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Overview: The Advantages Of Artificial Intelligence In Education Based On Scopus Data-Based Assessment (2020 – 2026)

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Abstract:
This study aims to analyze the overall picture of the benefits that artificial intelligence brings in education in the period 2020–2026, and identify key research trends and typical contributing countries and authors. The systematic review method is applied according to the PRISMA process, using data collected from the Scopus facility to screen and analyze relevant scientific publications. The results showed that 484 articles met the selection criteria and were included in the analysis. The number of publications tends to increase markedly in recent times. In addition, the study noted the participation of many countries with different levels of interest, while highlighting key research directions and identifying the benefits that AI brings to education. The conclusion shows that AI is becoming an important research direction in modern education, while providing a basis for further research and supporting its application in teaching practice.

Keywords: *AI; intelligent systems; ChatGPT; teaching technology; education*

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I. Introduction

With the impact of the industrial revolution 4.0, especially artificial intelligence (AI) has been increasingly affecting all aspects of life, all professions in society, including the field of education. AI is being widely applied in education, in many aspects including content development, teaching methods, student assessment and communication between teachers and students (Chassignol et al., 2018). AI is transforming education by enabling personalized learning pathways, intelligent tutoring systems (Nalbant, 2021). As a result, AI is increasingly being featured as a strategically valuable tool for education (Seldon & Abidoye, 2018).

Loeckx (Loeckx, 2016) asserts that AI has the potential to reduce academic pressure on teachers and students by creating a more effective learning environment. When combined with digital transformation, gamification, and personalized learning methods, AI becomes a key player, driving the formation of advanced educational solutions in the new era. AI has the potential to revolutionize the way we learn and teach, making learning more personalized, engaging, and effective (Alneyadi et al., 2023). According to Harry et al. (Harry & Sayudin, 2023), the potential of AI in education is clearly demonstrated by its ability to promote teaching and learning efficiency. Specifically, AI-based personalized learning allows learners to access knowledge at the right pace, thereby significantly improving outputs. At the same time, the implementation of intelligent support systems and automated grading tools helps optimize teachers' time budget, while providing feedback indicators with higher accuracy and systematicity than traditional methods. With the help of AI, education can become more accessible and inclusive, allowing learners from all walks of life to access high-quality education.

It can be seen that AI can bring a lot of benefits to education. However, to get the most comprehensive view of the research paper with the aim of providing an overview of the benefits of AI in the current educational context, by analyzing bibliographic records in the Scopus database, it is possible to extract valuable information about the collaborative network and research interests of scholars in the field of AI and education around the world. In the study focused on the following questions:

Q1. How many research-related publications were there in each year, between 2020 and March 2026?
Q2. What are the prominent keywords related to the research problem?
Q3. Which countries have a lot of research on the advantages of AI and the links between countries in the research on the advantages of AI in education?
Q4. What are the most cited articles on the advantages of AI in education?
Q5. What key advantages are identified in the research literature on the advantages of AI in education?

The research paper is structured into the following sections: Part 1) giving the reasons for the study, part 2) Describing the method used in the study, part 3) Presenting the relevant research results and discussion, and finally the conclusion.

II. Materials And Methods

Data source and procedure

This study used the bibliographic co-citation method. Simultaneous citation analysis in bibliography is a technique for mapping the intellectual structure of a field of study by reviewing which documents (or authors, or journals) are frequently cited together in reference lists of later publications. Core idea: when two works appear together several times in the bibliography, they are said to share a conceptual or thematic relationship — even if neither works directly cites the other (Mustafee et al., 2010; Surwase et al., 2012)**.** Bibliometric co-citation analysis serves as a fundamental methodology for mapping the intellectual structure and cognitive development of scientific disciplines (Surwase et al., 2012). This technique groups together papers that are frequently cited in pairs, enabling researchers to visualize specialized research areas and science as a whole through clustering and multidimensional scaling techniques (Surwase et al., 2012). Modern bibliometric analysis has evolved with sophisticated tools like VOSviewer, CiteSpace, and Bibliometrix, which provide diverse capabilities for analyzing large datasets and identifying influential authors, collaboration networks, and emerging research trends (Kumar, 2025).

With this study, the data source from Scopus was selected. Scopus represents a significant value proposition for the research community as the world's largest curated abstract and citation database, providing high-quality bibliometric data through rigorous content selection processes overseen by an independent advisory board (Baas et al., 2020; Schotten et al., 2017). The database offers comprehensive coverage of scientific journals, conference proceedings, and books from over 5,000 publishers worldwide, with extensive author and institution profiles created through advanced algorithms and manual curation (Schotten et al., 2017). Scopus enables high-value research decisions and supports various applications including national research assessments, university rankings, and research landscape studies (Meester, 2023; Schotten et al., 2017). Recent innovations like Scopus AI demonstrate the platform's evolution, accelerating research processes by synthesizing evidence and helping researchers identify influential works, explore keywords, and discover research gaps, despite some limitations in concept simplification (Aguilera-Cora et al., 2024). The database's trustworthiness has established it as a primary data source for quantitative science studies and bibliometric analyses (Baas et al., 2020).

All searches were performed on the Scopus database in March 2026, and the data needed for bibliographic analysis was subsequently collected. The search strategy includes identifying all materials containing the terms “artificial intelligence” and “advantages” and “education”.To ensure updates, the search timeframe is limited between 2020 and 2026. In addition, the search parameters are limited to the English language, research in the form of articles, at the final stage of publication, and open access data to ensure the wide applicability of the research content.

Analytical methods and software

This study uses bibliometric analysis combined with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) process to systematically identify, screen, and analyze research works related to artificial intelligence in education. The research process consists of five main stages: data source identification, suitability screening and evaluation, data extraction, bibliographic visualization – analysis, and interpretation of results.

Stage 1. Identification of data sources: The research data were collected from the Scopus database, one of the major scientific databases, and widely used in academic studies. A pre-built search strategy for retrieving works related to artificial intelligence in education. Initial search results obtained 3,009 materials, including books, book chapters, journal articles, and conference articles, published between 2020 and March 2026.

Stage 2. Screening and conformity assessment (PRISMA procedure): After the data identification phase, the dataset is screened according to a number of criteria to ensure the suitability and quality of the selected works. Those criteria include:

+ Publication time: 2020 – 2026 with 2,546 documents found.
+ Type of document: Article has 1,015 documents found.
+ Publication status: Final has 958 documents found.
+ Language: English has 866 documents found.
+ Accessibility: Open access (gold) has 484 documents found.

After the screening process according to the above criteria, 484 articles fully met the requirements and were selected for the next analysis steps.

Stage 3. Data extraction: From the selected set of 484 articles, important bibliographic information is extracted, including author name, article title, source of publication (journal), country of publication, number of

citations, and other relevant bibliographic indicators. These data form the basis for conducting further bibliographic analyses.

Stage 4. Analyze and visualize bibliography: The bibliographic analysis is performed using VOSviewer software, which allows the construction and visualization of bibliographic networks. The study focused on a number of important indicators such as co-occurrence, co-citation, and citation linkages between works. In addition, the Wordcloud tool is also used to visualize the frequency of keywords, thereby helping to better identify outstanding research topics.

Stage 5. Interpretation of results: The analysis results are synthesized and interpreted through tables, graphs, and network diagrams generated from VOSviewer and Wordcloud software. These visual representations help clarify research trends, influential works, and key thematic clusters about the benefits that the field of artificial intelligence brings to education in education.

III. Results

Summary Statistics

Data analysis from 484 publications (a total of 9545 citations) reveals the diversity of the academic network on AI in education. The study sample includes contributions from 158 authors, 160 organizations, and 159 journals, using a system of 5306 specific keywords. With an average of 19.7 citations per article and participation from 96 countries, the data demonstrates the international appeal of this topic. Among them, the work of Kamalov et al. (Kamalov et al., 2023) plays a central role with 689 citations, leading in terms of influence within the sample.

How many publications related to the study were there in each year, from 2020 to March 2026?

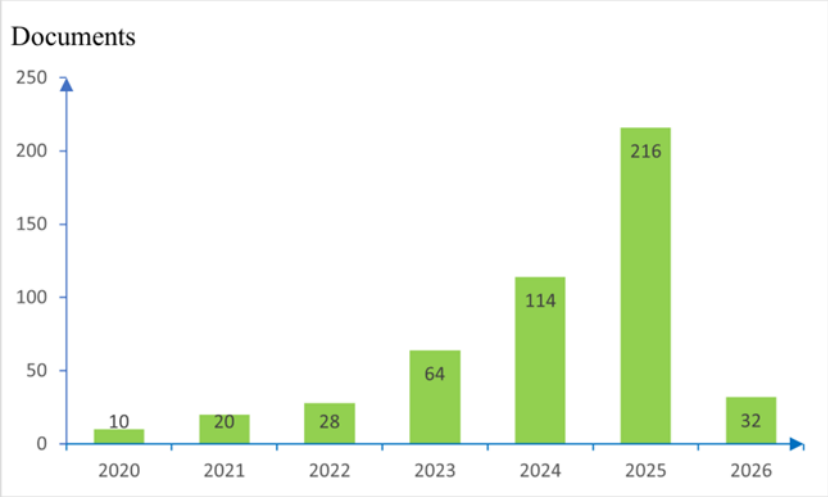

Figure 1. Total of studies by year

The number of research works in this field tends to increase markedly over time. Specifically, in the period 2020-2022, the number of publications is still low and increasing slowly, reaching 10 articles (2020), 20 articles (2021) and 28 articles (2022), respectively. This shows that the field of research in the early stages has not attracted much attention from the scientific community. From 2023, the number of publications began to grow strongly, reaching 64 articles, more than twice higher than in 2022. The upward trend continued in the following years, with 114 posts in 2024 and a peak of 216 posts in 2025. This rapid increase reflects the increasing level of interest among researchers, and shows that the field has become a prominent and topical research topic in recent years. By 2026, the number of publications recorded 32 articles, lower than in 2025. However, this decrease can be explained by the incomplete 2026 data at the time of collection, thus not fully reflecting the total number of works published throughout the year. Figure 1 shows that the research topic is increasingly attracting the attention of the academic community and has the potential to continue to expand in the following years.

What are the prominent keywords related to the research problem?

To determine which keywords are most prominent in relation to the research on the benefits of AI for education, Wordcloud software was used. Based on Figure 2, it can be seen that artificial intelligence and education keywords with the largest font size show the most frequency, other keywords with smaller font sizes appear with lower frequency. Thereby, it is possible to see a broad picture of the strong intersection between artificial intelligence technology and practical areas, in which education plays a leading role.

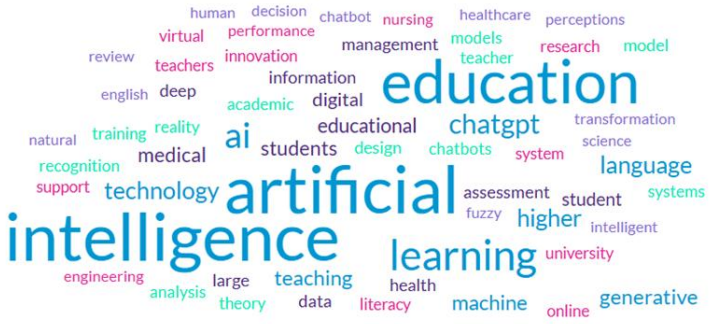

Figure 2. Visual representation of the Co-occurrence network of keywords in publications related to the advantages of AI in education. Source: Analysis results obtained with Wordcloud software

In order to study more clearly the relationship between keywords and research topics, this content is also shown by Figure 3, a co-occurring keyword network map built with VOSviewer software to clarify the structure and research topics in the field of artificial intelligence. In this network, the size of the node reflects the frequency of keyword occurrences, the links denote the co-occurrence relationship between keywords in scientific works, while the colors of the nodes represent different research topic clusters. The analysis results show that the keyword "artificial intelligence" is at the center of the network with the largest number of links, showing that this is the core topic connecting many different research directions.

Based on VOSviewer's clustering algorithm, keywords are divided into several main topic clusters. The red cluster focuses on research related to the application of artificial intelligence in education, with typical keywords such as chatgpt, chatbots and artificial intelligence in education, reflecting the new research trend of integrating artificial intelligence tools in teaching activities. The yellow cluster associated with the topic of education and the teaching-learning process, including keywords such as education, teaching and learning and sustainability, shows the role of AI in supporting and innovating educational methods. The green cluster refers to the medical field and medical education, with keywords such as medical students, healthcare and systematic review, showing the trend of AI application in health workforce training and medical research.

In addition, the purple cluster focuses on the core methods and techniques of artificial intelligence, including machine learning, deep learning, and virtual reality, which serve as the technology foundation for many AI applications in education. The blue cluster reflects the research direction of educational technology and generative AI, with keywords such as educational technology, generative artificial intelligence and AI literacy, emphasizing the development of AI capabilities in the learning environment. In addition, the light blue cluster relates to natural language processing and large language models, including keywords such as natural language processing, large language models, and chatbots, which are important technological platforms for the development of conversational AI systems.

In general, the close link between the clusters of topics shows that the field of research in artificial intelligence in education is highly interdisciplinary, combining computer science, educational technology and other fields of application. At the same time, the prominence of keywords such as ChatGPT, generative artificial intelligence and large language model also reflects new research trends that are attracting a lot of interest in recent years.

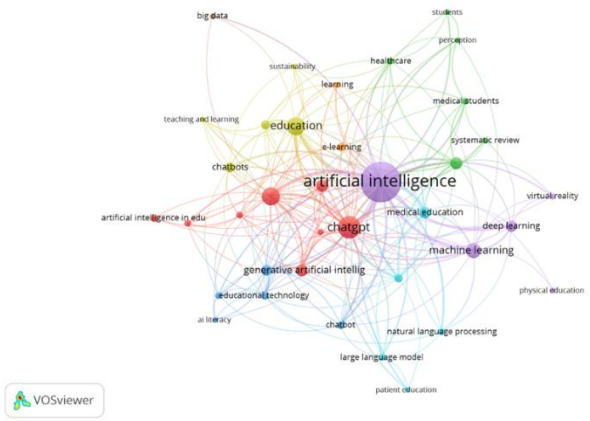

Figure 3. The countries concerning the production of research papers in advantages of AI in education

Which countries have a lot of research on the advantages of AI and the links between countries in the research on the advantages of AI in education?

This content is shown in Figure 4. It is not difficult to recognize the research problem related to the benefits that AI brings to education that is of great interest to many countries around the world. In which, the darker the color, the more research the country has and vice versa. Based on Figure 4, it can be seen that China is the country with the most research in this field. Countries in different continents also have different levels of research, of which Africa is the continent with few countries publishing articles related to this field.

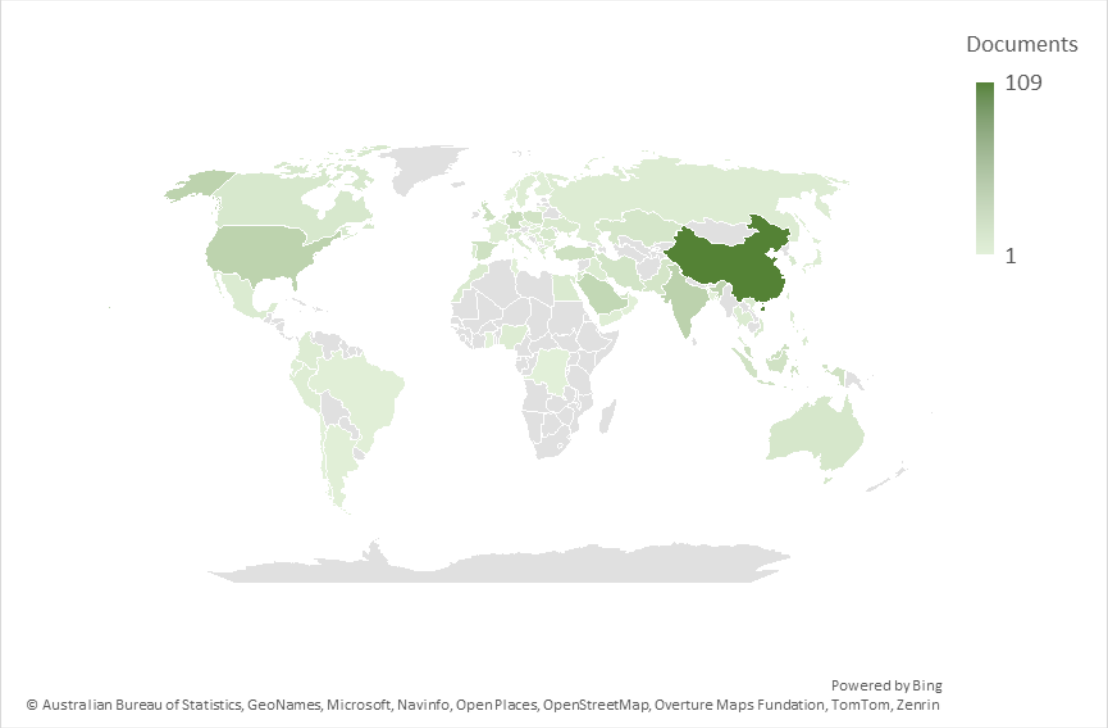

Figure 4. ***The countries concerning the production of research papers in advantages of AI in education***

Besides considering the distribution of studies by country, Table 1 below more clearly shows the number of publications related to the advantages of AI in education in the top 30 countries.

Table 1. List of 30 countries with the most published publications related to research content in the period 2020 – March 2026

Country	China	India	United States	Saudi Arabia	Germany	Malaysia	United Kingdom	Spain	Turkey	Indonesia
Documents	109	30	29	25	20	18	17	16	16	15
Country	Poland	United Arab Emirates	Iran	Pakistan	South Africa	Kazakhstan	Australia	Jordan	Canada	Romania
Documents	14	14	13	12	12	11	10	10	9	9
Country	South Korea	Ukraine	Egypt	Greece	Italy	Morocco	Philippines	Portugal	Taiwan	Viet Nam
Documents	9	8	7	7	7	7	7	7	7	7

Based on the table, it can be confidently stated that China is the country with the most contributions to the research field (109 publications), followed by India with 30 publications, 3.6 times fewer than the leading country. The United States is in third place with 29 publications, one less than India, and China has 80. Subsequent countries have fewer publications. From the top 30 countries with the most publications related to research, it's easy to see that Asia has the most countries in the ranking. This also demonstrates the Asia-Pacific region's strong interest in the benefits of AI for education.

In addition to considering which country has the most published research-related publications, the relationship or collaboration between countries in research is also taken into account. Figure 5 below clearly illustrates the research linkages between countries.

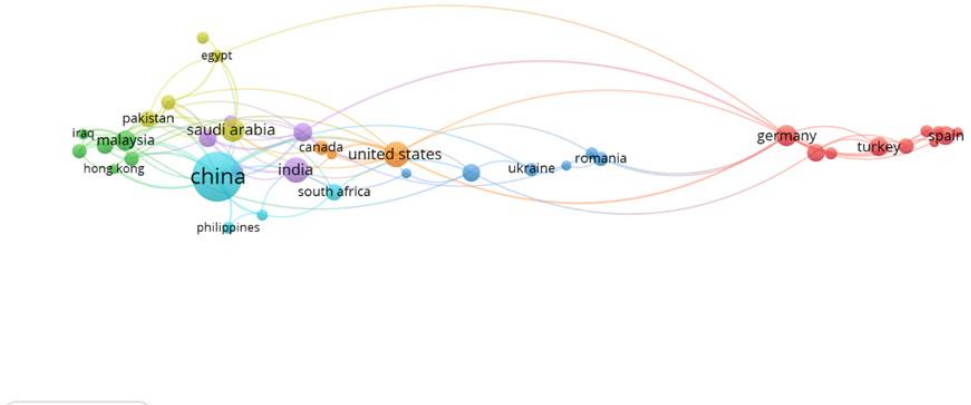

Figure 5. Network Visualization of Country Research

The analysis results show that China is the country with the largest node size and located at the center of the network, showing that it is a country with a large number of publications and a high level of international cooperation in this field of research. China has many links with other countries such as the United States, India, Malaysia, Pakistan and Saudi Arabia, reflecting its important role in promoting international research cooperation activities. Besides, the United States is also an important center of cooperation in the network, with many links with countries such as Canada, Ukraine, Romania and South Africa. This shows that the United States plays a connecting role among many different groups of countries in the global research network.

Analysis by color clusters shows that the national cooperation network is divided into several main groups. The green cluster includes countries such as Malaysia, Iraq and Hong Kong, representing a group of countries with relatively close cooperation in the Asian region. The yellow cluster includes Pakistan, Saudi Arabia and Egypt, reflecting research collaboration in the Middle East and South Asia. The purple cluster consists of India and Canada, showing research links between countries of different regions. The blue cluster includes the United States, Ukraine, Romania, and South Africa, representing a network of research collaborations spanning multiple geographies. Meanwhile, the red cluster consists of Germany, Turkey and Spain, reflecting the group of European countries with relatively close research cooperation.

Meanwhile, the red cluster consists of Germany, Turkey and Spain, reflecting the group of European countries with relatively close research cooperation. In particular, China and the United States play an important role as connection centers, contributing to the development and spread of research in the field of artificial intelligence on a global scale.

What are the most cited articles on the advantages of AI in education?

Table 2 lists the 10 most cited papers. Based on Table 2, it can be seen that the majority of the works published in the period 2021-2023, of which 2023 accounted for an overwhelming proportion, reflecting the rapid increase of research related to artificial intelligence, especially generated AI technologies such as ChatGPT in education and related fields. Among the listed works, the paper "New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution" (Kamalov et al., 2023) has the highest number of citations with 689 citations, showing the significant influence of this study on the academic community. Next is "Chatbots in Education and Research: A Critical Examination of Ethical Implications and Solutions" (Kooli, 2023) with 501 citations, focusing on ethical issues and solutions when applying chatbots in education and research. In addition, the article "The dark side of generative artificial intelligence: A critical analysis of controversies and risks of ChatGPT" (Wach et al., 2023) also received 491 citations, showing the researchers' significant interest in risks and challenges related to artificial intelligence.

Table 2. Top 10 papers with the highest citations about advantages of AI in education

No.	Documents	Year	Total cites
1	New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution (Kamalov et al., 2023)	2023	689
2	Chatbots in Education and Research: A Critical Examination of Ethical Implications and Solutions (Kooli, 2023)	2023	501
3	The dark side of generative artificial intelligence: A critical analysis of controversies and risks of ChatGPT (Wach et al., 2023)	2023	491
4	Developing a model for AI Across the curriculum: Transforming the higher education landscape via innovation in AI literacy (Southworth et al., 2023)	2023	464
5	Artificial Intelligence in Education: AIEd for Personalised Learning Pathways (Tapalova & Zhiyenbayeva, 2022)	2022	418
6	AI-generated feedback on writing: insights into efficacy and ENL student preference (Escalante et al., 2023)	2023	369
7	Machine Learning in Chemical Engineering: Strengths, Weaknesses, Opportunities, and Threats (Dobbelaere et al., 2021)	2021	272
8	ChatGPT applications in medical, dental, pharmacy, and public health education: A descriptive study highlighting the advantages and limitations (Sallam et al., 2023)	2023	229
9	Effect of Artificial Intelligence Tutoring vs Expert Instruction on Learning Simulated Surgical Skills Among Medical Students: A Randomized Clinical Trial (Fazlollahi et al., 2022)	2022	169
10	Challenges for higher education in the era of widespread access to Generative AI (Walczak & Cellary, 2023)	2023	156

Analysis of other articles can show that the works with a high number of citations focus on three main research directions: (i) overview analysis and impact of artificial intelligence in education; (ii) research on ChatGPT and generative AI, including benefits, challenges and ethical issues; and (iii) specific application of AI in teaching and specialized training. This shows that artificial intelligence is becoming one of the central research topics in the field of education, and reflects the growing interest of the scientific community in exploiting modern AI technologies in teaching and learning.

What key advantages are identified in the research literature on the advantages of AI in education?

From the 10 most cited articles, the authors researched and analyzed the benefits of AI in education. Table 3 shows that AI is currently considered to offer many benefits to education. The authors categorized the specific benefits of AI in education and analyzed in detail which studies demonstrated these benefits.

Table 3. The main advantages identified in the research literature about advantages of AI in education

Specific advantages criteria	Detailed description of advantages	Related studies
Personalize your experience	AI analyzes learning styles, individual needs to provide individual learning pathways, instructional materials, and feedback to individual students,…It allows the learner to progress at his or her own pace.	1) New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution (Kamalov et al., 2023) 2) Artificial Intelligence in Education: AIEd for Personalised Learning Pathways (Tapalova & Zhiyenbayeva, 2022) 3) Chatbots in Education and Research: A Critical Examination of Ethical Implications and Solutions (Kooli, 2023) 4) ChatGPT applications in medical, dental, pharmacy, and public health education: A descriptive study highlighting the advantages and limitations (Sallam et al., 2023)
Increased productivity and management efficiency	Automate tedious, repetitive administrative tasks such as planning, drafting emails, and organizing schedules,… This saves the instructor considerable time to focus on the more complex intellectual tasks,	1) Challenges for higher education in the era of widespread access to Generative AI (Walczak & Cellary, 2023) 2) New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution (Kamalov et al., 2023) 3) Chatbots in Education and Research: A Critical Examination of Ethical Implications and Solutions (Kooli, 2023) 4) AI-generated feedback on writing: insights into efficacy and ENL student preference (Escalante et al., 2023)
Automate reviews and feedback	AI has the ability to score automated tests and provide immediate, detailed feedback, helping students recognize errors immediately. These systems also assist in detecting cheating in examinations	1) Kamalov et al. (2023),; Fazlollahi et al. (2022); Escalante et al. (2023); Tapalova & Zhiyenbayeva (2022). 2) New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution (Kamalov et al., 2023) 3) Effect of Artificial Intelligence Tutoring vs Expert Instruction on Learning Simulated Surgical Skills Among Medical Students: A Randomized Clinical Trial (Fazlollahi et al., 2022) 4) AI-generated feedback on writing: insights into efficacy and ENL student preference (Escalante et al., 2023) 5) Artificial Intelligence in Education: AIEd for Personalised Learning Pathways (Tapalova & Zhiyenbayeva, 2022)
Intelligent tutoring system	Provide 24/7 virtual tutors for dialogue, explain difficult concepts, and support students to	1) Kamalov et al. (2023); Fazlollahi et al. (2022); Tapalova & Zhiyenbayeva (2022); Sallam et al. (2023).

	practice in a simulated environment (such as medical or language),…	2) New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution (Kamalov et al., 2023) 3) Artificial Intelligence in Education: AIEd for Personalised Learning Pathways (Tapalova & Zhiyenbayeva, 2022) 4) ChatGPT applications in medical, dental, pharmacy, and public health education: A descriptive study highlighting the advantages and limitations (Sallam et al., 2023)
Increase global accessibility	Breaking down geographical and language barriers through online platforms and instant translation makes high-quality education more accessible in remote areas or developing countries,…	1) Kamalov et al. (2023),; Walczak & Cellary (2023); Kooli (2023). 2) New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution (Kamalov et al., 2023) 3) Challenges for higher education in the era of widespread access to Generative AI (Walczak & Cellary, 2023)
Fostering creative thinking and ideas	Serving as a source of inspiration and a starting point for logical analyses, helping students explore new approaches to problems and develop their imagination,…	1) Challenges for higher education in the era of widespread access to Generative AI (Walczak & Cellary, 2023) 2) AI-generated feedback on writing: insights into efficacy and ENL student preference (Escalante et al., 2023)
21st Century Career Skills Preparation	Helping students become familiar with new technological tools, enhance digital competence and adaptability to succeed in the labor market of the future that is being shaped by AI,…	1) Southworth et al. (2023),; Walczak & Cellary (2023); Wach et al. (2023). 2) Developing a model for AI Across the curriculum: Transforming the higher education landscape via innovation in AI literacy (Southworth et al., 2023) 3) Challenges for higher education in the era of widespread access to Generative AI (Walczak & Cellary, 2023) 4) The dark side of generative artificial intelligence: A critical analysis of controversies and risks of ChatGPT (Wach et al., 2023)

Based on the synthesis of the studies in Table 3, it can be recognized that artificial intelligence (AI) brings many outstanding benefits to the field of education. First of all, AI contributes to personalizing the learning process by adapting the content and learning pathways to suit the needs, style and learning speed of each learner. Adaptive learning systems are capable of analyzing learning data to suggest appropriate content, helping learners consolidate their knowledge before moving on to new topics. In addition, AI also enhances the performance of lecturers by automating many administrative and assessment tasks, such as grading, document drafting or classroom management, thereby giving lecturers more time to focus on teaching and supporting learners.

In addition, AI is capable of providing instant and detailed feedback, helping learners quickly identify errors and adjust learning strategies. AI tools can also act as intelligent tutoring systems, supporting one-on-one interactive learning and providing 24/7 ongoing support, especially useful in explaining complex concepts or simulating real-life situations. At the same time, the integration of AI in education also promotes creative thinking and the development of digital competence, helping learners improve their technology skills and better prepare for the labor market in the digital era. Finally, AI contributes to expanding access to education, overcoming geographical, economic and linguistic barriers, thereby facilitating the provision of quality learning opportunities for a variety of audiences and promoting equity in education.

IV. Discussions

The results show that the number of scientific publications related to artificial intelligence (AI) in education has increased significantly in recent years, especially after 2020. This trend reflects the growing interest of the academic community in the application of AI to innovate teaching methods and improve educational efficiency.

Keyword network analysis shows that the term “artificial intelligence” plays a central role and is closely linked to many other research topics such as machine learning, generative artificial intelligence, chatbots , educational technology and medical education. This shows that research in AI in education is developing in an interdisciplinary direction, combining information technology, data science and educational science to exploit the potential of AI in supporting learning, personalizing education and improving teaching efficiency.

The findings of this study are similar to the results of many previous works. Studies have shown that AI can effectively support the learning process through personalizing the learning path, providing automated feedback, and supporting data-driven decision making. At the same time, the development of generative AI tools such as ChatGPT has opened up many new research directions related to the use of chatbots and large language models in supporting learning, academic writing and scientific research. In addition, the analysis results also show that AI is being applied strongly in a number of professional training areas, especially medical education, where simulation technologies and intelligent tutoring systems can support students' professional skills and clinical decision making. However, along with those benefits, some studies also highlight potential challenges and risks when applying AI in education, including issues related to academic ethics, algorithm transparency, and the risk of over-reliance on technology. This shows that AI research in education needs to be approached in a balanced way between exploiting technology benefits and managing the social-educational impacts of AI.

From an academic and practical perspective, the results of this study have some important implications. First of all, the rapid increase of AI research in education shows the urgent need to integrate AI into the training and development of digital competence for learners. Educational institutions should focus on developing training programs in AI literacy, helping students understand how AI tools work, the potential and limits of learning and career. In addition, the results of keyword network analysis show that AI has the potential to be applied in many different training fields, from general education to higher education and specialized training. Therefore, education managers and lecturers should consider properly integrating AI into teaching activities to improve learning efficiency while ensuring the central role of learners and lecturers in the educational process.

However, there are certain limitations to this study. First, research data is only collected from the Scopus database, so it may not fully cover all related research published in other databases such as Web of Science or Google Scholar. Second, bibliometric analysis mainly focuses on the quantitative characteristics of scientific publications, such as the number of articles, citations, and keyword networks, so it cannot fully reflect the content and academic quality of each study. Third, the results of keyword network analysis depend on how the author selects and uses keywords in the paper, which in turn can influence the identification of research topic clusters. Therefore, future studies can expand the range of data by combining many different databases, while using more qualitative or content analysis methods to gain a deeper understanding of AI trends and impacts in education.

Overall, the research results show that artificial intelligence is playing an increasingly important role in the educational innovation process. Continuing to research and apply AI responsibly and sustainably will contribute to improving the quality of education, expanding knowledge access opportunities, and promoting the development of smart education models in the future.

V. Conclusions

This study analyzed trends and characteristics of scientific publications related to the application of artificial intelligence (AI) in education based on data from the Scopus database using bibliographic analysis. The results show that this field of study is developing rapidly and is increasingly attracting the attention of the academic community globally. The research topics focus mainly on exploiting the potential of AI in supporting teaching, developing educational technologies and expanding the application of AI in various training fields. The findings of the study contribute to providing an overview of the knowledge structure and development trends of the field of AI in education, thereby helping researchers and education managers identify key research directions as well as the potential application of AI in teaching and training.

However, since the scope of the data is limited to the Scopus database and the analysis method is mainly based on quantitative indicators, future research needs to expand the data source and incorporate other analysis methods to provide a more comprehensive view of the development and impact of AI on education.

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