through educational technology research centres and policy-driven initiatives. Its emphasis on ethical frameworks, data privacy, and equitable access to AI tools in education sets it apart as not only a technological but also a thought leader in responsible AI adoption.

7.4. Germany and India – Key Knowledge Hubs

Germany, ranked fourth with 231 publications, reflects Europe's broader commitment to integrating AI into higher education and vocational training. German research emphasizes engineering applications, intelligent tutoring systems, and human–computer interaction in learning environments.

India, ranked fifth with 217 publications, demonstrates its growing role in the global AI education ecosystem. With its large population of students, rapid expansion of higher education, and government-backed AI initiatives, India's contributions highlight both capacity building and innovative experimentation, particularly in STEM education and e-learning systems.

While the top five countries dominate, several other nationssuch as Canada, Australia, Japan, South Korea, and France also play significant roles. These contributions highlight international collaboration networks and the diffusion of AI education practices beyond the traditional power centers. This distribution not only reflects where innovation is occurring but also signals future trends in the democratization and diversification of AI applications in education worldwide.

5.8. Most cited countries of AI in Science

The below figure 4 illustrates the distribution of citations across countries, providing insight into the geographical concentration of scholarly impact within the dataset. At the forefront, the United Kingdom emerges as the most cited country, with approximately 6,854 citations, indicating its leading role in producing highly influential research. This prominence may be attributed to strong research infrastructure, international collaboration networks, and high-impact publication outlets. Closely following is the United States, with around 5,811 citations, reaffirming its long-standing dominance in global research productivity and citation impact. The US continues to serve as a central hub for innovation, particularly in interdisciplinary and technology-driven fields. China occupies the third position with approximately 4,595 citations, reflecting its rapidly growing research output and increasing global visibility. This trend aligns with the expansion of research funding and institutional capacity in recent decades. A notable decline is observed after the top three countries. Germany contributes around 2,008 citations, maintaining a strong but comparatively moderate presence within the European research landscape.

The remaining countries Hong Kong (159 citations), Australia (154 citations), Canada (140 citations), Spain (162 citations), India (63 citations), and Turkey (45 citations) demonstrate relatively lower citation counts. These figures suggest either emerging research contributions or more specialized and localized scholarly outputs. From an analytical perspective, the distribution highlights a highly skewed citation pattern, where a small number of countries dominate the global research impact. This aligns with bibliometric principles such as Lotka's Law and Bradford's Law, which describe uneven distributions in scientific productivity and dissemination. Furthermore, the comparatively lower citation count for India suggests a potential gap between research output and global citation visibility, emphasizing the need for increased international collaboration, publication in high-impact journals, and enhanced research dissemination strategies.

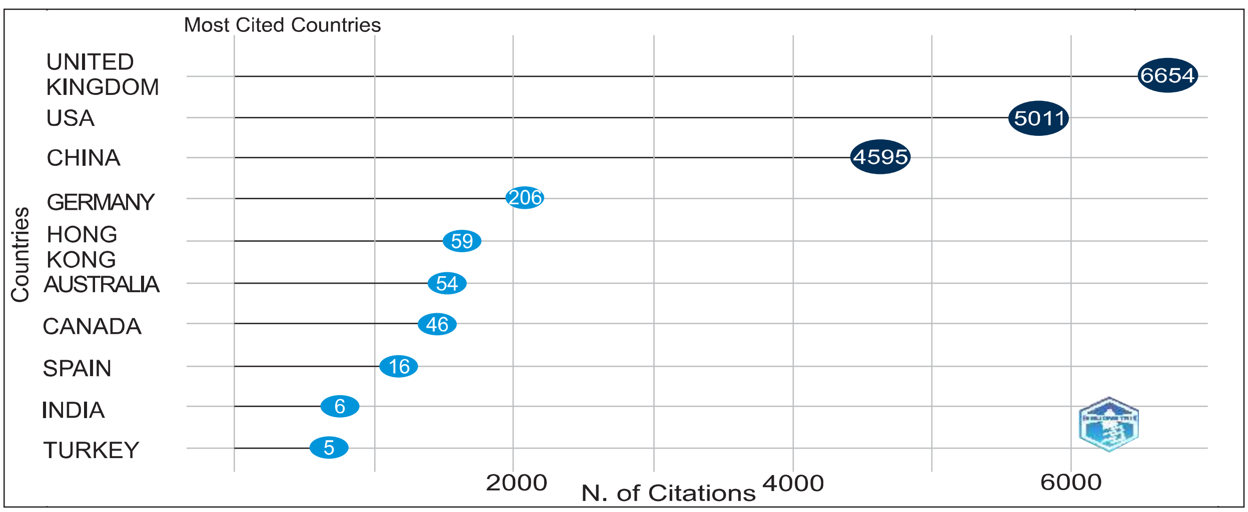

Figure 4: Most cited countries (*Source:* Authors)

5.9. Publications by Funding Sponsor in AI and Science Education

When we turn our attention to Figure 4, which illustrates the role of funding agencies in advancing research on AI in science education, we recognize the critical influence of financial support in shaping the global research landscape. Funding is not merely about numbers it is about enabling ambitious ideas, fostering collaborations, and translating cutting-edge AI technologies into transformative tools for teaching and learning.

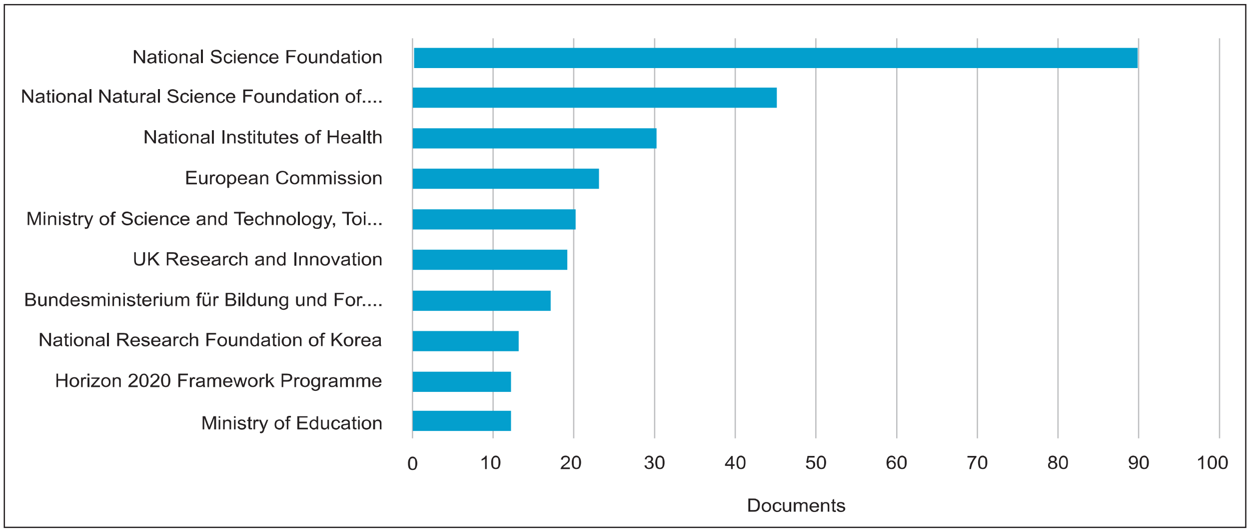

Figure 5: Number of publications by funding sponsors (***Source:*** Authors)

At the forefront stands the National Science Foundation (NSF) of the United States, which has supported 259 publications in this field. The NSF's contribution reflects the U.S. commitment to basic and applied research in AI and education. It has been instrumental in funding projects on intelligent tutoring systems, adaptive learning platforms, human-AI collaboration in classrooms, and large-scale data-driven educational reforms. This leadership is consistent with the U.S. being the top publishing country, showing how funding and output are directly correlated.

Second in rank is the National Natural Science Foundation of China (NSFC), which has supported 83 publications. The NSFC has strategically aligned funding to national goals, particularly in STEM education, machine learning for pedagogy, and AI-enabled classroom practices. China's rapid growth in AI research reflects not only scientific ambition but also policy-driven momentum, with funding agencies acting as catalysts for innovation. Third in rank is the European Commission, contributing to 80 publications. Unlike national funding bodies, the European Commission's strength lies in fostering multinational, cross-border research collaborations across Europe. Programs such as Horizon 2020 and Horizon Europe have promoted AI in Science education as a priority area, emphasizing equity, digital inclusion, and ethical frameworks. This reflects Europe's distinct approach: balancing technological innovation with societal and cultural considerations.

Beyond these top three, many other funding sponsors play vital roles. For example, the Ministry of Education, which occupies the 10th position with 22 publications, highlights how governmental educational bodies are now taking direct responsibility in shaping the AI-in-Science education agenda. Smaller but significant contributions from regional foundations, private-sector partnerships, and interdisciplinary funding schemes demonstrate that the field is not confined to a handful of large agencies, but rather supported by a diverse ecosystem of sponsors. Finally, the funding sponsors' contribution to AI in science education reveals the indispensable role of financial support in advancing this transformative domain. The National Science Foundation leads as the strongest global supporter, the National Natural Science Foundation of China demonstrates rapid expansion, and the European Commission embodies a model of collaborative investment. Together, these agencies, along with others, ensure that AI in Science education is not just a theoretical construct but a practical reality with global reach and local impact.

CONCLUSION

In conclusion, the scientometric analysis of AI in science education paints a picture of a rapidly expanding, highly collaborative, and multidisciplinary field. The growth in publications, dominance of conference proceedings, leadership by key authors and institutions, and the support of leading funding agencies all signal the vitality of this area. As we look to the future, AI in science education will likely continue to shape pedagogical strategies, learner engagement, and research innovation. It is essential for us as scholars and educators to foster inclusive collaboration, cross-disciplinary integration, and ethical considerations as we embrace the transformative potential of AI.

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