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Exploring Risks and Benefits in Generative Artificial Intelligence through Systematic Review and Bibliometric Analysis

Ingrid del Valle García-Carreño

Pablo Olavide University, Seville, Spain

Abstract: The rapid development of Generative Artificial Intelligence in education presents new opportunities but also raises concerns about inequality and the integrity of academic practices. This study explores its impact, trends, and risks in education through an extensive review of existing academic literature. The methodology includes a systematic review conducted via the Scopus platform, incorporating documentary analysis with descriptive statistics, systematic content analysis, and bibliometric analysis of citations, co-citations, and co-words in scientific research on the topic. Network maps were created using VOSviewer, and graphs were produced with Microsoft Excel. Moreover, qualitative content analysis was further deepened using ATLAS.ti, . 24. The major findings indicate that generative artificial intelligence, as a set of information-processing tools, has significantly advanced over the past century, especially notable for its ability to process information quickly and adapt to human objectives. Its rapid adaptation is transforming education, particularly by enhancing personalization, improving knowledge retention, and supporting interactive learning environments. However, the use of GenAI also raises ethical and equity concerns, including risks to academic integrity, data privacy, and potential algorithmic bias, alongside challenges in ensuring equitable access and adequate teacher training. The main focus of current applications lies in commercial, collaborative, and natural language strategies, which surpass other uses such as images and videos. GenAI aligns with pedagogical theories that promote student autonomy, active learning, and collaboration, if implemented with clear educational intent. However, since machines lack human social perception, it is necessary to reflect critically on the ethical boundaries and appropriate use of AI in the linguistic and educational domains. Gen AI offers transformative potential for education by enabling personalized and efficient learning; however, addressing associated risks, ethical challenges, and issues of equity is essential to ensure its benefits are realized without compromising academic integrity or exacerbating inequalities.

Keywords: Artificial intelligence; bibliometric analysis education; generative artificial intelligence; systemic review, VOSviewer.

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Introduction

Artificial intelligence (AI), within just five years of its emergence from scientific research to the forefront of public and social discourse, has significantly impacted economies and the labor landscape, particularly in education and continuous training. Recent studies examine how AI is transforming education and affecting foundational educational skills and principles (Echaiz et al., 2021; Miao & Holmes, 2023; Bond et al. 2024; Yusuf et al. 2024).

The implementation of Artificial Intelligence in Education (AIEd) presents significant challenges related to social equality and interpersonal communication. According to the OECD (2024), AI tools in education have transformative potential, such as adapting learning to student needs, but their adoption often occurs without systematic oversight or regulation. The development of AIEd has evolved over decades, blending educational theories with emerging technologies, from the 1990s to early 2000s, research expanded into intelligent tutoring systems (Woolf, 2009), adaptive learning environments (Desmarais & Baker, 2012), and collaborative learning support-(Dillenbourg & Jermann, 2007). In the last decade, AI's role in education grew rapidly with advances in machine learning, natural language processing, and cognitive computing. This led to new tools like chatbots, automated grading, predictive analytics, and personalized adaptive platforms. Despite progress, challenges remain concerning ethical use (Holmes et al., 2021), transparency (Khosravi, 2022), and pedagogical impacts of autonomous (Han et al., 2023; Noroozi et al., 2024).

Organizations such as UNESCO (2021) are dedicated to reimagining the role of AI to facilitate the attainment of Sustainable Development Goal 4 (SDG4) within the Education 2030 Agenda, which aims to foster inclusion and ensure equitable access to education at all stages of life (Flores-Vivar & García-Peñalvo, 2023). The incorporation of AI prompts concerns regarding educational materials, instructional methods, the responsibilities of teachers, as well as ethical and society implications (UNESCO, 2021).

The Beijing Consensus (UNESCO, 2019, 2021; Lee, 2019) explores the challenges faced by AI in the educational field (Yilmaz et al., 2022), encompassing its incorporation into educational policies, its implementation in school administration, support for teachers, redefinition of student progress assessment, promotion of values, lifelong learning, and advocacy for fair AI usage, gender equality, and ethics in the application of educational data and algorithms. The complex interaction between AI and education focuses on adaptive learning, such as the role of intelligent virtual tutors. In education, various challenges arise, addressing issues such as social justice and sociability. Agreements include the potential integration of AI with education, which is likely to alter traditional principles of teaching and learning (Eguchi et al., 2021; Delgado de Frutos et al. 2024). Those challenges have been magnified by the extensive shift to online education, particularly underscored by the disruptions experienced in educational institutions during the COVID-19 pandemic.
In the domain of AIEd has brought transformative changes across all levels, ranging from elementary to higher education. One of the most significant advancements is the development of adaptive learning systems, which customize educational experiences by analysing students' progress and individual learning styles, thereby tailoring content to meet diverse needs (García-Peñalvo et al., 2024). Woolf (2023) further elaborates on how these systems utilize real-time data to personalize learning pathways, resulting in improved academic outcomes and enhanced student motivation. Additionally, virtual tutors play a crucial role in supporting learners by delivering clear explanations, responding to inquiries, and generating customized activities that address specific student requirements. VanLehn (2024) underscores the efficacy of virtual tutors in facilitating individualized learning through their capacity to provide immediate assistance and adapt instructional strategies accordingly. Complementing these innovations, Holmes et al. (2021) provide a comprehensive review of various AI applications, highlighting the potential of intelligent tutoring systems and personalized assistants to enrich student engagement and interaction. Moreover, automated assessment technologies contribute to the efficiency of educational practices by automating exam grading and offering prompt feedback. Baker & Smith (2022) discuss how such systems reduce the workload associated with grading and enable timely feedback, which collectively foster accelerated and more effective learning processes.

Other notable advantages and applications of AIEd include the use of predictive analytics to forecast academic performance and enable early interventions for at-risk students. Predictive models leverage engagement metrics and historical performance data to personalize learning trajectories and improve educational outcomes (Li., & Chai, 2025; Zawacki-Richter et al., 2020). In addition to instructional benefits, AI significantly enhances administrative efficiency by automating tasks such as record management and class scheduling, which reduces workload and minimizes errors.

Kearney & Thompson (2021), who found that machine learning (ML), driven automation systems reduce task completion time by nearly 40% and improve resource utilization. Additionally, Brown & Green (2022) found that such systems significantly reduce scheduling conflicts and improve resource utilization, corroborating the effectiveness of these systems in educational management contexts.

Furthermore, AI-driven platforms and virtual tutors provide personalized feedback and adaptive learning experiences that foster student creativity and critical thinking (Alam, 2023). These tools, including those based on advanced algorithms like ChatGPT, enable real-time, individualized interactions that support self-paced and engaging learning (García-Carreño, 2024). In terms of access, AI extends educational opportunities globally through digital platforms, online courses, and tools designed to support diverse learner needs, including those in remote locations or with special needs (Steele, 2023). These AI-enhanced environments contribute to the development of essential 21st-century skills such as creativity, collaboration, and adaptability (UNESCO, 2021, 2023).

Collectively, the integration of AIEd promotes increased efficiency, personalization, and equity, benefiting both students and educators by transforming academic forecasting, administration, and instructional methods (Brown & Green, 2022; UNESCO, 2023).

This study seeks to deepen the understanding of how Generative Artificial Intelligence (GAI) is transforming the social sciences and education. The objective is to provide an overview of the current state and trends of Generative AI in education that serves as a foundation for future research and advancements in this rapidly evolving field. It offers a critical perspective and serves as a reference for future research and practice while addressing one specific research question:

How is Generative Artificial Intelligence (GenAI) transforming teaching methods and learning processes within the educational domain, and what are the prevailing trends, opportunities, and challenges associated with generative approaches?

Generative Artificial Intelligent

Generative Artificial Intelligence (GenAI) refers to AI methodologies capable of generating a variety of original content formats, including textual compositions, video segments, and digital imagery. Notable examples of GenAI tools include ChatGPT, extensively documented in recent studies (Cooper, 2023; García-Carreño, 2025). In light of the increasing adoption of these technologies, academic institutions globally have established policies to oversee the use of GenAI by students. These policies are designed to promote ethical practices and ensure the responsible application of such tools, particularly in the context of academic evaluations.
Experts such as Monett and Lewis (2018) argue that it is no generally recognized academic meaning of AI. While AI technologies are indeed designed by humans, a consensus may reveal properties we compare with human intelligence (Tegmark, 2018). In terms of capabilities, AI can be categorized into weak/strong AI (Russell & Norvig, 2010) and fine/universal, wonderful AI (Fjelland, 2020). The trial of establishing a good explanation necessitates relating AI near several twigs of human information owing near old expansion. AI,

whether seen as a collective element or through AI Assisted Education (AIED), adopts its tentative broad status (Hwang et al., 2020; Wang & Cheng, 2021).

GenAI is a newly accessible technology undergoing continuous and rapid development. Its public accessibility is profoundly transforming how we produce and consume multimedia content. This technological advancement presents both a significant challenge and a valuable opportunity to prepare students for their future careers while fostering a critical and reflective understanding of technology. As Bremmer (2023) aptly states: The onset of a new technological revolution is set to influence politics, the economy, and society at large. Just a year ago, there was not a single global leader. The author previously interacted with individuals who discussed artificial intelligence. Nowadays, every leader mentions it. In this short time, we have seen the rapid emergence of GenAI systems such as ChatGPT and Midjourney.

GenAI refers to a subset of artificial intelligence capable of autonomously generating content in response to written prompts within conversational natural language frameworks. It can produce diverse types of outputs, such as text, images, videos, music, and software. This technology uses advanced algorithms to comprehend context and deliver coherent, relevant responses based on the input it receives, leveraging data sourced from websites and social media platforms (Miao & Holmes, 2023). Importantly, GenAI does not simply compile information from existing web pages; instead, it generates completely original content across multiple formats by performing statistical analyses on word patterns, pixel data, and other distributions to recognize and reproduce common relationships, like word associations (García-Peñalvo & Vázquez-Ingelmo, 2023).

Ray (2023) succinctly describes the numerous and promising applications of GenAI in education. These include creating personalized learning materials and lesson plans tailored to individual student needs, providing immediate feedback and guidance during the learning process, generating relevant materials such as interactive exercises, and assisting teachers in evaluating and delivering constructive feedback to each student. Furthermore, adaptive learning environments that respond to each student's progress and performance can be developed.

While there is considerable enthusiasm for harnessing the potential of generative AI (GenAI), this excitement must be balanced with a clear understanding of how the technology operates and the sources of the databases it relies on. The associated risks include concerns about the system’s reliability and accuracy, as well as the existence of cultural and linguistic biases within the training data.

Another important issue is the tendency to place too much trust in artificial intelligence, which may hinder our ability to engage in critical evaluation. AI-generated outputs can differ greatly in quality and accuracy, and often the reasoning behind these outputs is not transparent, making it difficult for users to critically assess them (Symbio6, 2024; Zhao et al., 2022). In research settings, matters such as data privacy, intellectual property rights, transparency, and accountability are crucial, requiring careful governance to prevent misuse and safeguard stakeholders (Cheong, 2024; Zendesk, 2024). Biases embedded in training datasets can result in unfair outcomes, perpetuating discrimination and posing threats to human autonomy (Zhao et al., 2022).

Additionally, a fundamental limitation of generative AI is its lack of true contextual understanding and inability to grasp social nuances inherent in language, which restricts its capacity to develop genuinely innovative solutions to complex real-world problems (Floridi, 2019; Crawford, 2023).

Despite its precision, the accuracy of GenAI cannot be guaranteed. ChatGPT (OpenAI, 2023; Cooper, 2023) acknowledges that while the generated responses may sound reasonable, their accuracy cannot be relied upon 100%. Mistakes generated by AI often go unnoticed unless the user has a strong understanding of the subject matter. GenAI functions through technologies known as machine learning (ML), as demonstrated by platforms like Azure (https://azure.microsoft.com/).

Educational Tools Utilizing GenAI Technologies

During 2023, there has been a sharp rise in the integration of intelligent features into computing materials. This surge can be largely attributed to the widespread adoption of large-scale language models. Gruetzemacher & Paradice (2022) note that the term "large" reflects the concurrent expansion of AI capabilities, with these models being trained on vast data sets and requiring significant computational power. Large Language Models (LLMs) have gained recognition due to the success of Generative Pretrained Transformer (GPT), particularly in versions 3.5 (2022) and 4 (2023), which power ChatGPT. However, it's crucial to remember that GPT is only one among several LLMs, all built on the Transformer architecture introduced by (Vaswani et al. 2017). The integration of GenAI technologies, particularly large language models (LLMs) like GPT-3.5 and GPT-4, has rapidly advanced educational tools by enabling personalized, adaptive learning and support systems. The Table 1 resume the area of application.

Table 1

Key points regarding educational tools utilizing GenAI technologies

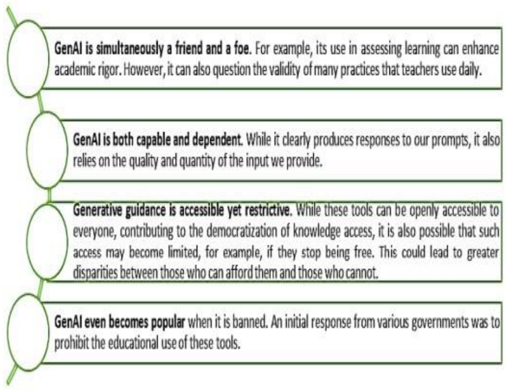
Area of Application	Description	Key References
Curriculum Design and Personalized Learning	GenAI assists in curriculum design, adaptive pathways, personalized tutoring, and automated feedback, enabling customization for diverse learners.	Haindl and Weinberger (2024); Almohesh (2024); Nugroho et al. (2024); Jauhiainen and Guerra (2024); Avsheniuk et al. (2024); Economides, & Perifanou (2024)
Student Learning Support	AI tools help students by consolidating notes, generating practice questions, offering real-time tutoring, and fostering critical thinking via AI output evaluation.	Bitzenbauer (2023); Lu et al. (2024); Wu & Yu, (2023); Emran et al. (2024); Urban et al. (2024)
Data Analysis and Research Skills	AI supports students in exploring datasets, designing surveys, and validating research findings.	Almohesh (2024); Rahimi et al. (2025); Pavlenko and Syzenko (2024)
Language Learning and Coding Education	AI tools provide interactive, iterative support such as conversational practice and code debugging to enhance learning.	Young and Shishido (2023); Sun et al. (2024); Saleem et al. (2024)
Challenges and Ethical Considerations	Issues include ensuring accuracy, managing bias, and ethical use of AI-generated content in education.	Gouia-Zarrad and Gunn (2024); Saleem et al. (2024); Chan et al. (2024); Fokides and Peristeraki (2024)
Institutional Governance and Best Practices	Institutions and educators explore governance and best practices to maximize benefits and minimize risks of GenAI use in education.	Huesca et al. (2024); Su & Yang (2023); Chan & Tsi (2024); Urban et al. (2024)

Inherently Paradoxical Nature of GenAI

The impact of GenAI evokes ambivalent emotions, both positive and negative. The two contrasting views reveal the paradoxical nature of GenAI in education, where it has the potential to disrupt certain educational methods while simultaneously enhancing others. To research into these opposing viewpoints, four central paradoxes of GenAI's role in education are identified and discussed. This phenomenon prompts us to reflect on our attitudes towards this technology. Lim et al. (2023) examine these mixed emotions and emphasize extreme positions. Some perceive GenAI as a catastrophic threat capable of dismantling the educational system (a "Ragnarok"). Others envision a promising future where information and automation significantly enhance educational quality, akin to a new dawn. These two opposing perspectives generate intense debate (Figure 1). Lim et al. (2023) have recognized four paradoxes that illustrate this ambivalence and reflect the mixed feelings of many educators. On one hand, there is an attraction to GenAI due to its potential benefits, but at the same time, there are lingering reservations and concerns. These paradoxes represent the complexity of our perceptions and attitudes towards GenAI in the educational field.

Figure 1

The four central paradoxes of GenAI's role in education



Fundamental Context and Prior Studies on the Subject

- A systematic review by Yusuf et al. 2024 analysed 407 publications on generative AI (GenAI) in education using EPPI Reviewer. The review examined publication types, educational levels, disciplines, research areas, and applications. It identified eight key themes emphasizing GenAI’s roles in pedagogical improvement, specialized training, writing assistance, professional skills development, and interdisciplinary learning. The review viewed GenAI broadly as a tool enhancing education through these diverse applications. However, notable research gaps include limited studies on K-12 GenAI use, few experimental impact assessments, and scarce exploration of ethical and cultural perspectives. These gaps highlight directions for future research to rigorously and ethically harness GenAI’s educational potential.
- Another study by Salinas-Navarro et al. (2024) explore how GenAI can optimize education by redesigning learning experiences. Using ethnographic research, it emphasizes authentic assessment and experiential learning, suggesting that GenAI tools can transcend mere aids to become active agents supporting these educational approaches.
- Banh and Strobel (2023) provide a comprehensive overview of GenAI’s rapid development and market growth, expected to reach $6.5 billion by 2026. The study traces GenAI’s evolution, its diverse industrial

applications, and adoption strategies in Korea and globally. It discusses both opportunities and challenges, as well as government and private sector initiatives to integrate GenAI technology.

- Feng-Shihui and Law-Nancy (2021) reviewed 1,830 articles on artificial intelligence in education (AIED) from 2010 to 2019, using keyword co-occurrence network analysis to map knowledge structures and trends. Two major themes emerged: Intelligent Tutoring Systems (ITS) and Massive Open Online Courses (MOOCs). Key educational trends include digital learning, game-based learning, collaborative methods, assessment, emotional engagement, and instructional design. Related AI techniques involve natural language processing, educational data mining, learning analytics, and machine learning. Emerging keywords are neural networks, deep learning, eye tracking, and personalized learning. This review presents a holistic view of the evolving AI-shaped educational landscape, highlighting diversity and focal research areas.

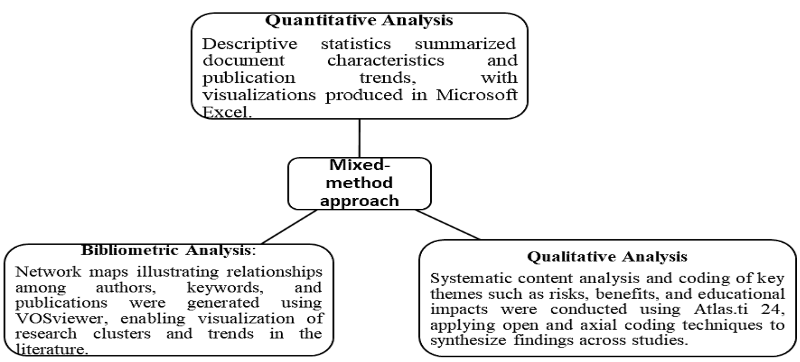
Methodology

This study aims to address the following research question:
How is Generative Artificial Intelligence (GenAI) transforming teaching methods and learning processes within the educational domain, and what are the prevailing trends, opportunities, and challenges associated with generative approaches?

To answer this question, the study employs a comprehensive bibliometric-systematic literature review methodology. This approach integrates bibliometric analysis—a quantitative method utilizing citation data, co-authorship networks, and keyword co-occurrences—with systematic review techniques, ensuring a rigorous, transparent, and replicable synthesis of existing literature. Through bibliometric tools, the study maps the intellectual structure, influential contributors, publication dynamics, and emerging research clusters related to GenAI in education. Concurrently, the systematic review provides an in-depth qualitative synthesis of thematic trends, opportunities, and challenges identified within the selected studies. The combination of these methods facilitates a holistic analysis, capturing both the quantitative patterns of knowledge production and the qualitative insights necessary for theoretical development. The selected articles were analysed using a mixed-method framework, as illustrated in Figure 2, enhancing comprehension of both empirical evidence and conceptual contributions in the field.

Figure 2

The selected articles were analysed using a mixed-method approach



In summary, the methodology combined systematic literature selection following PRISMA guidelines, quantitative descriptive analysis, qualitative thematic coding via ATLAS.ti, and bibliometric network mapping with VOSviewer. This multimethod approach provided a comprehensive, transparent, and replicable assessment of emerging trends and challenges related to GenAI applications in education Table 2.

Table 2

Summary of the methodology combined systematic literature

Aspect	Description	Software Used
Study Type	Systematic review to collect, synthesize, and analyse evidence on Generative AI (GenAI) in education.	N/A
Inclusion/Exclusion Criteria	Predefined criteria established to select articles relevant to GenAI in education based on population, design, year, etc.	N/A
Review Protocol	Followed the PRISMA flow diagram to ensure transparency and reproducibility in article selection.	N/A
Quantitative Analysis	Descriptive statistics used to summarize document characteristics.	Microsoft Excel
Qualitative Analysis	Systematic coding and content analysis to identify key themes and patterns in textual data.	ATLAS.ti. 24
Bibliometric Visualization	Construction of network maps to analyse relationships among authors, keywords, and publications.	VOSviewer

Materials and Methods

To propose a methodology that enables the achievement of the objective outlined in this document, the importance of retrieving large volumes of data for bibliometric analysis is initially emphasized. A search was conducted in the Scopus database, renowned for its capacity to identify scientific literature published in high-impact journals, yielding a total of 2,057 documents published between 2023 and 2024. Subsequently, the area of knowledge, authors, countries, journals, and other relevant data from the results were analysed. Additionally, the data were downloaded in CSV (Comma-Separated Values) format for subsequent analysis using VOSviewer software, which facilitates the identification of correlations and co-occurrences by generating maps and criteria based on the retrieved data. This analysis also contributed to determining the categories created from various concept groups organized into clusters, which were ultimately related to the primary components mentioned at the beginning of this document, thereby giving coherence to this literature review.

The combined use of systematic review methodology and bibliometric analysis reflects an evolving approach in literature synthesis that influences the strengths of both qualitative and quantitative techniques. Systematic review, originally developed and disseminated predominantly in the health sciences since the 1970s, was adapted for management research by Tranfield et al., (2003) and Petticrew., & Roberts (2006), who emphasized the need for rigor, transparency, and replicability in reviewing management knowledge. Earlier foundational work by Denyer et al., (2001*)* further elaborated on the challenges and methodological adaptations required for evidence-based management reviews, although it did not specifically discuss bibliometric analysis integration.

More recently, Linnenluecke., et al (2020) have provided explicit practical guidance for combining systematic literature reviews with bibliometric mapping and citation analyses, framing this integrated approach as a powerful tool to enrich literature synthesis and reveal research trends, especially in business and management fields. This dual-method approach—termed the Bibliometric-Systematic Literature Review (B-SLR)—has gained traction as it allows researchers to systematically identify, appraise, and synthesize existing knowledge, while quantitatively mapping scholarly networks and intellectual structures to support theoretical development (Tranfield et al., 2003; Denyer et al., 2001; Linnenluecke et al., 2020). As such, these methodologies together establish a robust, complementary framework for comprehensive literature synthesis. The bibliometric analysis method following the steps proposed by Anand and Brix (2022), published in *The Learning Organization,* they applied a combined systematic and bibliometric review methodology based on publications from the past three decades, their approach included:

- Collecting data from the Scopus database
- Analysing leading authors, countries, and highly cited papers
- Determining current tendencies and emerging themes within the study domain
- Offering avenues for future research based on findings

For the systematic literature review, we relied on the PRISMA statement published by Moher et al., (2009), they recommend that the criteria used should be explicitly stated, including techniques to minimize bias, heterogeneity, and inaccuracies in the obtained data. The equation in Table 3 provides the initial inputs for bibliometric analysis.

Table 3

Equation No. 1. Initial Search Criteria.

Equation No. 1
(("educ*" OR "learn*" OR "teach*") AND ("genera* artificial intelligence" OR "genera* AI"))

The formulation of the search terms, along with the criteria for inclusion and exclusion (Table 5), follows the guidelines outlined by Zawacki-Richter et al. (2020) for structured reviews in educational research, along with the insights from Marín (2022) regarding studies in educational technology. The process adhered to the guidelines of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement to ensure transparency and replicability of the review (Moher et al., 2009; Page et al., 2021), the PRISMA flow diagram was used to document and report the article selection and exclusion process comprehensively. Predefined inclusion and exclusion criteria were carefully established to select relevant studies. These criteria included publication status, language (English only), access to full texts, relevance to GenAI in education and social sciences, publication date within 2023-2024, and focus on the implementation or impact of GenAI (Marín, 2022; Gough et al., 2017). The criteria ensured that only studies providing meaningful insights into educational applications of GenAI were included.

Database Search Strategy

As previously mentioned, the selected academic database was Scopus, the articles for this review study were filtered to the period from 2023 to 2024. In the initial stage, 388 articles were identified.

The methodical literature examination follows the principles outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement as established by Moher et al. (2009). This framework ensures transparency and comprehensiveness in the reporting of systematic reviews and meta-analyses. The research questions guiding this study follow the methodology outlined by Gough et al. (2017). By posing more specific questions, we aim to expand our understanding, validated by academics who have implemented analogous methods in this field of inquiry (Bannister et al. 2023; Luo, 2024; Chng et al. 2023). The questions are as follows table 4:

Table 4

The research questions guiding this study

Research Question (RQ)	Description/Expected Analysis
RQ1	Characteristics of the elements of the final review corpus: publication dates, types of texts, sources used, main journals, involved authors, and the geographic diversity of their origins.
RQ2	In which disciplinary fields are the studies conducted?
RQ3	What are the benefits that generative artificial intelligence offers to education?
RQ4	What challenges and potential risks are associated with the research in the reviewed works?
RQ5	What is the word cloud?
RQ6	How is the Keyword Co-occurrence Analysis conducted?
RQ7	How is the co-occurrence analysis of the number of citations of the main authors conducted?

Selection and rejection guidelines

To meet the objectives of the research and respond to the study's inquiries, a tailored set of inclusion and exclusion parameters were designed to select relevant studies on the topic of GenAI in education. These criteria ensure that only studies aligned with the research scope are retained for analysis.

- Inclusion parameters: These standards are crafted to filter in articles that provide insight into the research topic, focusing on pertinent aspects such as technological implementation, educational frameworks, and GenAI's role in teaching.
- Exclusion parameters: These specify studies that fall outside the scope of the research, such as articles lacking a direct connection to the educational applications of GenAI.

To address the research objectives and questions effectively, inclusion and exclusion criteria were meticulously designed to filter the selected articles relevant to the topic of GenAI in education (Table 5). These criteria ensured that only studies closely aligned with the scope of the investigation were included.

Qualitative content analysis

For the systematic review analysis, ATLAS.ti, version 24 was utilized to facilitate a rigorous qualitative content analysis. PDF documents were imported and subjected to open coding on a line-by-line basis, enabling the extraction of concepts and experiential data directly from the texts. This approach allowed for a nuanced interpretation that went beyond traditional keyword analysis, in line with Silver and Lewins (2014). Subsequently, a second-cycle coding process was applied to refine initial codes into coherent thematic categories through iterative comparison and integration of the reviewed articles. The use of ATLAS.ti, enhanced the management of codes, as well as the organization of writing and data visualization, thereby increasing analytical transparency and methodological rigor. This systematic and replicable qualitative synthesis effectively addressed the research questions, uncovering significant advancements, persistent challenges, and critical implications associated with GenAI in educational contexts.

Table 5

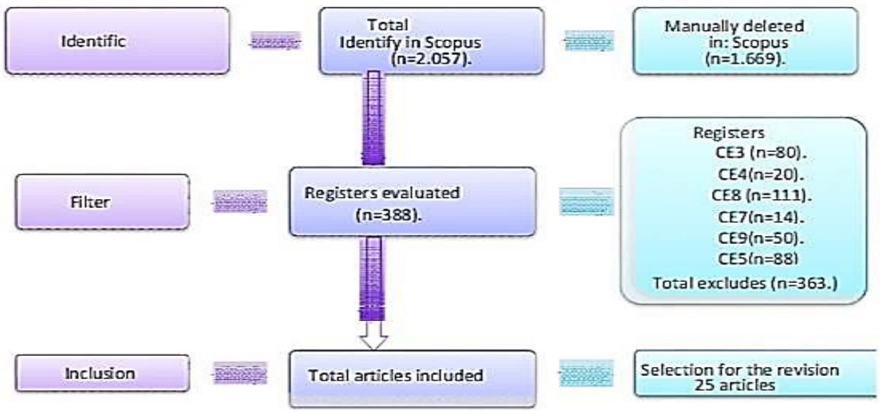
Selection and rejection guidelines

Inclusion criteria	Exclusion criteria
CI1: The article must be published or accepted for publication, with early access available if applicable.	**CE1**: None
CI2: The content should not consist of brief notes or letters.	**CE2**: The article is classified as a note or letter.
CI3: The article must be available in English	**CE3**: The article is written in a language other than English.
CI4: Full access to the article must be available.	**CE4**: The full text of the article is inaccessible.
CI5: The content must be relevant to the use of generative artificial intelligence in the fields of education and social sciences.	**CE5**: The article does not address the application of generative artificial intelligence in education or the social sciences.
CI6: The article should offer insights or reflections on educational practices involving generative AI.	**CE6**: The article fails to offer insights or reflections on the educational use of generative AI.
CI7: The article must have been published within the timeframe of 2023-2024.	**CE7**: The article was not published within the timeframe of 2023-2024.
CI8: The article must focus specifically on Generative AI technology.	**CE8**: The article does not exclusively focus on Generative AI.
CI9: The central topic of the article must be related to the implementation or impact of Generative AI.	**CE9**: The article lacks a focus on the implementation or impact of Generative AI.

Predefined criteria for the inclusion of search articles will be established, and the main findings of the selected articles will be coded to synthesize and answer the specific research question of the study (Figure. 3).

Figure 3

The stages criteria PRISMA



Results

Research Question 1: Characteristics of the elements of the final review corpus: publication dates, types of texts, sources used, main journals, involved authors, and the geographic diversity of their origins.

As a primary result of this study, Table 6 presents the 25 references selected for the systematic review. Each reference is assigned a unique identifier number, which will be consistently used throughout the analysis. The table also provides detailed information about each reference, including the methodologies employed in the respective studies. This organized presentation facilitates a clear overview of the literature basis that supports the systematic examination of the topic.

Table 6

The 25 references selected for the systematic review

No.	Author(s) & Year	References information	Methods	Conclusions
1	Lim, W., Gunasekara, A., Pallant, J., Pechenkina, F. (2023)	Generative AI and the future of education: Regranok or reformation? A paradoxical perspective for management educators. *The International Journal of Management Education*, 21 (2023). https://doi.org/10.1016/j.ijme.2023.100790	Conceptual perspective on future of education with generative AI	Presents generative AI as a paradoxical force in education; potential for reformation or disruption.
2	Victor, B. G., Kubiak, S., Angell, B., Perron, B. E. (2023)	Time to Move Beyond the ASWB Licensing Exams: Can Generative Artificial Intelligence Offer a Forward for Social Work? *Research on Social Work Practice*, 33(5), 517. https://doi.org/10.1177/10497315231161458	Research into AI applications for social work licensing	Argues AI can transform and improve social work licensing exams and processes.
3	Voß, S. (2023)	Bus Bunching and Bus Bridging: What Can We Learn from Generative AI Tools like ChatGPT? *Sustainability*, 15, 9625. https://doi.org/10.3390/su15129625	Case analysis of bus scheduling using AI	AI tools improve transport scheduling and reduce bus bunching.
4	Sharples, Mike. (2023)	Towards social generative AI for education: theory, practices, and ethics. *Learning: Research and Practice*, 9, 2, 159-167. https://doi.org/10.1080/23735082.2023.2261131	Ethical and theoretical review	Emphasizes ethical practice in social generative AI applications in education.
5	Lodge, J. M., Thompson, K., y Corin, L. (2023)	Mapping out a research agenda for generative artificial intelligence in tertiary education. *Australian Journal of Educational Technology*, 39(1), 1-8. https://doi.org/10.14742/ajet.8693	Research agenda formulation	Identifies research priorities for generative AI use in tertiary education.
6	Hsu, Yu-Chang; Ching, Yu-Hui (2023)	Generative artificial intelligence in education, part one: the dynamic frontier. *TechTrends*, 67, no 4, 600-607.	Analytical exploration	Discusses AI's evolving frontier and impact on education.
7	Michel-Villarreal, R.; Villalta-Perdomo, E.; Salinas-Navarro, D.; Thierry-Aquilera, R.; Genardou, F. (2023)	Challenges and Opportunities of Generative AI for Higher Education as Explained by ChatGPT. *Education*, 3, 856. https://doi.org/10.3390/educsci13090856	Case study using ChatGPT	Explores challenges and opportunities of AI integration in higher education.
8	Kelly, A., Sullivan, M., y Strampel, K. (2023)	Generative artificial intelligence: University student awareness, experience, and confidence in use across disciplines. *Journal of University Teaching y Learning Practice*, 20(6). https://doi.org/10.53761/1.20.6	Empirical study on student perceptions	Students demonstrate awareness and varying experience/confidence in AI use across fields.

No.	Author(s) & Year	References information	Methods	Conclusions
9	Mao, J., Chen, B., y Liu, J.C. (2024)	Generative Artificial Intelligence in Education and Its Implications for Assessment. *TechTrends* 68, 58. https://doi.org/10.1007/s11528-023-00911-4	Research and trend analysis	AI is reshaping educational assessment practices significantly.
10	Lee, A., Tan, S. y Teo, C. (2023)	Designs and practices using generative AI for sustainable student discourse and knowledge creation. *Learn. Environ.*, 10, 59 (2023). https://doi.org/10.1186/s40561-023-00279-1	Case studies on AI in student discussions	AI fosters sustainable discourse and knowledge co-creation among students.
11	Bannister, P., Santamaria, A., Alcala, E. (2023)	A systematic review of generative AI and (English medium instruction) higher education. *Avalua Abierta*, 10 4, p. 401-409. http://doi.org/10.17811/rife.5.4.2023.401-409	Systematic literature review	Summarizes key findings and gaps in generative AI application in higher education.
12	Victor, B. G., Sokol, R. L., Goldkind, L., y Perron, B. E. (2023)	Recommendations for social work researchers and journal editors on the use of generative AI and language models. *Journal of the Society for Social Work and Research*, 14(3), 563. https://doi.org/10.1086/726021	Editorial and guideline recommendations	Offers guidelines for ethical and effective AI use in social work research.
13	Fleckenstein, J., Meyer, J., Johann, D., Keller, D., Köller, A., Möller, J. (2024)	Do teachers spot AI? Evaluating detectability of AI-generated texts among student essays. *Computers and Education: Artificial Intelligence*, Volume 6, p. 100209. https://doi.org/10.1016/j.caeai.2024.100209	Empirical test on AI-generated text detection	Evaluates how well teachers can identify AI-generated student writing.
14	Chiu, T. (2024)	Future research recommendations for transforming higher education with generative AI. *Computers and Education: Artificial Intelligence*, vol. 6, p. 100197. https://doi.org/10.1016/j.caeai.2023.100197	Review and recommendation paper	Calls for research to maximize AI benefits and mitigate risks in higher education.
15	Cummings, R.; Monroe, S.; Watkins, M. (2024)	Generative AI in first-year writing: An early analysis of affordances, limitations, and a framework for future. *Computers and Composition*, vol. 71, p. 102827. https://doi.org/10.1016/j.compcom.2024.102827	Early career study in writing education	Analyzes AI's potential and challenges in supporting first-year students' writing.
16	Salinas-Navarro, D.E.; Villalta-Perdomo, E.; Michel-Villarreal, R.; Mouteisnios, L. (2024)	Using Generative Artificial Intelligence Tools to Explain and Enhance Experiential Learning for Auth	Case studies and assessments	AI tools improve explanations and enrich experiential learning outcomes.
17	Shi, S.J., Li, Y.R., Zhong, J.W. (2024)	A study on the impact of Generative Artificial Intelligence supported Situational Interactive Teaching on students' "flow" experience and learning effectiveness – a case study of legal education in China. *Pacific Journal of Education*, 44:1, 112-138. https://doi.org/10.1080/02188791.2024.2305161	Case study of legal education employing AI-supported interactive teaching	AI support enhances student engagement and learning effectiveness.
18	Hsu, Y.C., Ching, Y.H. (2023)	Generative Artificial Intelligence in Education, Part Two: International Perspectives. *TechTrends*, 67, 890. https://doi.org/10.1007/s11528-023-00913-2	Analytical overview	Provides further perspectives on AI's global application and implications.
19	Stone, C. (2023)	Artificial intelligence in social work practice education. The potential use of Generative AI for learning. *Journal of Practice Teaching and Learning*, 20(3). https://doi.org/10.1921/jpts.v20i3.219	Review and potential use case analysis	AI has strong potential to enhance social work education learning practice.
20	Duah, J. y McGivern, P. (2024)	How generative artificial intelligence has blurred notions of authorship and academic norms in higher education, necessitating clear university usage policies. *International Journal of Information and Learning Technology*. https://doi.org/10.1108/IJILT-11-2023-0213	Theoretical and policy analysis	Calls for updated institutional policies addressing AI's impact on authorship and academic integrity.

No.	Author(s) & Year	References information	Methods	Conclusions
21	Moorhouse, B. (2024)	Beginning and first-year language teachers' readiness for the generative AI age. *Computers and Education: Artificial Intelligence*. 6.100201. https://doi.org/10.1016/j.caeai.2024.100201	Empirical readiness assessment	Highlights gaps in AI readiness of new language teachers.
22	Xu, X. (2024)	Navigating the AI Revolution: Implications for Business Education and Pedagogy. *Journal of Curriculum and Teaching*, 13, 1, 371-391. https://doi.org/10.5430/jct.v13n1p371	Analytical and pedagogical discussion	Discusses AI's transformative implications for business curricula and teaching methods.
23	Mishra, P., Oster, N., Henriksen, D. (2024)	Generative AI Teacher Knowledge and Educational Research: Bridging Short- and Long-Term Perspectives. *TechTrends* 68, 205-210. https://doi.org/10.1007/s11528-024-00938-1	Research synthesis	Integrates short- and long-term perspectives on AI's impact on teacher knowledge and research.
24	Liu, J., Wang, C., Liu, Z., Gao, M., Xu, Y. (2024)	A bibliometric analysis of generative AI in education: current status and development. *Asia Pacific Journal of Education*, p. 1-20. *Asia Pacific Journal of Education*, *44*(1), 156–175. https://doi.org/10.1080/02188791.2024.2305170	Bibliometric analysis	Identifies current research trends and growth areas in generative AI education research.
25	Luo, J. (2024)	A critical review of GenAI policies in higher education assessment: a call to reconsider the "originality" of students' work. *Assessment & Evaluation in Higher Education*, p. https://doi.org/10.1090/02602938.2024.2309963	Critical policy analysis	Urges reconsideration of originality policies in light of generative AI's role in student assessments.

The yearly research output from 2023 to 2024, representing the distribution of documents indexed in the SCOPUS database by year, is summarized. The primary journals in which the selected articles were published are presented in Table 7. Most of these articles are from 2023, accounting for 76% of the total, indicating that the adoption and study of GenAI is a relatively new and rapidly evolving field. Furthermore, the predominance of journal articles in this review offers a comprehensive perspective on the topic. Table 7 lists the leading journals and the number of articles they have contributed.

Table 7

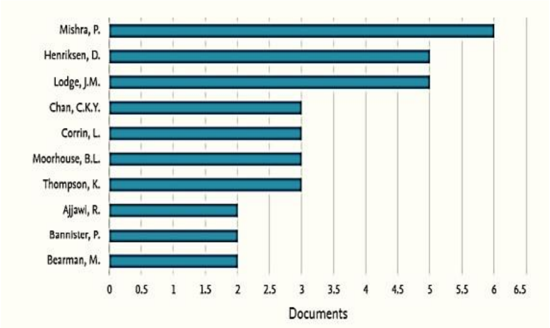
The main10 journals from Scopus

Main journals	Number of articles
Jmir Medical Education	11
Journal of Applied Learning and Teaching	8
Australasian Journal of Educational Technology	7
Tec Trends	5
Sustainability Switzerland	5
Education Sciences	5
Computers And Education Artificial Intelligence	5
International Journal of Educational Technology in Higher Education	4
Smart Learning Environments	3
International Journal of Management Education	3

The figure 4 presents a ranked list of authors based on their publication productivity, measured by the number of documents they have published. Mishra, P. stands as the most productive author with nearly six documents, indicating a significant contribution. Following closely are Henriksen, D. and Lodge, J.M., each with approximately five publications, demonstrating strong engagement in research dissemination.

Figure 4

The 10 most prominent authors.



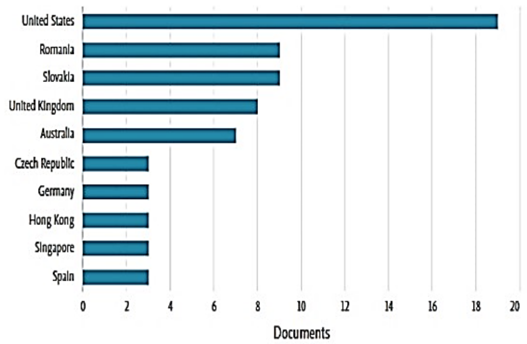
Authors such as Chan, C., Corrin, L., Moorhouse, B., and Thompson, K. reflect moderate productivity, each contributing around three to four documents, which suggests consistent involvement in scholarly output. Ajjawi, R., Bannister, P., and Bearman, M. have fewer publications, about two documents each, indicating more limited but still relevant contributions within the studied field.

This distribution underscores important authors who have driven research forward, potentially influencing academic discourse and development within their domain. It can be used to identify key researchers for collaboration, citation, or further study of their work. The data also offers insight into the research landscape by highlighting prolific authors and varying publication patterns among scholars.

The spatial distribution of the articles Figure 5 reveals notable geographic trends in research on GenAI in education. The United States emerges as the most prominent contributor, with 19 articles, reflecting its significant investment and interest in educational technology and artificial intelligence. Romania and Slovakia also show strong representation, each contributing 9 articles, which may indicate growing research activity and focus on GenAI within Eastern Europe. The United Kingdom follows closely with 8 articles, demonstrating active engagement in this field, likely supported by its advanced academic institutions and AI research centers. Australia contributes 7 articles, highlighting its role in GenAI scholarship in the education sector. This geographic distribution suggests a concentration of research in North America, Europe, and Oceania, illustrating regional variations in the study and application of generative AI technologies in education contexts. These patterns provide insight into where scholarly attention is currently focused and where future collaboration or investigation might expand. (Figure 5)

Figure 5

The spatial distribution of the articles

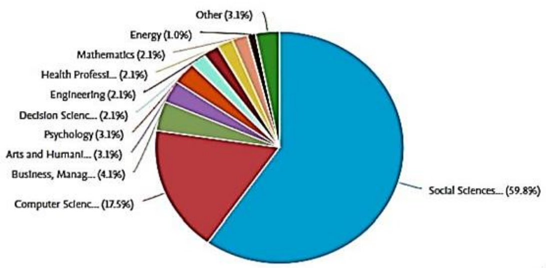


Research Question 2. In which disciplinary fields are the studies conducted?

Figure 6 illustrates the distribution of various academic fields. Social Sciences represent the largest segment by far, accounting for nearly 60% of the total. This indicates a substantial focus on areas such as sociology, anthropology, economics, and political science, reflecting the importance of understanding human society and behaviour. Computer science comes next as the second-largest field, comprising 17.5%. This considerable share points to strong emphasis on technology, programming, data analysis, and related computational skills. Business and management make up 4.1% of the distribution, showing attention to organizational operations, leadership, and corporate strategies. Arts and humanities, alongside psychology, each share 3.1%, contributing to the study of culture, history, creative expression, and human cognition or behaviour. Other technical and scientific areas such as decision science, engineering, health professions, and mathematics each account for about 2.1%, reflecting diverse skill sets in analytical thinking, problem-solving, healthcare, and quantitative reasoning. Energy is the smallest distinct category at 1.0%, focused on power and resource management. The remaining 3.1% falls into an "Other" category, encompassing miscellaneous or less common disciplines. Overall, the distribution reveals a dominant orientation toward social sciences and technology, with a balanced presence of business, humanities, psychology, and technical fields, indicating a well-rounded and interdisciplinary academic landscape.

Figure 6

The disciplinary fields



Research Question 3. What are the benefits that generative artificial intelligence offers to education?

A review of the 25 articles on GenAI's contributions to education reveals several key areas where AI is delivering substantial benefits. From the review, it emerges that GenAI's contributions to education can be summarized in eight key themes and perspectives:

1. Transformative Potential and Paradoxes in Education

Generative AI can both reshape and disrupt traditional education, posing challenges to authorship, originality, and academic integrity that require new institutional policies (Lim et al., 2023; Duah & McGivern, 2024; Luo, 2024).

2. Enhancement of Teaching, Learning, and Assessment

AI improves student engagement, experiential learning, and collaboration, and transforms assessment, with tools like ChatGPT offering both opportunities and challenges for its curricular integration (Salinas-Navarro et al., 2024; Lee et al., 2023; Mao et al., 2024; Michel-Villarreal et al., 2023 Loor-Rivadeneira et al., 2024).

3. Teacher Readiness and Knowledge

There are gaps in teacher preparation for generative AI, highlighting the need for ongoing training to incorporate short- and long-term perspectives (Moorhouse, 2024; Mishra et al., 2024).

4. Student Awareness and Confidence in AI Use

Students have varying awareness and confidence about AI, which is key to its effective educational implementation (Kelly et al., 2023).

5. Ethical, Social, and Policy Considerations

The ethical use of AI is emphasized, with guidelines for researchers and educators and the urgent need for policies that maintain academic integrity (Sharples, 2023; Victor et al., 2023; Bannister et al., 2023; Duah & McGivern, 2024; Luo, 2024).

6. Research Agenda and Trends

Research highlights priorities for maximizing benefits and mitigating risks, with growing trends in studies on generative AI in education (Lodge et al., 2023; Chiu, 2024; Liu et al., 2024).

7. Specific Domain Applications

AI is transforming specific sectors such as social work education and business, and supports early writing instruction with frameworks that highlight strengths and limitations (Victor et al., 2023; Stone, 2023; Xu, 2024; Cummings et al., 2024).

8. Challenges in Detection and Integrity

Detecting AI-generated text remains a challenge for educators, raising concerns about assessment integrity (Fleckenstein et al., 2024).

The four classifications correspond to key thematic areas in the integration of generative AI in education

The four classifications are key to integrating GenAI in education. They help tailor learning to individual needs, improve assessment methods, boost student motivation, and reduce educators' workload. Together, they create a more effective, equitable, and efficient educational experience.

Generative AI is transforming education by creating new opportunities in teaching, learning, and assessment. It enables personalized learning by adapting content and activities to each student's unique needs, fostering a more effective and inclusive education. Additionally, it supports innovative assessment methods that move beyond traditional exams, offering dynamic and continuous evaluation of student progress. Generative AI also enhances engagement by providing interactive and creative learning environments that boost motivation and participation. For educators, this technology reduces workload by automating routine tasks and improving instructional design and feedback. These four themes—personalized learning, innovative assessment, enhanced engagement, and educator support—are essential for revolutionizing education. They help close learning gaps, improve outcomes, and make the educational process more dynamic and efficient for both students and teachers. Overall, generative AI promotes a more inclusive and transformative educational ecosystem. The importance of these four themes in the context of generative AI in education lies in their potential to revolutionize the learning and teaching process for better outcomes:

1. Personalized and Adaptive Learning with Generative AI is crucial because it addresses diverse learner needs, helping to close achievement gaps by offering customized pathways that maximize each student's potential.
2. Innovative Assessment with Generative AI is important as it moves assessment beyond static exams toward more meaningful, real-time evaluation, providing timely feedback that supports continuous improvement and deeper learning.
3. Enhanced Engagement with Generative AI matters because increased student motivation and active participation are foundational for effective learning, and AI-driven interactive experiences can make education more appealing and relevant.
4. Support for Educators with Generative AI is vital since it alleviates workload pressures, enhances teacher effectiveness, and allows educators to focus more on instruction and personalized student support rather than administrative tasks.

Together, these themes reflect how generative AI can create a more inclusive, effective, and dynamic educational ecosystem, transforming both learner experiences and instructional practices for the future.
The four classifications correspond to key thematic areas in the integration of generative AI in education:

1. Personalized and Adaptive Learning with Generative AI: Tailoring educational content and pacing to individual learners' needs using AI-driven customization.
2. Innovative Assessment with Generative AI: Developing new forms of evaluation that leverage AI to create dynamic, formative, and authentic assessments.
3. Enhanced Engagement with Generative AI: Using generative AI to increase student motivation, interaction, and participation through interactive and immersive learning experiences.
4. Support for Educators with Generative AI: Providing educators with AI tools to assist in lesson planning, grading, feedback, and professional development.

Theme 1 Personalized and Adaptive Learning with Generative AI

These articles address how generative AI can personalize learning, adapting to students' individual needs. They highlight use cases in higher education and experiences that enhance engagement and knowledge through AI tools. Table 8.

Table 8

Theme Personalized and Adaptive Learning with Generative AI

No.	Author(s) & Year	References information	Methods	Conclusions
1	Lim, W., Gunasekara, A., Pallant, J., Pechenkina, F. (2023)	Generative AI and the future of education: Regranok or reformation? A paradoxical perspective for management educators. *The International Journal of Management Education*, 21 (2023). https://doi.org/10.1016/j.ijme.2023.100790	Conceptual perspective on future of education with generative AI	Presents generative AI as a paradoxical force in education; potential for reformation or disruption.
6	Hsu, Yu-Chang; Ching, Yu-Hui (2023)	Generative artificial intelligence in education, part one: the dynamic frontier. *TechTrends*, 67, no 4, 600-607.	Analytical exploration	Discusses AI's evolving frontier and impact on education.
7	Michel-Villarreal, R.; Villalta-Perdomo, E.; Salinas-Navarro, D.; Thierry-Aquilera, R.; Genardou, F. (2023)	Challenges and Opportunities of Generative AI for Higher Education as Explained by ChatGPT. *Education*, 3, 856. https://doi.org/10.3390/educsci13090856	Case study using ChatGPT	Explores challenges and opportunities of AI integration in higher education.
10	Lee, A., Tan, S. y Teo, C. (2023)	Designs and practices using generative AI for sustainable student discourse and knowledge creation. *Learn. Environ.*, 10, 59 (2023). https://doi.org/10.1186/s40561-023-00279-1	Case studies on AI in student discussions	AI fosters sustainable discourse and knowledge co-creation among students.
16	Salinas-Navarro, D.E.; Villalta-Perdomo, E.; Michel-Villarreal, R.; Mouteisnios, L. (2024)	Using Generative Artificial Intelligence Tools to Explain and Enhance Experiential Learning for Auth	Case studies and assessments	AI tools improve explanations and enrich experiential learning outcomes.
18	Hsu, Y.C., Ching, Y.H. (2023)	Generative Artificial Intelligence in Education, Part Two: International Perspectives. *TechTrends*, 67, 890. https://doi.org/10.1007/s11528-023-00913-2	Analytical overview	Provides further perspectives on AI's global application and implications.

Theme 2 Innovative Assessment with Generative AI

This article focuses on the transformation of educational assessment, including automation, analysis of student work, and new assessment models powered by AI. Some articles call for reconsidering regulations on originality and ethics in assessments. Table 9.

Theme 3 Enhanced Engagement with Generative AI

These articles explore how AI increases student motivation and involvement through interactive learning environments, simulations, and personalized content that maintain attention and foster active participation. Table 10.

Table 9

Theme 2 Innovative Assessment with Generative AI

No.	Author(s) & Year	References information	Methods	Conclusions
2	Victor, B. G., Kubiak, S., Angell, B., Perron, B. E. (2023)	Time to Move Beyond the ASWB Licensing Exams: Can Generative Artificial Intelligence Offer a Forward for Social Work? *Research on Social Work Practice*, 33(5), 517. https://doi.org/10.1177/10497315231161458	Research into AI applications for social work licensing	Argues AI can transform and improve social work licensing exams and processes.
9	Mao, J., Chen, B., y Liu, J.C. (2024)	Generative Artificial Intelligence in Education and Its Implications for Assessment. *TechTrends* 68, 58. https://doi.org/10.1007/s11528-023-00911-4	Research and trend analysis	AI is reshaping educational assessment practices significantly.
15	Cummings, R.; Monroe, S.; Watkins, M. (2024)	Generative AI in first-year writing: An early analysis of affordances, limitations, and a framework for future. *Computers and Composition*, vol. 71, p. 102827. https://doi.org/10.1016/j.compcom.2024.102827	Early career study in writing education	Analyzes AI's potential and challenges in supporting first-year students' writing.
23	Mishra, P., Oster, N., Henriksen, D. (2024)	Generative AI Teacher Knowledge and Educational Research: Bridging Short- and Long-Term Perspectives. *TechTrends* 68, 205-210. https://doi.org/10.1007/s11528-024-00938-1	Research synthesis	Integrates short- and long-term perspectives on AI's impact on teacher knowledge and research.

Table 10

Theme 3 Enhanced Engagement with Generative AI

No.	Author(s) & Year	References information	Methods	Conclusions
3	Voß, S. (2023)	Bus Bunching and Bus Bridging: What Can We Learn from Generative AI Tools like ChatGPT? *Sustainability*, 15, 9625. https://doi.org/10.3390/su15129625	Case analysis of bus scheduling using AI	AI tools improve transport scheduling and reduce bus bunching.
8	Kelly, A., Sullivan, M., y Strampel, K. (2023)	Generative artificial intelligence: University student awareness, experience, and confidence in use across disciplines. *Journal of University Teaching y Learning Practice*, 20(6). https://doi.org/10.53761/1.20.6	Empirical study on student perceptions	Students demonstrate awareness and varying experience/confidence in AI use across fields.
17	Shi, S.J., Li, Y.R., Zhong, J.W. (2024)	A study on the impact of Generative Artificial Intelligence supported Situational Interactive Teaching on students' "flow" experience and learning effectiveness – a case study of legal education in China. *Pacific Journal of Education*, 44:1, 112-138. https://doi.org/10.1080/02188791.2024.2305161	Case study of legal education employing AI-supported interactive teaching	AI support enhances student engagement and learning effectiveness.
19	Stone, C. (2023)	Artificial intelligence in social work practice education. The potential use of Generative AI for learning. *Journal of Practice Teaching and Learning*, 20(3). https://doi.org/10.1921/jpts.v20i3.219	Review and potential use case analysis	AI has strong potential to enhance social work education learning practice.

Theme 4 Support for Educators with Generative AI

This theme looks at the role of AI tools in assisting teachers by automating routine tasks, providing insights into student learning patterns, and offering resources to improve instructional practices and professional development. Table 11

Table 11

Theme Support for Educators with Generative AI

No.	Author(s) & Year	References information	Methods	Conclusions
4	Sharples, Mike. (2023)	Towards social generative AI for education: theory, practices, and ethics. *Learning: Research and Practice*, 9, 2, 159-167. https://doi.org/10.1080/23735082.2023.2261131	Ethical and theoretical review	Emphasizes ethical practice in social generative AI applications in education.
5	Lodge, J. M., Thompson, K., y Corin, L. (2023)	Mapping out a research agenda for generative artificial intelligence in tertiary education. *Australian Journal of Educational Technology*, 39(1), 1-8. https://doi.org/10.14742/ajet.8693	Research agenda formulation	Identifies research priorities for generative AI use in tertiary education.
12	Victor, B. G., Sokol, R. L., Goldkind, L., y Perron, B. E. (2023)	Recommendations for social work researchers and journal editors on the use of generative AI and language models. *Journal of the Society for Social Work and Research*, 14(3), 563. https://doi.org/10.1086/726021	Editorial and guideline recommendations	Offers guidelines for ethical and effective AI use in social work research.
21	Moorhouse, B. (2024)	Beginning and first-year language teachers' readiness for the generative AI age. *Computers and Education: Artificial Intelligence*. 6.100201. https://doi.org/10.1016/j.caeai.2024.100201	Empirical readiness assessment	Highlights gaps in AI readiness of new language teachers.

Qualitative Summary on Personalized and Adaptive Learning in the Context of Generative AI

Recent studies highlight how generative artificial intelligence is transforming education by enhancing personalized and adaptive learning tailored to individual student needs.

- **Conceptual perspectives** (Lim et al., 2023) present generative AI as a paradoxical force in education, with the potential to both deeply reform and disrupt teaching and learning practices. This suggests that adaptive AI-driven applications can enrich personalized learning experiences but also raise concerns about technology dependence and educational quality.
- **Analytical explorations** (Hsu & Ching, 2023) emphasize the dynamic and evolving frontier of AI in education, where adaptive technologies adjust content and pedagogical strategies based on student interactions and progress, thereby strengthening personalized learning across diverse international contexts.
- **Case studies** (Michel-Villarreal et al., 2023; Lee, Tan & Teo, 2023; Salinas-Navarro et al., 2024) demonstrate that generative AI fosters sustainable student discourse, co-creation of knowledge, and enhances experiential learning outcomes. These adaptive approaches promote more meaningful and personalized learning by providing real-time explanations and resources tailored to each learner's needs and learning style.
- **Challenges and opportunities** arise in integrating these tools, including the need to ensure that personalization does not compromise equity or quality, and to ethically manage data use and maintain student autonomy.

Research Question 4. What is the risk of GenAI to education according to the 25 authors?

The 25 articles identify several key academic integrity risks related to the use of GenAI in education:

1. **Plagiarism and Misrepresentation**

   GenAI enables students to submit AI-generated work as their own, leading to plagiarism and misrepresentation of original authorship. This includes generating essays, assignments, or ideas without proper attribution, violating academic honesty standards (Luo, 2024; Fleckenstein et al., 2024).
2. **Fabrication and Hallucination**

   AI-generated content may include fabricated information like false citations, data, or results (known as 'AI hallucination'), which can distort academic work and lead to misinformation within assessments (Gaburro, 2025).

3. **Collusion and Unauthorized Collaboration**
   Students using the same GenAI tools may produce similar work that appears as collusion in individual assessments, complicating the evaluation of independent work (Flagler Library, (2025, January 28).
4. **Challenges in Detection**
   Detecting AI-generated work is difficult with current tools, which produce false positives and negatives. This weakens enforcement of academic integrity policies and necessitates reliance on updated assessment designs and pedagogical approaches rather than solely on detection technologies (Lodge et al., 2023).
5. **Unequal Impact and Digital Divide**
   Students with unequal access or competency in GenAI use may face disparate impacts, risking equity and fairness in academic integrity enforcement (Moorhouse, 2024).
6. **Assessment Validity**
   Traditional assessments may fail to evaluate students' authentic competencies if GenAI is misused, necessitating redesigned assessments that emphasize critical thinking and application beyond easy AI-generated outputs (Mao et al., 2024).
7. **Ethical and Policy Gaps**
   There is an urgent need for clear institutional policies, ethical guidelines, and educational practices addressing appropriate GenAI use to preserve trust in academic processes (Victor et al., 2023).

In summary, the risk landscape as synthesized in these articles highlights plagiarism, fabrication, collusion, detection difficulties, inequity, and assessment validity threats posed by generative AI in education. Mitigating these requires systemic changes in pedagogy, policies, student and faculty education, and development of fair, transparent, and adaptable academic integrity frameworks. Table 12 summarizes various risk categories associated with the use of Generative AI in education, detailing specific risks within each category along with references to the authors who identified them.

GenAI is redesigning education by personalizing learning, creating innovative assessments, and improving administrative tasks. Its tailors' content and feedback to individual students, enabling adaptive and engaging experiences. GenAI also supports new assessment types that foster creativity and critical thinking beyond traditional exams.

However, GenAI integration poses challenges. Academic integrity risks increase due to potential plagiarism and misuse of AI-generated work. Assessment validity suffers if students rely too heavily on AI rather than demonstrating their knowledge. Inequitable access to GenAI may worsen educational disparities, especially for under-resourced students. Detecting AI-generated content remains difficult, complicating standard enforcement. Ethical issues, data privacy concerns, and unclear policies further complicate responsible use.

Table 12

Identified Risks of Generative AI in Education

Risk Categories	Description	Authors
Educational Quality and Evaluation	- Inadequate Assessments and Difficulty Detecting Plagiarism. - Less Authentic Assessments and Issues with Originality in Academic Work. - Limitation of Creativity and Originality in Student Writing.	Victor, B. G., Chen, B., Fleckenstein, J. Salinas-Navarro, D.; Duah, J.; Luo, J. Cummings, R.
Ethics and Privacy	- Ethical and privacy risks in the implementation of Gen AI. - Complication of authorship and originality in academic work.	Sharples, Mike; Victor, B. G.; Duah, J.
Inequality and Access	- Exacerbation of digital divides and limitation of access for disadvantaged students. - Cultural differences affecting AI perceptions.	Hsu, Yu-Chang; Hsu, Y.C.
Dehumanization and Dependency	- Exacerbation of digital divides and limitation of access. - Cultural differences affecting perceptions.	Lim, W.; Voß, S.
Preparation and Training	- Lack of preparation and training for students and teachers. - Rapid adoption without sufficient research and adaptation.	Kelly, A.; Moorhouse, B. Lodge, J. M.; Chiu, T.
Discipline Specificity	- Inadequate capture of social and emotional skills in social work. - Changes in English teaching and language immersion. - Altered teaching methods in fields like law and business.	Victor, B. G.; Stone, C. Bannister, P. Shi, S.J.; Xu, X.
Interaction and Participation	- Promotion of superficial interactions affecting learning depth. Failure to promote sustainable student discourse.	Lee, A. Shi, S.J.; Lee, A.
Dehumanization and Dependence	- Depersonalization of education and reduced human interaction. - Excessive dependence diminishing judgment.	Lim, W.

To balance benefits and risks, clear policies, digital literacy training for educators, and inclusive access are essential. When combined with strong pedagogy, GenAI can boost creativity, autonomy, and learning outcomes without undermining educational values. Continued research and policy development are vital to ensure ethical, equitable, and effective GenAI use for all learners (UNESCO, 2023). GenAI is transforming education by enabling personalized learning, innovative assessments, and streamlined administration. It customizes content and feedback to individual students, fostering adaptive and engaging learning, while supporting new assessment methods that encourage creativity and critical thinking beyond traditional exams.

However, challenges include risks to academic integrity from AI-generated plagiarism, threats to assessment validity due to overreliance on AI, and the potential to deepen educational inequities for under-resourced learners. Detecting AI content remains difficult, complicating academic standards enforcement. Ethical concerns, data privacy, and unclear policies further complicate responsible use (Cheong, 2024).
Balancing benefits and risks require clear policies, teacher training in digital literacy, and equitable access initiatives. With sound pedagogy, GenAI can enhance creativity and learning outcomes without compromising educational values. Ongoing research and policy must focus on ethical, equitable, and effective GenAI implementation (UNESCO, 2023) Table 13.

Table 13

Identified Risks and Benefits of Generative AI in Education

Aspect	Principal Risks of GenAI in Education	Principal Benefits of GenAI in Education
Academic Integrity	Plagiarism and misrepresentation of authorship by submitting AI-generated work as original; fabrication of false data or citations; collusion through similar AI-generated outputs.	Supports personalized feedback and formative assessment by generating tailored learning resources and examples.
Assessment Validity	Threats to validity of traditional assessments as students may rely on AI-generated content instead of demonstrating independent competence.	Enables creation of innovative assessment formats that emphasize critical thinking and creative application beyond regurgitation.
Equity and Access	Unequal access to GenAI technology widens digital divide, potentially disadvantaging some students.	Provides adaptive learning support that can be accessed anytime, assisting diverse learners and supporting inclusive education.
Detection and Enforcement	Difficulty detecting AI-generated work with current tools leads to challenges in enforcing academic integrity policies.	Facilitates automation of administrative tasks, grading, and plagiarism checks, saving educator time and allowing focus on pedagogy.
Ethical and Policy Challenges	Lack of clear institutional policies and guidelines causes uncertainty about appropriate AI use and ethical concerns.	Promotes development of digital literacy and ethical AI use education for students and faculty, fostering responsible use of technology.
Creativity and Learning	Risk that over-reliance on AI reduces development of critical thinking, problem-solving skills, and original creativity.	Enhances creativity by supporting idea generation, brainstorming, and exploration of new concepts in a collaborative way.

Research Question 5. What is the word cloud?

The visual representation of words in the cloud illustrates the frequency of each term, where their size corresponds to how often they appear. In AIGen contexts, while the word arrangement might seem scattered, the most commonly used words are centrally placed and appear larger, making them more noticeable, as shown in Figure 7.

Figure 7

Visual representation of words in the cloud.

Research Question 6. How is the Keyword Co-occurrence Analysis conducted?

The Keyword Co-occurrence Analysis in the reviewed articles on GenAI and education identified the most relevant research topics by examining how frequently keywords appeared together. To ensure consistency and thematic coherence, clusters were formed only when at least five keywords co-occurred.

In the co-occurrence network (illustrated in Figure 8), keywords are grouped into color-coded clusters—typically red, green, blue, and yellow—each representing thematic areas. The size of each keyword node indicates its frequency, and lines connecting nodes show how often keywords appear together, reflecting their relationships.

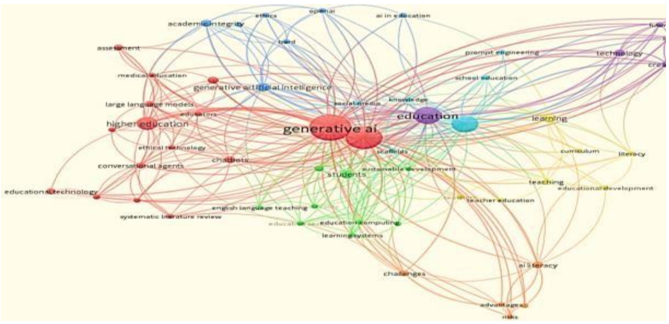
The analysis revealed several prominent clusters:

- One cluster (often red) focuses on foundational AI terms like "artificial intelligence," "machine learning," and ethical considerations related to GenAI.
- Another cluster (green) centres on educational levels and processes, including terms like "higher education," "K-12," "teaching," and "learning."
- A blue cluster groups keywords related to educational technology, such as "chatbot," "education technology," and "GPT."
- The yellow cluster often highlights deep learning and specific AI techniques applied in education contexts.

These clusters mirror the interdisciplinary nature of GenAI research in education, covering technological, pedagogical, ethical, and application-focused themes. The network map visually emphasizes the strongest connections and thematic groupings, helping to identify current research emphases and gaps in the field. Overall, the keyword co-occurrence analysis provides a structured overview of how research topics related to GenAI and education interrelate, supporting a deeper understanding of the field's landscape and guiding future inquiries.

Figure 8

Keyword Co -occurrence Analysis



Cluster 1 (7 items) academic integrity, ai, authentic assessment, chatbots, educational innovation, generative artificial intel, higher education.

Cluster 2 (7 items) conversational agents, educators, ethical technology, gpt-4, large language model, large language models, medical education.

Cluster 3 (6 items) artificial intelligence, creativity, education, learning, literacy, technology.

Cluster 4 (5 items) assessment education computing engineering education high educations sustainable developer

Cluster 5 (5 items) ChatGPT knowledge building students teacher education teachers'

Cluster 6 (5 items) artificial intelligence in bing chat midjourney prompt engineering

Research Question 7. How is the co-occurrence analysis of the number of citations of the main authors conducted?

The co-occurrence analysis of the number of citations of main authors, coupled with keyword co-occurrence analysis, is a powerful bibliometric method used to identify the most relevant research topics and influential contributors in the field of GenAI and education. This analysis visually and quantitatively maps the relationships between keywords or authors based on their frequency of joint appearances in academic articles.

In the context described, the co-occurrence network was designed with clusters of keywords or authors that frequently appear together, which helps reveal thematic groups and research focus areas. Colours code different clusters, indicating tightly linked keywords or authors, while shapes and distances represent the strength and nature of these relationships. For example, clusters of keywords related to adaptive learning, intelligent tutoring systems, and educational technology might emerge, portraying dominant research themes in GenAI and education.

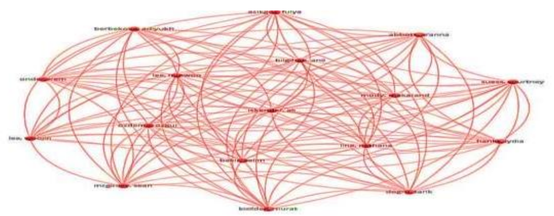
Specifically, the co-citation network analysis of author citations focuses on connections between authors who are cited together in the same articles. By analysing only authors with 25 or more citations and emphasizing "first authors" to avoid clutter, the study can identify the most influential researchers and how they relate within the scholarly community. This method follows the bibliometric approach outlined by Waltman and van Eck (2012), which provides a rigorous framework for clustering and mapping publication relationships.

This co-citation analysis visualized in Figure 9 highlights the leading authors in genAI and education research by showing which authors are most frequently cited together, indicating intellectual linkages and potentially shared research interests or collaborations. The network analysis thereby offers a holistic interpretation of the scholarly landscape, not just identifying influential individuals but also revealing the structure of the research community and key thematic connections.

Such analyses enable researchers to understand prevailing research clusters, emerging trends, and key contributors shaping the field of GenAI and education, guiding both literature reviews and future research directions.
In summary, co-occurrence and co-citation network analyses use citation frequencies and keyword relationships to uncover the intellectual structure and main research topics within educational applications of generative AI, as clearly represented in the thematic clusters and author networks of Figure 9, based on established bibliometric methodologies.

Figure 9

Co-occurrence analysis of the number of citations of the main authors



Author	Document	Citations
Adarkwah, Michael Agyemang	1	216
Agyemang, Brighter	1	216
Bozkurt, Aras	1	216
Hickey, Daniel T.	1	216
Huang, Ronghuai	1	216
Shehata, Boulus	1	216
Tlili, Ahmed	1	216
Gunasekara, Asanka	1	112
Lim, Weng Marc	1	112
Pallant, Jason Ian	1	112
Pallant, Jessica Leigh	1	112
Pechenkina, Ekaterina	1	112

Discussion

This article provides a comprehensive discussion on the transformative impact of Generative AI (GenAI) in the fields of social sciences and education. It effectively presents an overview of the current state and emerging trends of GenAI applications in educational contexts, laying a solid groundwork for future investigations in this quickly advancing domain. The surge in annual research outputs illustrates a clear and growing scholarly interest in Generative AI (GenAI) within education, reflecting widespread recognition by academics and educators of its transformative potential. Echaiz et al. (2021) highlight early recognition of GenAI's capacity for pedagogical innovation, while Miao and Holmes (2023) underscore its facilitation of tailored learning experiences. Bond et al. (2024) and Yusuf et al. (2024) further confirm GenAI's effectiveness in developing intelligent tutoring systems, which offer responsive and interactive educational support. Together, these findings emphasize a comprehensive academic acknowledgment of GenAI's multifaceted impact on teaching and learning practices. This body of research demonstrates the field's dynamic evolution and the central role GenAI is poised to play in shaping future educational paradigms.

The study's methodological rigor is notable for its comprehensive use of a systematic review guided by PRISMA protocols, which has been recognized as a gold standard in research synthesis (Liu et al., 2024). By integrating multiple analytical techniques—quantitative descriptive analysis, qualitative thematic coding using ATLAS.ti, and bibliometric mapping through VOSviewer—the study achieves a multifaceted and nuanced examination of the literature. Similar methodological approaches have been endorsed by scholars like Tranfield et al. (2003) and Petticrew & Roberts (2006), who emphasize the importance of combining quantitative and qualitative analyses for a thorough understanding of complex research landscapes.

The use of ATLAS.ti, for thematic coding aligns with Silver and Lewins (2014) advocacy for qualitative methods in educational research, enabling deep insight into emerging themes and patterns. Meanwhile, bibliometric mapping with VOSviewer, as supported by Waltman and van Eck (2012), provides a powerful tool for visualizing relationships and trends within the scientific literature. Together, these methodologies facilitate robust visualization and synthesis, enhancing comprehension of how Generative AI tools are progressively adopted and adapted within educational contexts. Beyond methodological strengths, the discussion reflects growing academic momentum around GenAI, consistent with views expressed by researchers like Holmes et al. (2019), who underscore the need for critical frameworks when implementing emerging technologies in education. This study contributes meaningfully by illuminating both the rapid evolution of GenAI research and the imperative for responsible integration, highlighting the balance between innovation and ethical considerations that future research must address.

Articles retrieved from the Scopus database revealed publication trends, leading countries, key institutions and authors, and patterns of collaboration. The study also identified influential journals, frequently cited publications, and main research themes. Findings are based on this comprehensive analysis and existing literature. Through a detailed analysis of leading countries, prolific authors, and co-occurrence patterns, this study provides valuable insights into the principal contributors and collaborative dynamics within the field of GenAI in education. The spatial distribution of articles on GenAI in education reveals key geographic trends.

The United States leads with 19 articles, reflecting strong investment in educational technology and AI. Romania and Slovakia each contribute 9 articles, indicating rising research activity in Eastern Europe. The United Kingdom follows with 8 articles, supported by its advanced academic and AI research institutions. Australia adds 7 articles, highlighting its role in GenAI scholarship within education. This distribution points to research concentration in North America, Europe, and Oceania, showing regional variations in generative AI studies and applications. These patterns align with García-López and Trujillo-Liñán (2025), who note international differences in GenAI adoption and research focus, while also indicating potential for future collaboration and expansion.

Among individual contributors, Haiyang Wu from China is identified as the most prolific author, reflecting the global spread of expertise in this domain. All top ten authors have successfully established research teams, underscoring a strong organizational framework supporting GenAI scholarship.

Current collaboration patterns reveal active cooperative networks at national, institutional, and individual levels. The development of these networks resonates with the study of García-López and Trujillo-Liñán (2025), who stress the importance of interdisciplinary partnership in integrating legal, ethical, and pedagogical expertise. Moving forward, fostering such interdisciplinary cooperation will be crucial to advance comprehensive research and practical applications of GenAI in education, promoting innovation while addressing ethical, regulatory, and pedagogical challenges. These collaborative efforts are essential for harnessing the full potential of GenAI technologies to enhance personalized learning, academic efficiency, and equitable access within educational environments.

The review of 25 articles reveals that generative AI offers significant benefits to education by reshaping teaching, learning, and assessment while enhancing student engagement and collaboration (Salinas-Navarro et al., 2024; Lee et al., 2023; Mao et al., 2024). However, it also brings challenges around authorship and academic integrity, requiring new institutional policies (Lim et al., 2023; Duah & McGivern, 2024; Luo, 2024). Teacher readiness and student confidence vary, highlighting the need for ongoing training and AI literacy (Moorhouse, 2024; Mishra et al., 2024; Kelly et al., 2023). Ethical use and strong policies are crucial for responsible integration (Sharples, 2023; Victor et al., 2023; Bannister et al., 2023). GenAI shows promise in fields like social work and early writing (Victor et al., 2023; Stone, 2023; Xu, 2024), but detecting AI-generated content remains challenging, risking assessment integrity (Fleckenstein et al., 2024). Overall, successful adoption requires balanced strategies addressing both opportunities and risks.

Thus, the study not only maps the current landscape of GenAI research contributions but also highlights the strategic necessity for inclusive, multidisciplinary collaboration to foster robust and responsible innovations in education with Generative AI. A substantial body of research shows that Generative AI has emerged as a key area focused on developing innovative approaches to improve education's efficiency and effectiveness. The rapid advancement of generative AI technology offers new opportunities for educational innovation and transformation, enabling personalized learning, enhanced student engagement, and smarter instructional design (Liu et al., 2024). For instance, Saleem et al. (2024) provided a thorough analysis of generative AI's role in medical education, highlighting both its strengths and limitations. Lee, M. (2019) extensively examined current status, issues, and prospects of generative AI in education, while Fokides & Peristeraki, (2024), investigated ChatGPT's applications in language teaching and learning, unveiling its benefits and challenges.

Conclusion

This study provides a meaningful foundation for understanding how Generative AI is advancing educational research and practice. It calls for ongoing investigation into how these technologies can be harnessed responsibly to foster innovation while addressing emerging challenges. The evolving nature of the field demands interdisciplinary collaboration to shape future directions that benefit diverse learners and educational stakeholders.

This study is important for two main reasons. First, it thoroughly examines the current research status and development challenges of the widely discussed topic of Generative AI in education by using bibliometric methods and tools (VOSviewer). This approach clarifies the progress and difficulties in the field while presenting the findings visually, thus addressing the limitations of traditional content analysis techniques. Second, the study quickly and accurately identifies the key research contributors and major achievements related to Generative AI in education. This helps researchers efficiently find relevant journals, authors, and publications for reference. Additionally, an in-depth analysis of research hotspots offers researchers precise and comprehensive insights into the development of Generative AI in education. Overall, this study provides valuable guidance and serves as a reference for further research and practical applications of Generative AI in the educational sector.

This research employs a mixed research method, combining bibliometric analysis and content analysis, to uncover and comprehend the core concepts within the field of AIED. The findings from both approaches converge, providing a comprehensive understanding of AIED concepts. This study contributes to the body of AIED literature reviews by emphasizing the importance of grasping the conceptual structure of the field. Additionally, the research suggests several future directions, including the need to incorporate latest AI technologies, strengthen AIED research in the preschool education context, enhance research quality through mixed methods, prioritize theoretical contributions and enhance collaboration among computer scientists, psychologists, educators, and MIS experts.

Generative artificial intelligence holds great potential to transform education by enhancing teaching, learning, and assessment while promoting student engagement and collaboration. However, its adoption also raises important challenges related to academic integrity, ethical use, and the preparedness of both teachers and students. Addressing these challenges through comprehensive training, clear policies, and ongoing research is essential to harness AI's benefits responsibly. Ultimately, a balanced and thoughtful approach will enable educational institutions to integrate generative AI effectively, maximizing its positive impact while minimizing risks.

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Corresponding Author Contact Information:

Author name: Ingrid del Valle García-Carreño

Department: Facultad de Ciencias Sociales. Grupo GIAS.

University, Country: Pablo de Olavide University, Seville, Spain

Email: ivgarcar@acu.upo.es

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