

Research trends in AI for inclusive education: a bibliometric analysis

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Abstract

Purpose – This study reviews documents and analyzes features of a knowledge base represented by AI-inclusive education through bibliometric analysis. The intention is to shed light on research subjects, theoretical frameworks, and publication trends in AI-inclusive education. The results will support the advancement of AI-powered inclusive education systems and aid in closing comprehension gaps.

Design/methodology/approach – The findings reveal the primary study topics and their theoretical underpinnings, promoting further development of AI-driven solutions for inclusive education.

Findings – According to the report, AI-inclusive education is fueled by technological breakthroughs, but it is imperative to integrate these tools with efficient teaching strategies.

Originality/value – To ensure that AI technology effectively promotes inclusive education, future research must address the difficulties of integrating AI into various educational settings and for various user groups.

Keywords Artificial intelligence, AI, Inclusive education, AI-Inclusive education, Bibliometric analysis

Paper type Literature review

1. Introduction

Artificial intelligence (AI) has sparked transformative opportunities across various aspects of human life, driven by rapid technological advancements. While AI tools often garner attention, critiques also arise, highlighting issues such as algorithmic biases, privacy risks, accountability challenges, and concerns about equity and inclusion. AI, as a versatile technology, is anticipated to transform numerous sectors, including advertising, agriculture, criminal justice, education, finance, health, marketing, science, security, and transportation (OECD, 2019). Its benefits in these areas include more efficient decision-making, cost reduction, and better resource distribution.

As every aspect of public life becomes increasingly digital, educational systems are asked to design models that provide students with the values, attitudes, abilities, and information necessary to build a more unified, inclusive, and productive world (Van der Vlies, 2020). This request includes expectations for social, ethical, and emotional skills in addition to technological ones (Zawacki-Richter *et al.*, 2019). The swift progress of AI in education is transforming traditional views on teaching and learning (De-Arteaga *et al.*, 2019). In the upcoming years, traditional learning models and approaches will probably shift drastically (Young, 2023; Chen *et al.*, 2022). Recent advancements in AI, including Large Language Models and ChatGPT, have exerted widespread influence across various sectors of society, including education (Lee *et al.*, 2023; Peters *et al.*, 2023; Zhai, 2023). Research on AI in education (AIED), including intelligent tutoring systems, automatic scoring, and sentiment



analysis, has attracted significant attention in recent years (Chen *et al.*, 2022; Prahani *et al.*, 2022). These advancements in AI have offered increasing opportunities to enhance the quality and efficiency of educational practices (Chen *et al.*, 2022; Zhai, 2023), possessing the potential to revolutionize future educational paradigms. Although important challenges remain, especially in implementation and adoption, AI consistently demonstrates a strong ability to address gaps in education and assist both teachers and students through more personalized and effective approaches (Young, 2023).

Ogan *et al.* (2015) stated that a significant issue is that intelligent systems often underperform when used in learning scenarios that are culturally different from their original context. According to reports, several stakeholders are skeptical that AI in education can be inclusive, even though there are many well-known misconceptions about the technology, including that it is too hard to understand, should not be trusted (particularly in the education sector), or that it will alter the role of the employee (in this case, the teacher) (European Commission, 2022). Conversely, if AI is designed with the right pedagogical and technological expertise, it can ensure access and inclusivity (European Commission, 2022). Despite this potential, its impact on education has been slower to emerge than in other fields, highlighting ongoing significant challenges. This slow progress is largely due to the complexity of educational systems, where technology alone rarely drives substantial change without the support of professional development, better learning resources, and innovative teaching strategies (Lee *et al.*, 2023; Peters *et al.*, 2023). The real impact depends on educators' perceptions and how they integrate technology with appropriate pedagogies. Therefore, studying the evolution of innovative technologies like AI can provide valuable insights for research and practice, helping to develop new pedagogies and materials that address educational needs (Zhai, 2023). Therefore, AI could have a significant impact on education systems, particularly in terms of equity and inclusion. This paper examines debates about the relationship between AI, equity, and inclusion in education. It explores the opportunities and challenges presented as AI tools transform the educational landscape, aiming to foster a meaningful discussion on maintaining equitable and inclusive education in the face of AI advancements.

In order to celebrate diversity, encourage involvement, and remove obstacles to learning and participation for everyone, UNICEF (2014) characterizes inclusive education as “a dynamic process that evolves continuously based on local culture and context, < . . . >.” Furthermore, the theory of inclusive education focuses on determining the best ways to adapt to a particular and changing context, that is, a novel and particular circumstance that one must adjust to by creating structures, methods, tools, projects, and other protocols (Kohout-Diaz, 2023). The idea behind inclusion education is that everyone should be able to improve their skills and abilities, get the help they need, and have success in school, social, cultural, or other activities without being judged (Mohammed and Watson, 2019). Contrary to popular belief, inclusive education originates from changes in more varied and less homogeneous learning communities, extending beyond just special needs. It is essential to focus on the challenges within inclusive education itself, rather than just relying on technology, which can sometimes reinforce outdated or biased teaching resources. Therefore, this paper reviews key topics, including the impact of AI on inclusive education, engagement, and technology integration, to create equitable, accessible, and effective learning environments for all learners.

Many studies, including UNESCO's 2019 report ‘Artificial Intelligence in Education: Challenges and Opportunities for Sustainable Development’ and the 2021 UNESCO Recommendation on the Ethics of Artificial Intelligence, highlight the significance of ethical AI use and international cooperation in transforming education. The 2019 UNESCO report advocates for preventing the “de-humanization” of classrooms by using AI to assist rather than replace teachers and encouraging continuous professional development. The 2021 guidance further emphasizes the importance of human oversight, awareness, and literacy, along with policy measures in education and research. It highlights the need for accessibility, cultural

relevance, and diversity in R&D, especially including voices from the Global South. It also focuses on developing AI tools for captioning, multilingual settings, and participatory design to support learners with disabilities. The [UNESCO \(2025\)](#) competency framework highlights the shift towards human-centered education, emphasizing interaction, empathy, cultural diversity, and the protection of rights. It also highlights the importance of preventing algorithmic bias, preserving human agency, and minimizing over-reliance on automation in teaching methods. This paper stresses that, as AI becomes increasingly prevalent in global education, policies often lag behind technological progress. [UNESCO \(2025\)](#) asserts that the right to education should guide the adoption of AI, rather than the other way around, particularly in the context of inclusive education. Without a focus on inclusion, AI might reinforce disparities related to language, location, socio-economic factors, or disabilities instead of reducing them. These resources underscore the importance of inclusive AI integration and international collaboration in educational reform.

Research also emphasizes the practical potential of AI to improve teaching and learning. AI tools have shown a strong ability to tailor educational settings to meet each learner's needs, aiding both academic achievement and personalized curriculum delivery ([Gibellini et al., 2023](#); [Knox et al., 2019](#)). Intelligent tutoring systems, for example, adapt to students' pace, thereby enhancing comprehension and retention by utilizing machine learning algorithms that detect areas of difficulty and provide targeted feedback ([Carbonell Bernal and Hernández Prados, 2024](#)). As observed by [Khine \(2024\)](#), AI further supports the creation of accessible learning materials, including image descriptions for students with visual impairments and automatic speech transcriptions for individuals with hearing impairments—thereby promoting genuine classroom inclusion.

Bibliometric reviews evaluate the thematic content, theoretical foundations, and publication landscape within a knowledge domain ([Zupic and Cater, 2015](#)). As AI's role in education expands, there is a growing focus on knowledge transfer and easily measurable skills, often at the expense of more humanistic, dynamic, and less quantifiable qualities ([Chen et al., 2020b](#)). Recent research underscores the swift growth of AIED, as shown by [Guan et al. \(2020\)](#) through a bibliometric analysis. Their findings indicate a surge in scholarly publications, with AIED research diversifying and crossing into various disciplines. Major focus areas now include intelligent tutoring systems, learning analytics, natural language processing, and automated assessment. This rapid expansion demonstrates the increasing acknowledgment of AI's potential to revolutionize education and enhance learning results. Nonetheless, there are few systematic reviews focused specifically on examining AI-driven approaches in inclusive education settings. This study highlights key opportunities and challenges related to AI systems in inclusive education. While it does not list every AI system or tool, many are already in use in schools, with associated opportunities and challenges. This raises the question of whether policymakers should support or regulate these systems via a centralized approach. Although a definitive answer is not yet available, addressing this issue now is essential.

The study aims to consolidate key findings, identify gaps in the literature, and suggest future research directions and strategies that maximize the use of AI without undermining human agency. Specifically, we address the following research questions:

RQ1. What are the global trends in AI-inclusive education research and related subject classifications?

The answer to this question will enable researchers to better analyze AI-inclusive education research's emerging patterns and current landscape.

RQ2. Which researchers and countries have conducted in-depth studies on AI-inclusive education?

The response to this query will enable researchers to identify global partnerships and possible partners for AI-inclusive education studies.

RQ3. What are the most talked-about research subjects and new developments in AI-inclusive education?

Once this question has been answered, scholars can investigate new study areas, research gaps, and possible subjects related to the application of AI-inclusive education.

1.1 Related work

Several comprehensive review studies have examined the application of AI in various educational settings over the years (Chen *et al.*, 2020b, c, 2022d). However, there are not many comprehensive systematic reviews that focus exclusively on the use of AI techniques in inclusive education, even though relevant technologies are increasingly being integrated across various learning disciplines (Salas-Pilco *et al.*, 2022a, b; Mohammed and Watson, 2019; Serholt *et al.*, 2022; Li and Wong, 2022; Song *et al.*, 2024). The UNESCO (2019) report, “Artificial Intelligence in Education: Challenges and Opportunities for Sustainable Development,” emphasizes that the implementation of AI should adhere to the principles of equity, inclusion, and human-centered design. The report highlights that AI should support teachers rather than replace them, enhance accessibility for all students, and accommodate diverse social and cultural contexts in education.

Review studies on AI applications in education have explored their overall progress and specific areas, including AI technologies, disciplinary practices, and regional approaches. For example, Chen *et al.* (2022d) analyzed research themes related to AI in education, highlighting trends and prospects. The authors emphasize that future research should focus more on underrepresented areas, such as the Global South, low-resource learning settings, diverse language groups, and learners with disabilities. Instead of thinking of AI as a replacement for teachers, it should be viewed as a tool to enhance educators’ abilities and promote effective collaboration between humans and machines. For this to work, AI systems must provide clear reasoning and feedback, enabling teachers and learners to understand and trust the results generated by the technology.

Chu *et al.* (2022) aimed to identify and summarize the most influential research on AI in higher education (HE) by analyzing the top 50 most-cited articles on AI in HE indexed in the Web of Science (WoS). They used a technology-based learning model as a framework to explore the implementation of AI in HE. The study highlights the importance of educators and institutions recognizing AI’s role in supporting learning and teaching, extending beyond technological aspects to encompass pedagogy and strategic planning. Similarly, Liang *et al.* (2021) examined studies from the WoS database on the use of AI in language education. Their review highlights gaps in the existing literature, noting that many studies primarily focus on basic skills and technologies, while fewer address complex pedagogical concepts, such as critical thinking and collaborative learning, or explore different contexts. Lastly, the research offers implications and future directions, suggesting an increased focus on broader skills, inclusion of diverse language and learner settings, and the integration of theory, pedagogy, and technology. Huang *et al.* (2021) conducted a study examining the role of AI in language instruction. The authors reviewed 88 empirical studies on augmented reality (AR) and virtual reality (VR) in language learning, published through 2020. Between 2000 and 2019, interest in AI-assisted language learning increased, driven by the availability of larger datasets. Most studies reported positive results, including improved language learning, increased learner motivation, and positive attitudes toward AR/VR tools. Authors point out that many studies target university students, while fewer explore younger learners, K-12 settings, or diverse socio-cultural contexts, such as low-resource areas or multilingual communities. The paper emphasizes the need for teacher training, broader implementation strategies, and studying learner factors such as engagement and satisfaction alongside language performance.

Du (2021) evaluated 1,014 publications from the WoS database between 2010 and 2019 to identify the most common AI technologies and teaching scenarios, highlighting the main themes in AI-enhanced language education. Janeliauskienė *et al.* (2023) analyzed textual data

to find recurring keywords and extract relevant terms, which improved the understanding of AI's specific contributions to language education. Their bibliometric study revealed that English was the most frequently mentioned language in the key terms. The key trends discussed were closely linked to educational technology. [Lee and Liang \(2019\)](#) predicted future educational scenarios in their analysis of AI tools and technologies, suggesting the possibility of employing robot teachers to enhance learning experiences. Their research examined various factors, including the participants, learning environments, application fields, data analysis methods, learner outcomes, teaching methods, the roles of AI robots, and the challenges faced in research.

For instance, [Tang et al. \(2021\)](#) examined papers published between 1998 and 2019 and used co-citation network analysis to examine how AI-enhanced e-learning settings have changed. Similarly, [Song and Wang \(2020\)](#) conducted an analysis of over 8,500 studies on AI in education in recent twenty years, identifying patterns of international collaboration, publication trends, clusters, and shifts in research focus.

Recent bibliometric research highlights the rapid global growth of AI in education (AIED), based on the analysis of 2,038 publications, with leading contributions from China, the United States, the United Kingdom, and Australia ([Zhou et al., 2025](#)). The field is driven by technologies such as machine learning, deep learning, natural language processing, and computer vision, applied in intelligent tutoring systems, automated assessment, and educational robotics. Early studies focused on developing intelligent systems and applying data analytics to core educational challenges ([Song and Wang, 2020](#)). Since 2022, however, AIED has entered a phase of accelerated development, marked by the rise of generative AI tools such as ChatGPT and increasing interest in large language models, STEM education, and educational games. Despite these advances, challenges related to interpretability, contextual adaptation, and educational equity remain significant, requiring further research and critical attention.

While there have been numerous evaluations of AI's advancement in education, none have delved explicitly into AI's role in supporting inclusive education. As inclusive education gains prominence as a burgeoning area of study and application ([Mohammed and Watson, 2019](#)), it is essential to comprehensively review the existing literature to evaluate its current status and developments. Both [Tomlinson \(2012\)](#) and [Ainscow \(2013\)](#) have expressed concerns regarding the potential oversight of certain groups in inclusive education research.

[Lynch et al. \(2024\)](#) conducted a systematic review on how technology aids children with disabilities in primary schools in low- and middle-income countries. Their findings highlight a significant evidence gap, mainly focused on sensory disabilities within specialized schools. They advocate for more inclusive, participatory research that accounts for intersectional factors, such as gender and location, to create technological solutions that meet the needs of all students. Conversely, [Toto et al. \(2024\)](#) examined how emerging technologies impact inclusive teaching, emphasizing educators' experiences with tools such as Assistive Technology, AR, and AI. These technologies show promise in enhancing inclusive education by making learning more effective and engaging, especially for students with disabilities. [Salas-Pilco et al. \(2022a, b\)](#) analyzed 27 studies on AI and new technologies in inclusive education for minority students. Results indicate that these tools enhance accessibility and personalised learning for students from diverse sociocultural backgrounds, although challenges such as limited resources and inadequate teacher training persist.

Building on these findings, the systematic review further shows how AI supports inclusive education by allowing the customization and adaptation of learning environments to cater to each student's needs, a core aspect of inclusive education ([Toyokawa et al., 2023](#); [Patiño-Toro et al., 2023](#)). Technologies like MOOCs and adaptive platforms play a key role in removing communication barriers and providing equitable access to students with disabilities ([Toyokawa et al., 2023](#)). These results align with previous research highlighting AI's contribution to improving accessibility via educational tools tailored to various learning needs ([Gródek-Szostak et al., 2023](#)). While these benefits show promise, their success depends on

overcoming systemic challenges like digital inequality, limited infrastructure access, and the availability of trained personnel. Addressing these factors is essential to ensure AI's potential is realized fairly across different educational settings. [Lin and Chang \(2024\)](#) highlight that access to technological infrastructure and teacher training are crucial prerequisites for optimizing AI benefits. Conversely, our results place less focus on these contextual barriers, indicating that perceptions and priorities might differ by educational setting. This difference underscores the need to customize implementation strategies to fit the unique circumstances of each context.

The adoption of advanced technologies, like humanoid robots, is still limited mainly because of their high costs for both purchase and upkeep ([Monova-Zheleva and Prodanov, 2024](#)). This finding supports other research showing that insufficient training on new tools can prevent teachers from fully utilizing AI to support inclusive learning ([Gibellini et al., 2023](#); [Lin and Chang, 2024](#)). To overcome these barriers, forming public–private partnerships and promoting low-cost tech solutions, such as open-source software, could help close these gaps and enhance AI's role in inclusive education.

Literature suggests that technology plays a vital role in fostering development and inclusion for individuals. While research on AI in education is growing, important studies in the area of AI-inclusive education remain underrepresented in current reviews. It is therefore essential to thoroughly examine how technological tools are utilized to promote inclusion in educational settings. This research seeks to identify, analyze, and synthesize existing evidence on effective practices and technologies that enhance the participation of students with diverse needs. Additionally, it aims to address knowledge gaps and highlight areas for further investigation, guiding future educational innovations. Therefore, this study aims to bridge this gap by examining the intellectual structure and development of AI in inclusive education. This method will help identify the intellectual framework, key research areas, and emerging trends in AI-inclusive education.

2. Bibliometric review method

2.1 Overview

The research seeks to uncover the patterns and trends in publications related to AI-inclusive education using bibliometric analysis. Bibliometric review is distinct among review methods regarding purpose, data, and analytical tools. A bibliometric review aims to document and analyse features of a knowledge base represented by a discipline or a line of inquiry. Bibliometric reviews aim to gain insight into a knowledge base's publication landscape, theoretical structure, and topical composition ([Zupic and Čater, 2015](#)). The document repositories include journal articles, books, book chapters, conference papers, and other sources.

Bibliometric reviews aim to identify trends in “knowledge production” rather than synthesize specific empirical findings or theories from individual studies. This goal guides the review process, which involves the quantitative analysis of bibliographic metadata from a large document database using specialized software ([Van Eck et al., 2010](#)). Consequently, bibliometric reviews, “*introduce a measure of objectivity into the evaluation of scientific literature and hold the potential to increase rigor and mitigate researcher bias in reviews of scientific literature by aggregating the opinions of multiple scholars working in the field*” ([Zupic and Čater, 2015](#)). The analysis incorporated bibliographic data, including keywords and publication citations, to offer a thorough overview.

2.2 Preparing for the review

The preliminary phase of a bibliometric review is analogous to the initial stages of a systematic literature review. The review begins by identifying a pertinent issue about theory, policy, research, or practice and then articulating the research gap. This methodological foundation guarantees a rigorous approach, thus establishing bibliometric reviews as a robust tool for

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2.3 The search process

Bibliometric data were gathered from the WoS database, which includes reputable journals, books, and conference proceedings (Baber *et al.*, 2022). The criteria used for data retrieval are outlined in Table 1.

On December 01, 2024, we conducted a search limited to materials published between January 1, 2020, and December 01, 2024, with the terms for the current research (see Figure 1). The dataset obtained included various document types and details like titles, abstracts, authors, keywords, and cited references. Following the methodologies of similar studies (Song and Wang, 2020), a specific set of parameters was established to identify

Table 1. The search query utilized in the current research

Topic	Terms
Education AND Artificial intelligence PERIOD	“inclusive” OR “inclusive education” “learning” OR “education” “artificial intelligence” OR AI 01/01/2014–25/03/2024

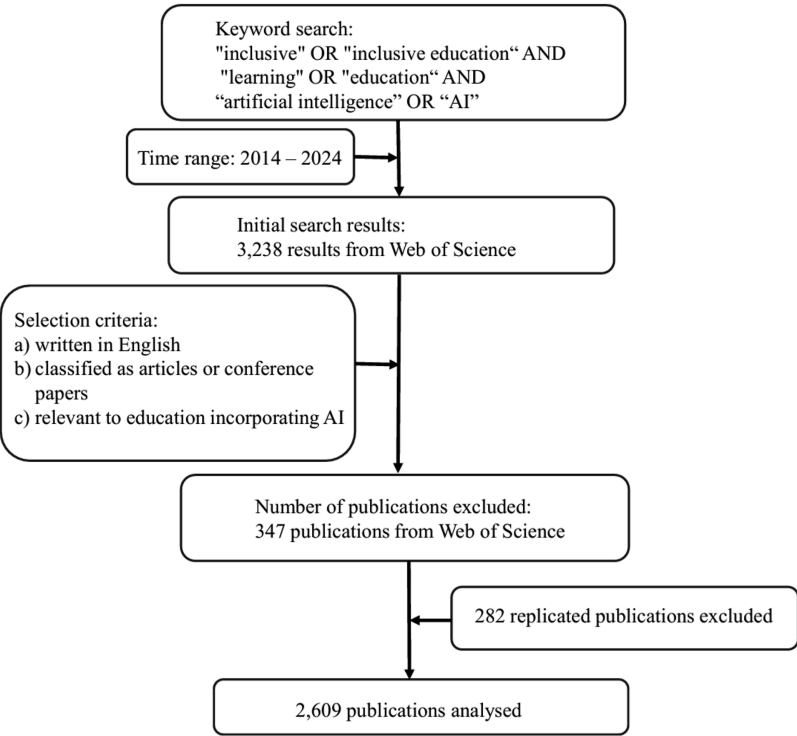


Figure 1. Steps for searching and selecting relevant publications for analysis

appropriate publications for review. In order to qualify, papers must meet all of the following inclusion criteria:

- (1) Written in English;
- (2) Classified as articles or conference papers;
- (3) Relevant to education incorporating AI.

The initial search results were reduced to 3,238 records from WoS, which were then exported from two databases for further screening. Titles and abstracts were reviewed based on specific criteria to exclude irrelevant papers. This process reduced the number of publications to 347 from WoS. Many were excluded because they related to sectors outside education, such as medicine and marketing. After removing duplicates between the two databases, a total of 2,609 publications remained for analysis (see [Figure 1](#)).

2.4 Data analysis

This article showcases different bibliometric analyses performed with VOSviewer software ([Van Eck and Waltman, 2020](#)). [Hallinger \(2023\)](#) noted that VOSviewer is designed to build and visualize bibliometric networks that feature participants such as journals, researchers, or specific publications based on co-citation, bibliographic coupling, or co-authorship connections (p. 11). This software is user-friendly and free, with support from its creators and the user community ([Van Eck et al., 2010](#)).

The analysis is supported by visualizations of bibliometric data, where links illustrate connections or relationships between items. A positive numerical value indicates the strength of each link—the higher the value, the stronger the link. For instance, the link strength may represent the number of shared cited references between two publications (bibliographic coupling), the number of co-authored papers by two researchers (co-authorship), or the frequency with which two keywords appear together in publications (co-occurrence). The occurrences attribute indicates the number of documents that feature a specific keyword ([Van Eck et al., 2010](#)).

[Van Eck and Waltman \(2020\)](#) explained that VOSviewer organizes networks and maps into vibrant clusters of circles, known as nodes, where each circle symbolizes an author or a keyword. The size of an author node reflects the volume of their published works, while keyword nodes expand based on their co-occurrence in documents and the strength of their connections. Lines connecting the nodes illustrate relationships, with thicker lines indicating stronger associations. The colour of each node represents its corresponding cluster. The density visualization map highlights the importance and influence of particular areas. According to [Van Eck and Waltman \(2020\)](#), there are two types of density: item and cluster. Like heat maps, item density maps show item density through colour gradients ranging from blue (representing low density) to yellow (indicating high density), with nodes and clusters represented within this spectrum. Yellow signifies regions with the highest density, whereas blue indicates areas with minimal to no density.

3. Results

To address [RQ1](#), we analyzed the annual publication output and publication output across different categories. We also addressed [RQ2](#) by examining publication output across various geographical areas, author collaborations, and author productivity. To respond to [RQ3](#), we analyzed the keywords and textual data in the dataset used for this study.

Descriptive analyses are commonly used to investigate various aspects of literature, such as the annual growth of publications in the database, the geographic dispersion of the literature, the distribution of subject areas in the documents (e.g. engineering, social sciences), and the institutional affiliation of authors (e.g. universities, research institutes; [Hallinger, 2023](#)).

3.1 Yearly publication output
Analysis of the growth trajectory provides valuable insights into the development and advancement of a particular field or subject over time. These insights can help forecast the future potential for growth in the subject. [Table 2](#) illustrates 598 articles on artificial intelligence-inclusive education between 2020 and 2024. The highest number of publications occurred in 2023 (31.60%) and 2022 (24.40%), followed by 2021 (18.87%) and 2020 (14.87%). This analysis reveals a notable increase in research activity in 2023. The increase is likely related to the widespread adoption and use of generative AI tools, such as ChatGPT, which has sparked academic interest and the development of applications ([Lo et al., 2024](#)). This suggests a fundamental shift rather than a short-term increase, aligning with recent reviews that emphasize AI as a more integral part of pedagogical design, personalized learning, and assessment methods ([Halkiopoulos and Gkintoni, 2024](#)).

Data for 2024, up to December 1, show 62 publications (10.35%). While the publication count remains relatively stable across the years, the higher numbers in 2023 and 2022 indicate a peak in research interest during those years. However, these numbers also suggest no substantial and sustained increase in interest among researchers in this topic during the period under review.

3.2 Publication output across categories
The WoS categories reveal the research into using AI-inclusive education in various areas. [Table 3](#) shows the top ten subject categories that have appealed to researchers in this field. The use of AI-inclusive education has been highly researched within the following categories:

- (1) Computer Science Artificial Intelligence (14.54%);
- (2) Physics Particles Fields (13.54%);

Table 2. Publication counts over the years

Publication year	Record count	% of 598
2024	62	10.35
2023	189	31.60
2022	146	24.40
2021	113	18.87
2020	89	14.87

Table 3. The top 10 categories in WoS represent the highest number of documents

Categories	Record count	%
Computer Science Artificial Intelligence	87	14.54
Physics Particles Fields	81	13.54
Computer Science Interdisciplinary Applications	67	11.20
Education Educational Research	65	10.86
Computer Science Theory Methods	47	7.85
Computer Science Information Systems	43	7.19
Engineering Electrical Electronic	39	6.52
Environmental Sciences	34	5.68
Neurosciences	33	5.51
Green Sustainable Science Technology	26	4.34

- (3) Computer Science Interdisciplinary Applications (11.20%);
- (4) Education Educational Research (10.86%).

The indicated percentages constitute more than 100% because some of the documents are assigned to more than one category in the WoS database. The categories' titles were edited based on their classification in the WoS database.

3.3 Publication output across countries

Reviewing the countries that have contributed publications in this field aids in understanding the geographic spread of articles. According to [Table 4](#), the United States emerged as the top producer of academic papers on AI-inclusive education between 2020 and 2024, generating 13 articles (2.17%). Following closely behind was England, with 8 articles (1.33%), while China, Scotland, and Ukraine each contributed 5 articles (0.83%). In terms of citations, the United States led with 157 citations, followed by Ukraine with 109 citations. Singapore and China were each cited 63 times.

The uneven geographic distribution raises questions about whether AI tools can effectively address the diverse requirements of educational systems worldwide. Since educational systems vary significantly in terms of language, infrastructure, curricula, and student needs, excluding diverse contexts makes it challenging to ensure that AI solutions are adaptable, ethical, and relevant worldwide ([Holmes et al., 2023](#)). This study underscores the importance of developing a more inclusive research agenda that encourages participation from underrepresented regions. Facilitating transnational research collaborations, open-access publishing, and fair funding strategies can contribute to democratizing the creation and assessment of AI tools in education.

This strength reflects the number of publications where the parties have collaborated as co-authors. England (7), India (6), China (6), Australia (4), and the USA (4) exhibit higher overall bond strengths. [Figure 2](#) illustrates that the USA has collaborated with researchers from England, Canada, and India, while England has worked with Scotland, Italy, Australia, and China. China has partnered with India, Finland, Japan, and Australia.

It is important to note that parties not collaborating with other countries are automatically removed from the network. Of the 32 countries, 15 met the threshold by having at least 2 documents in two countries. The lines linking the nodes on the map represent the parties' overall authorship. In contrast, the distance between the nodes indicates their strength and the volume of publications produced through their authorship (see [Figure 2](#)).

Table 4. The leading 15 countries account for the most documents

Countries	Record count	Percentage	Citations	Total links stren
USA	13	2.17	157	4
England	8	1.33	9	7
Ukraine	5	0.83	109	0
Peoples R China	5	0.83	62	6
Scotland	5	0.83	6	2
India	4	0.66	8	6
Australia	4	0.66	18	4
Germany	3	0.50	7	2
Spain	3	0.50	5	0
Canada	2	0.33	3	3
Finland	2	0.33	51	3
Iran	2	0.33	10	3
Italy	2	0.33	5	3
Singapore	2	0.33	63	3
Japan	2	0.33	9	1

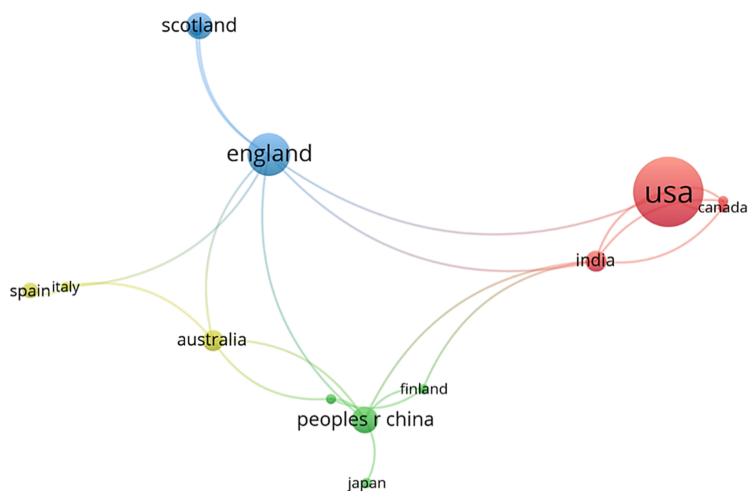


Figure 2. Based on the quantity of documents, co-authorship of countries can be determined

3.4 Authors' collaboration

Productivity, citations, and co-citations from the perspectives of authors, documents, and journals were considered in the performance analysis. Author co-citation maps are commonly used to analyze the intellectual structure of a field, depicting the dominant schools of thought (White and McCain, 1998; Zupic and Čater, 2015). Among the 598 documents analyzed, 228 authors were identified as contributors. Following Van Eck *et al.*'s (2010) criteria, we established a minimum threshold of two collaborative articles per author, resulting in four authors meeting this requirement. The largest connected group consisted of three items (highlighted in red in Figure 3), indicating the highest research output within this cluster. Michael Gallagher demonstrated the highest productivity among authors in this group, as depicted in Figure 3 and Table 5.



Figure 3. Collaborations among the 4 authors

Table 5. Authors who were the most productive between 2020 and 2024

No.	Author (Name, surname)	Total publications	Total citations	Average citations per paper	Total links stren
1	Gallagher Michael	3	2	0.66	4
2	Knox Jeremy	2	2	1	4
3	Wang Yuchen	2	2	1	4
4	Dai Yun	2	52	26	0

In Figure 3, we distinguished two distinct clusters, red and green, representing different schools of thought or invisible colleges within the literature. These clusters showcase the collaborative and intellectually diverse nature of the research in this field.

3.5 Authors' productivity and citation analysis

Analyzing authors' publication output and citations can help us understand their productivity and impact (Donthu *et al.*, 2021) in the AI-inclusive education field. Table 5 lists the top ten authors who extensively contributed to this topic from 2020 to 2024. Gallagher Michael is the most prolific author, with 3 articles, 2 citations, and a link strength 4. Among these highly productive authors, Dai Yun has the highest average citations per paper (26) and amassed 52 citations during the 2020–2024 period (see Table 5).

3.6 Journals on AI-inclusive education publishing

Figure 4 summarises publications and citations related to AI-inclusive education, highlighting the most prolific book and the top four journals in this area. In addition to data from VOSviewer, we calculated the average citations per paper and gathered several journal metrics, including Impact Factor (IF), H-index, category quartile, and journal category. Of the 34 sources we analyzed, only five met the threshold of having at least two publications each.

The publications on AI-inclusive education are found in esteemed journals. For instance, the journal Sustainability has published 9 articles on this topic from 2020 to 2024, featuring an H-index of 169 and an IF of 3.9. Furthermore, *Brain. Broad Research in Artificial Intelligence and Neuroscience* holds the highest average citations per paper at 12.83. *IEEE Access* stands

Rank	Journal	Total publications	Total citations	The average number of citations per paper	Total link strength	5-year IF	H-index
1	Artificial intelligence and inclusive education	9	32	3.55	2	–	–
2	Sustainability	9	9	1	1	3.9	169
	Journal Category/ Quartile						
	Computer Networks and Communications /Q2	Hardware and Architecture /Q2	Energy Engineering and Power Technology /Q2	Renewable Energy, Sustainability and the Environment /Q2	Environmental Science (miscellaneous) /Q2	Management, Monitoring, Policy and Law /Q2	Geography, Planning and Development /Q1
3	Brain. Broad research in Artificial Intelligence and Neuroscience	5	110	22	0	2.3	52
	Journal Category/ Quartile						
	Neurosciences in ESCI edition /Q4						
4	IEEE access	2	9	4.5	1	3.9	242
	Journal Category/ Quartile						
	Computer Science /Q1		Materials Science/Q1		Engineering/Q1		
5	Education sciences	2	0	0	0	2.8	53
	Journal Category/ Quartile						
	Computer Science Applications /Q2	Computer Science (miscellaneous) /Q2	Physical Therapy, Sports Therapy and Rehabilitation /Q2		Developmental and Educational Psychology /Q2	Education /Q2	Public Administration /Q2

Figure 4. A selection of books and the four leading journals featured the most publications on AI-inclusive education from 2020 to 2024

out with the highest H-index (242) and an IF of 3.9, while *Education Sciences* has an H-index of 53 and an IF of 2.8. Furthermore, the book *Artificial Intelligence and Inclusive Education* contains 9 publications and 32 citations, with the highest total link strength (2) compared to other sources (refer to [Figure 4](#)).

The number of publications in these high-impact references underscores the increasing academic acknowledgment of AI’s transformative role in inclusive education. Simultaneously, the variety of references featuring such studies indicates that interest is broadening across various subfields, such as learning analytics, personalized learning, and intelligent tutoring systems.

3.7 The most frequently cited references

[Figure 5](#) lists the top ten most cited references from 2020 to 2024. The articles “*Artificial Intelligence in Developing Countries: The Impact of Generative Artificial Intelligence (AI) Technologies for Development*,” “*Systematic Review of Research on Artificial Intelligence Applications in Higher Education – Where Are the Educators?*,” and “*Chatting about ChatGPT: How May AI and GPT Impact Academia and Libraries?*” were cited three times during this span. Their citations in the WoS Core Collection ranged from 475 to 140 times. Therefore, these results highlight an increasing focus on generative AI, the transformation of higher education, and the societal and institutional implications of large language models. The journal “*International Journal of Educational Technology in Higher Education*” publishes articles on technology-enhanced and digital learning in higher education, illustrating the ongoing link between AI research and educational innovation.

The monthly journal “*Nature Methods*” recorded the highest citation count in WoS, with 13,312 citations. This journal focuses on new methods and substantial improvements in basic life sciences research techniques. The article “*Deep Learning*,” which discusses a robust form of machine learning for solving perceptual challenges such as image and speech recognition, garnered 3,780 citations in the monthly journal “*Science*”. The article “*Machine Learning: Trends, Perspectives, and Prospects*” also examines developing computers that learn and improve automatically through experience.

Overall, citation trends show two main directions: (1) growing focus on specialized AI research in education, particularly around inclusion, teaching methods, and generative tech; and (2) continued dependence on foundational computational science literature that supports the theories and methods of AI-integrated education studies.

3.8 Popular research topics

Co-occurrence networks of all 270 keywords related to AI-inclusive education research are depicted in [Figure 6](#). A minimum occurrence threshold of two was set for keyword inclusion, resulting in the identification of 30 keywords. The largest interconnected group within this analysis consists of six items (shown in the red cluster in [Figure 6](#)), indicating the highest research output within this group. The proximity of nodes on the map indicates the level of similarity between keywords based on their co-citation frequency ([Gmur, 2003](#)). Keywords closely together have been frequently co-cited, while those positioned further apart have not. As a result, keywords situated in the same area of the map tend to share a closer intellectual affiliation ([Van Eck and Waltman, 2018](#)).

[Table 6](#) displays the frequency and link strength of the top 20 keywords out of 270 that met the minimum link strength threshold 2. The keyword “*artificial intelligence*” is particularly noteworthy as it appears most frequently in the field, occurring 21 times with a total link strength of 37. Following this, “*inclusive education*” appeared 11 times with a total link strength of 15, and “*education*” occurred 7 times with a total link strength of 17. Other significant keywords include “*machine learning*,” which had 6 occurrences and a link strength of 15, and “*educational technology*,” appearing 2 times with a total link strength of 11.

Rank	Title	Author	Year	Source	Citations/ Total /in WoS	Total link strength
1	Artificial intelligence in developing countries: The impact of generative artificial intelligence (AI) technologies for development	Mannuru, Nishith Reddy	2023	<i>Information Development</i>	3/3	11
2	Systematic review of research on artificial intelligence applications in higher education – where are the educators?	Zawacki-Richter, Olaf	2019	<i>International Journal of Educational Technology in Higher Education</i>	3/475	17
3	Chatting about ChatGPT: how may AI and GPT impact academia and libraries?	Lund, Brady D.	2023	<i>Library Hi Tech News</i>	3/104	15
4	Artificial Intelligence trends in education: a narrative overview	Chassignola, M.	2018	<i>Procedia Computer Science</i>	2/142	14
5	Machine learning: Trends, perspectives, and prospects	Jordan, M. I.	2015	<i>Science</i>	2/3780	14
6	Deep learning	Rusk, Nicole	2016	<i>Nature Methods</i>	2/13312	14
7	The impact of AI and robotics on physical, social-emotional and intellectual learning outcomes: An integrated analytical framework	Salas-Pilco, Sdenka Zobeida	2020	<i>British Journal of Educational Technology</i>	2	13
8	Engineering Education in the Era of ChatGPT: Promise and Pitfalls of Generative AI for Education	Qadir, Junaid	2023	<i>TechRxiv</i>	2	12
9	Interpretable Multiview Early Warning System Adapted to Underrepresented Student Populations	Cano, Alberto	2019	<i>IEEE</i>	2/44	10
10	Teachers and technology: Present practice and future directions	DeCoito, Isha	2018	<i>Contemporary Issues in Technology and Teacher Education</i>	2/-	10

Figure 5. During the years 2020–2024, the top 10 references that have been cited in publications on AI-inclusive education

Moreover, the seven key clusters illustrated in Figure 7 consist of 270 clustered keywords that have surpassed the minimum occurrence threshold and are closely linked to the subject. Some keywords are positioned closely or interconnected within a cluster, while others are scattered, forming smaller clusters. The proximity of these keywords signifies the strength of their relationships in the research concerning the application of AI in education.

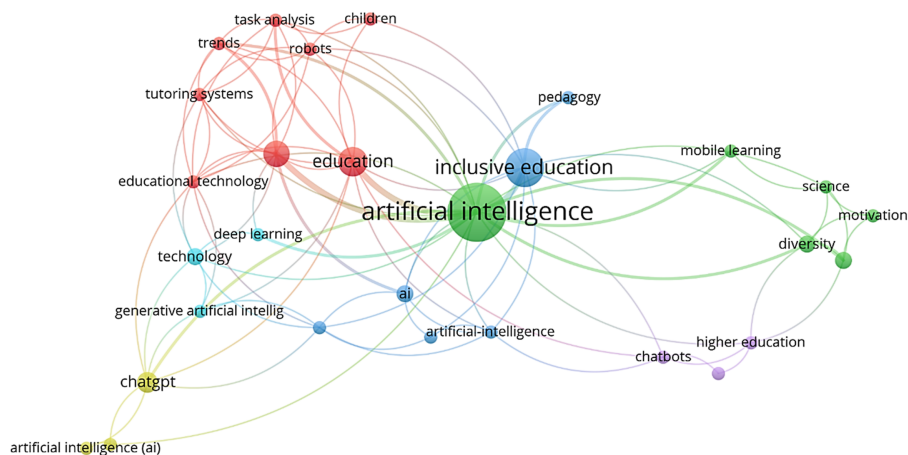


Figure 6. The map illustrates how keywords co-occur in AI-inclusive education research based on the weights assigned to each article

Table 6. The 20 keywords that occur most often

Rank	Keyword	Occurrences	Total links strength
1	Artificial intelligence	21	37
2	Education	7	17
3	Inclusive education	11	15
4	Machine learning	6	15
5	Educational technology	2	11
6	ChatGPT	4	9
7	Robots	2	9
8	Task analysis	2	9
9	Trends	2	9
10	Diversity	3	8
11	Learning analytics	2	8
12	Technology	3	8
13	Tutoring systems	2	8
14	AI	3	7
15	Artificial-intelligence	2	7
16	Inclusion	3	7
17	Chatbots	2	5
18	Generative artificial intelligence	2	5
19	Higher education	2	5
20	Science	2	5

The analysis of keywords across all six clusters (refer to [Figure 7](#)) revealed that Cluster 1 (highlighted in red) contains a significant number of keywords related to the topic, including “education” (7 occurrences, total link strength of 17), “machine learning” (6 occurrences, total link strength of 15), “educational technology” (2 occurrences, total link strength of 11), “robots” (2 occurrences, total link strength of 9), “task analysis” (2 occurrences, total link strength of 9), “trends” (2 occurrences, total link strength of 9), “tutoring systems” (2 occurrences, total link strength of 8), and “children,” which appears 2 times with a total link strength of 4—pointing to research that explores the integration of intelligent systems and AI tools in education, focusing on teaching, learning processes, and child-centered educational

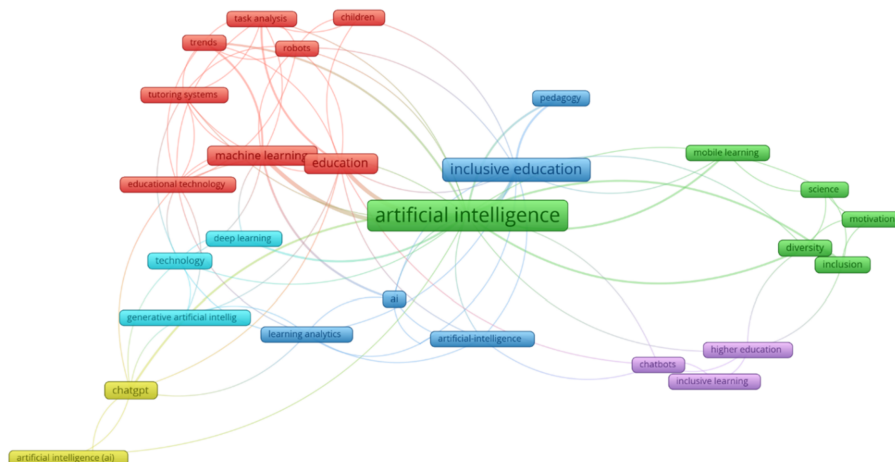


Figure 7. Cluster density visualization map. The nodes and clusters constitute the following colour scheme: red – cluster 1, green – cluster 2, blue – cluster 3, yellow – cluster 4, purple blue – cluster 5, green electric – cluster 6

technologies. We refer to this as the Educational Technologies and Intelligent Learning Systems cluster.

Cluster 2 (green colour) includes six substantial numbers of keywords associated with the topic, followed by “*artificial intelligence*”, the most popular keyword in the field with the highest occurrences of 21 and a total link strength of 37, “*diversity*” (3 occurrences, total link strength is 8), “*inclusion*” (3 occurrences, total link strength is 7), “*science*” (2 occurrences, total link strength is 5), “*mobile learning*” (2 occurrences, total link strength is 4), “*motivation*” (2 occurrences, total link strength is 3). Suggest focusing on AI in education, emphasizing inclusion, diversity, motivation, and accessible mobile learning technologies. We refer to it as the Artificial Intelligence, Diversity, and Inclusive Learning cluster.

Cluster 3 (blue colour) includes six substantial numbers of keywords associated with the topic followed by “*inclusive education*” (11 occurrences, total link strength is 15), “*learning analytics*” (2 occurrences, total link strength is 8), “*AI*” (3 occurrences, total link strength is 7), “*artificial-intelligence*” (occurrences of 2 and a total link strength of 7), “*pedagogy*” (2 occurrences, total link strength is 4), “*special education*” (2 occurrences, total link strength is 4). Highlight the connection between AI tools and data-driven analytics within inclusive and special education pedagogies – could be referred to as the Inclusive Education and Learning Analytics cluster.

Cluster 4 (yellow colour) is significant as it includes three substantial numbers of keywords associated with the topic, followed by “*ChatGPT*” (4 occurrences, total link strength is 9), “*generative AI*” (2 occurrences, total link strength is 3) and “*artificial intelligence (AI)*” (occurrences of 2 and a total link strength of 2). This cluster focuses on how large language models and generative AI tools support inclusive educational practices and could be referred to as the Generative AI and ChatGPT in Inclusive Education cluster.

Cluster 5 (purple, blue colour) includes three substantial numbers of keywords associated with the topic followed by “*chatbots*” (occurrences of 2 and a total link strength of 5), “*higher education*” (2 occurrences, total link strength is 5), “*inclusive learning*” (2 occurrences, total link strength is 2). Highlight AI-driven conversational systems, like chatbots, as tools to enhance inclusivity and student engagement in higher education – titled Chatbots and Inclusive Higher Education cluster.

Cluster 6 (green electric colour) includes three substantial numbers of keywords associated with the topic followed by “*technology*” (3 occurrences, total link strength is 8), “*generative artificial intelligence*” (2 occurrences, total link strength is 5), “*deep learning*” (occurrences of

2 and a total link strength of 4). This cluster outlines the technological foundations and recent innovations in AI, with an emphasis on deep learning architectures and generative models that are advancing research in educational technology, which could be referred to as Emerging AI Technologies: Deep and Generative Learning cluster.

4. Discussion

The study presents a comprehensive overview of research areas and foundational concepts, highlighting the evolution of research hotspots and recent advancements in AI-inclusive education. Besides reporting the findings, the discussion highlights how this study advances the field by providing a broader and more in-depth understanding of AI's applications in inclusive education. It addresses topics such as pedagogical agents for inclusive teaching (Savin-Baden *et al.*, 2019), learning analytics within teacher education (Salas-Pilco *et al.*, 2022a, b), the convergence of AI and inclusive education (Mohammed and Watson, 2019), and the design of inclusive AI learning for diverse learners (Song *et al.*, 2024). Unlike earlier reviews that provide general overviews, this research offers a detailed and context-aware analysis across various dimensions, including countries, journal distribution, most cited articles, popular research topics, clusters, and temporal changes. This level of detail enables stakeholders to identify research gaps and develop more precise interventions. Recognizing research trends enables us to understand the current landscape of AI in inclusive education and identify areas with the most scholarly and institutional focus.

The highest publication counts occurred in 2023 (31.60%) and 2022 (24.40%). The consistent increase leading into 2023 indicates that AI is shifting from an emerging innovation to a fundamental part of educational research and practice. This signifies a paradigm change rather than a fleeting trend, supporting recent reviews that describe AI as becoming an increasingly essential element of pedagogical design, personalized learning, and assessment methods (Ayeni *et al.*, 2024; Halkiopoulou and Gkintoni, 2024). Future research should be guided by solid theoretical frameworks and informed by emerging policy discussions on the ethical and effective implementation of these principles. Without such guidance, there is a risk that AI may be adopted inconsistently or unfairly as usage grows (Zou *et al.*, 2025).

Between 2020 and 2024, the United States led in publishing academic papers on AI-inclusive education. The USA collaborated mainly with researchers from England, Canada, and India. England's partnerships extended to Scotland, Italy, Australia, and China. This imbalance could be attributed to structural issues, such as limited research funding, unequal access to AI tools, or publication obstacles faced by scholars in the Global South (Rigley *et al.*, 2024). Consequently, the existing literature might overrepresent educational priorities, pedagogical models, and technological infrastructures typical of high-income or tech-centric countries. Such uneven geographic representation raises concerns about whether AI tools can sufficiently address the diverse needs of inclusive educational systems worldwide. These systems vary significantly in terms of language, infrastructure, curricula, and student needs. Without considering diverse educational contexts, it is challenging to develop AI solutions that are both adaptable and globally relevant, and also ethical (Holmes *et al.*, 2023).

Regarding the number of publications and citations, the 2019 book *"Artificial Intelligence and Inclusive Education"* comprises 12 chapters that focus on these aspects. It explores integrating AI technologies designed for automation, standardization, and efficiency into future educational practices, aiming to foster equality and fairness. This book combines AI and inclusive education to explore the future of teaching and learning in increasingly diverse social, cultural, emotional, and linguistic contexts. Authors Mohammed and Watson (2019) highlight that learners' cultural backgrounds and preferences often clash with mainstream educational systems in their chapter *"Towards Inclusive Education in the Age of Artificial Intelligence: Perspectives, Challenges, and Opportunities."* They stress the importance of addressing practical and cultural challenges and considering obstacles like limited resources and technical skills, along with the issues of incomplete and restricted data. De-Arteaga *et al.*

(2019) argue that acknowledging these factors is crucial for implementing AI strategies in underprivileged countries. The overarching objective is to leverage AI to foster inclusive and culturally relevant education (Moreno-Guerrero et al., 2020).

The most cited article, “Artificial Intelligence in Developing Countries: The Impact of Generative Artificial Intelligence (AI) Technologies for Development” (Mannuru et al., 2023), highlights the critical need for supportive infrastructure to enable generative AI to promote inclusive development instead of deepening current inequalities. This study underscores the necessity of integrating Generative AI into emerging nations’ Fourth Industrial Revolution framework. Technological progress is essential for developing and achieving equitable economic growth in these regions (Roll and Wylie, 2016).

The highly cited article “Systematic review of research on artificial intelligence applications in higher education – where are the educators?” (Zawacki-Richter et al., 2019) offers an overview of research on AI in higher education through a systematic review. Most studies originate from Computer Science and STEM fields, with AI in Education (AIED) research primarily using quantitative methods. These often focus on academic support, institutional services, and administrative systems. The review identifies four key areas of AIED application: 1. profiling and prediction, 2. assessment and evaluation, 3. adaptive systems and personalisation, and 4. intelligent tutoring systems. The authors note a lack of critical discussion about challenges and risks, as well as weak ties to pedagogical theories, and highlight the need for more research on ethical and educational considerations in AIED within higher education.

Third, the most cited article, “Chatting about ChatGPT: how may AI and GPT impact academia and libraries?” (Lund and Wang, 2023), offers a detailed look at the technology behind ChatGPT. It is divided into three sections: the first defines key concepts related to ChatGPT, the second explores its history, technology, and underlying principles, and the third provides an example of ChatGPT’s capabilities through an interview discussing AI and GPT’s impact on academia and libraries.

The six document co-citation clusters reveal the main research trends in the field, including “artificial intelligence”, “education”, “inclusive education”, “machine learning”, “educational technology”, and “diversity” recommendations. While all these areas relate to inclusive learning systems, they vary in scope and emphasis. The most cited references (Mannuru et al., 2023; Zawacki-Richter et al., 2019; Lund and Wang, 2023) in each cluster highlight the foundational studies, such as reviews on AIED and inclusive/adaptive learning; research on applying machine learning and other AI technologies in education; and the design of intelligent tutoring systems (ITSs) and inclusive/adaptive systems, focusing on areas like affective tutoring, learning style detection, and knowledge tracing. Additionally, the references address cognitive development and instructional design.

The main research areas identified in this study align with those in previous studies. For example, Li and Wang (2019) highlighted “big data” and “intelligent tutoring systems” as key research topics in AI education. Likewise, Jaleniauskiene et al. (2023) emphasized “machine translation,” “intelligent tutoring systems,” “chatbots,” and “machine learning” as common keywords for AI-based solutions.

The grouping of keywords illustrates the development of important research themes across different periods. Additionally, the rise of keywords such as *learning analytics*, *big data*, and *deep learning* indicates an increasing emphasis on predictive analytics for recommending inclusive educational resources. Combining *learning analytics*, *big data*, and *deep learning* allows for the development of adaptive learning systems. These systems continually adapt content delivery based on student performance, preferences, and engagement patterns, resulting in more effective personalised learning (Li and Wang, 2019). *Learning analytics* driven by *big data* and *deep learning* models can suggest the best learning paths by foreseeing future performance and learning needs and adjusting the speed and content in real-time to maximise learning efficiency (Li and Wong, 2023). The broad scope of subjects encompassed by the keywords *student* and *assistive technology* initially focuses on enhancing accessibility, inclusivity, and academic achievements for students with varying needs.

The results of co-occurring keyword clusters demonstrate the emerging trends in research on AI-inclusive education. Keywords like *assistive technology*, *opportunity*, *diversity*, and *learning analytics* have recently become prominent in educational equity, personalised learning, and inclusive practices. These areas collaborate to guarantee that all students, particularly those from diverse backgrounds and with varying abilities, have the chance to thrive in educational settings (Phillips and Ozogul, 2020).

The recent rise in popularity of keywords like *task analysis* and *chatbot*, as well as the term *generative artificial intelligence*, aims to enhance user experiences, automate processes, and improve learning and work environments. These technologies intersect, allowing for developing intelligent, interactive systems capable of understanding and responding to user needs more efficiently (Hwang and Tu, 2021).

Integrating technology and data-driven techniques in interconnected fields like inclusive education, *learning analytics*, *artificial intelligence (AI)*, *pedagogy*, and *special education* seeks to establish personalized and equitable learning environments that address the diverse needs of all students. These interconnected areas collaboratively enhance educational outcomes (Zhang and Zhang, 2020), particularly for students with special needs or varied backgrounds, by utilizing AI and analytics to support adaptive and inclusive teaching approaches.

As discussed by Moreno-Guerrero *et al.* (2020), the themes in publications on educational AI from the past few decades have primarily focused on the technologies applied, with a clear evolution in the integration of AI in teaching and learning processes. For research on AI to facilitate inclusive education, the results suggest that further studies are needed on the challenges of adopting AI technologies for various types of users (e.g. learners and teachers) and learning contexts (e.g. subject disciplines and learning environments), which have been emphasized in the literature on inclusive education. Furthermore, while the rapid development of AI technologies has largely driven the evolution of research on AI-inclusive education, the importance of related pedagogical approaches and practices should not be overlooked. The integration of AI technology with pedagogy needs to be addressed in future work so that AI can be better used to support inclusion in various modes of teaching and learning.

This study has several limitations that should be acknowledged. Firstly, it relies on a single database, WoS, without incorporating others such as Google Scholar or Scopus. This may introduce bias in analyzing and comparing results across different fields, such as institutions or countries (Echchakoui, 2020; Mongeon and Paul-Hus, 2016). The choice of one database can also impact citation counts and the scope of the research. Second, although the review discusses the general benefits and challenges of AI in inclusive education, it does not deeply examine how different AI applications align with specific pedagogical models or teaching strategies across disciplines and settings. Third, while ethical issues and digital dependency are acknowledged, the study does not examine the long-term impacts of AI, including changes in teachers' roles, student autonomy, or institutional policies.

Future research should focus on developing and testing ethical guidelines and frameworks that ensure responsible, transparent, and equitable AI use in education. This involves tackling issues such as data privacy, bias reduction, and accountability of algorithms. Researchers should also explore how AI tools complement or oppose traditional pedagogical methods, such as collaborative, inquiry-based, problem-based, game-based learning, constructivism, and connectivism. Additionally, finding effective ways to train and assist teachers in integrating AI both technically and pedagogically is essential, as well as understanding how this affects their teaching roles. Lastly, long-term studies are necessary to evaluate AI's lasting impact on learning outcomes, equity, student well-being, and institutional change.

5. Conclusion

This study presents a comprehensive, data-driven examination of the evolving role of AI in inclusive education, highlighting research trends, key themes, and collaborations from 2014 to 2024. The findings show that research in AI for inclusive education has grown rapidly. This

continuous expansion reflects a changing perspective on AI as an essential tool for enhancing equity, accessibility, and personalized learning. Six key themes emerged, including educational technologies, AI for diversity and inclusion, learning analytics and pedagogy, generative AI and ChatGPT, chatbots in higher education, and deep learning technologies. These themes demonstrate the field's broad scope—integrating pedagogy, data analysis, ethics, and technology design to create more adaptive and inclusive learning environments.

Overall, this research enhances the understanding of AI in inclusive education by providing a comprehensive and context-sensitive perspective, highlighting past progress and future directions. By exposing current trends, challenges, and possibilities, it provides a valuable foundation for policymakers, educators, and researchers aiming to create more equitable, data-driven, and inclusive educational systems.

Ethics approval and consent to participate

“Not applicable” in this section.

Consent for publication: “Not applicable” in this section.

List of abbreviations used in the manuscript

AI	artificial intelligence
WoS	Web of Science

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