

Exploring the Use of Generative AI Tools in Distance Education

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Abstract: The aim of this study is to identify the generative AI tools utilized in distance education environments and to delineate their intended purposes. Conducted through a systematic literature review, the research examined SSCI-indexed publications within the Web of Science (WoS) database. A total of 47 articles meeting the predefined inclusion criteria were rigorously analyzed and reported. In addition to content analysis, the study utilizes text mining methods and bibliometric analysis supported by VOSviewer software. Although the studies are distributed across various journals and countries, the results suggest that China is seen as the country with the most publications on this subject. Methodologically, it was observed that qualitative, quantitative, and mixed-method approaches were preferred. Furthermore, ChatGPT emerged as the most frequently emphasized generative AI tool. The study concludes that generative AI tools are utilized in distance education for purposes such as content design, adaptive learning, assessment and evaluation, cognitive skill enhancement, and providing support.

Keywords: distance education, generative AI, agentic AI, pedagogical scaffolding, community of inquiry, learning analytics, AI literacy, systematic literature review, bibliometric analysis.

Highlights

What is already known about this topic:

- Generative AI tools are widely visible in distance education.
- Generative AI is widely used for idea generation, writing assistance, and various forms of support.
- Generative AI in distance education encompasses a diverse range of methodologies, target populations, and technological frameworks.

What this paper contributes:

- It provides an overview of the geographical distribution of Generative AI research in distance education and the journals in which these studies are published.
- The study examines the diverse pedagogical and operational purposes of integrating Generative AI into distance education.
- This study characterizes the specific Generative AI tools used in distance education and categorizes their intended purposes.

Implications for theory, practice and/or policy:

- This study helps clarify the various objectives for utilizing Generative AI tools in the field of distance education.
- Research leveraging Generative AI should foster greater diversity in terms of methodologies, target populations, and data collection instruments.
- Distance education provides a guiding perspective on the strategic implementation of different Generative AI tools across various functional areas.

Introduction

The digital transformation in education emerged as a necessity during the COVID-19 pandemic (Iivari et al., 2020). This period of emergency remote teaching facilitated the implementation of diverse institutional models (Cassum et al., 2024), at the core of which lie distance education and its supporting technologies. While distance education was historically conducted through correspondence (Bynoth, 2021), it is now driven by advancements in information and communication technologies (Pregowska et al., 2021). The integration of these technological tools has led to the development of specialized platforms, such as Learning Management Systems (LMS), tailored for distance learning environments (Camilleri & Camilleri, 2022). Consequently, distance education has evolved through shifts in both technological infrastructure and pedagogical approaches (González et al., 2025; Martínez-García et al., 2023). Today, these technologies are no longer viewed merely as supplementary tools but as integral pedagogical components of the teaching-learning process. Within this framework, the applications of generative artificial intelligence (generative AI) in distance education have garnered significant scholarly attention.

Historically, AI technologies were primarily utilized for data classification, predictive modeling, or identifying meaningful patterns (Singh & Singh, 2024; Murty & Biswas, 2019). However, with the advent of generative AI, the focus has shifted toward content creation and information synthesis (Feuerriegel et al., 2024; Mittal et al., 2024; Artsin & Bozkurt, 2025). Generative AI models, such as ChatGPT and Gemini, are noted for their ability to generate explanations by mimicking human linguistic structures (Shukla et al., 2024; Buscemi & Proverbio, 2024). In contrast to earlier technologies used in distance education (Kentnor, 2015), current generative AI tools demonstrate capabilities in reasoning, problem-solving, and offering multifaceted solutions (Zhang, Tian, & Lu, 2025; Artsin & Bozkurt, 2026). While traditional instructional tasks such as lesson planning and presentation design are inherently time-consuming for educators, generative AI significantly streamlines these processes.

In distance education, generative AI tools are employed for diverse purposes, including the generation of text, images, and video content. Beyond direct content development, educators can leverage these tools to devise classroom interaction strategies (Crawford et al., 2023). In this context, generative AI contributes substantially to the creation of learner-centered materials (van den Berg & du Plessis, 2023), enabling instructors to foster both individualized learning and critical discourse. Consequently, the integration of generative AI allows educators to reallocate their time more efficiently in this new era of digital instruction.

Educators are increasingly adopting generative AI to enhance instructional productivity (Zhai, 2024; Barbieri & Nguyen, 2025). These tools assist in preparing syllabi, defining weekly objectives, and producing lecture materials. From the strategic planning of effective interactions to their practical implementation, generative AI offers comprehensive support. Furthermore, these tools are reported to provide efficient environments for student guidance and mentorship processes (Kelly et al., 2023).

Generative AI also enables educators to provide rapid and substantive feedback before, during, and after lessons. It supports preparatory work, real-time problem-solving during instruction, and the provision of high-quality post-lesson evaluations. However, the successful implementation of such practices necessitates that both educators and students possess generative AI literacy. The inclusion of these tools in distance education may also influence student interaction and motivation (Bai & Wang, 2025); indeed, research indicates that the use of generative AI in the classroom increases student engagement.

The proliferation of generative AI tools and the divergence of their intended uses across different studies highlight a critical area of inquiry. While numerous studies have explored the use of generative AI (Sevnarayan & Potter, 2024; Correia et al., 2024; Dogan et al., 2023), there is a pressing need for a

holistic evaluation of these findings within the context of distance education. Identifying which specific tools are used for which pedagogical purposes is essential. A systematic study is required to present the current state of generative AI tools utilized in these environments. Accordingly, this study conducts a systematic literature review focusing on the use of generative AI tools in distance education.

Literature

The integration of generative artificial intelligence, as an emerging technology, into distance education environments has become a significant issue. Technology acceptance is crucial for the integration of these tools into distance learning settings. It is noted that ChatGPT is considered easy to use and beneficial for students (Ding et al., 2023). Although its ease of use and perceived benefits appear to be an opportunity, it is also emphasized that the integration of this tool into distance education environments poses certain risks (Ding et al., 2023). Beyond the integration of these tools, it is essential for distance education students to possess literacy in generative AI technologies such as ChatGPT. In a study conducted by Gümüş & Kara (2025), it is argued that determining students' generative AI literacy levels is significant, ranging from instructional design to in-class strategies. It is important for instructors to utilize generative AI tools to pedagogically integrate data and prepare adaptive environments within instructional design processes (Evenstein Sigalov et al., 2025). Furthermore, considering the energy burden brought about by generative AI tools, it is also argued that teachers must use these tools effectively and efficiently in their classrooms with an awareness of environmental responsibility (Abdelmagid et al., 2025).

Beyond technology acceptance, integration, and energy consumption, it is also important for teachers to design effective lessons while using generative artificial intelligence tools in distance education environments. In this regard, a study by Abdelmagid et al. (2025) indicates that the ADDIE design model serves as a basis for instructional design in the creation of a hybrid learning environment. Additionally, another study focuses on integrating project-based learning environments into courses and establishing collaborative learning settings (McLaughlin et al., 2025). The importance of utilizing both instructional design models and diverse pedagogical approaches remains current. It is suggested that through the efficient integration of generative AI tools into distance education environments, settings that support critical inquiry and creative skills the highest levels of Bloom's Taxonomy can be fostered (Bai et al., 2025; Lubbe et al., 2025). Furthermore, it is emphasized that generative AI tools can help students move beyond rote memorization toward acquiring higher-order analysis and self-regulation skills (Martinez et al., 2025). Generative AI tools employed within instructional design processes in distance education can contribute to the enhancement of students' cognitive skills.

A study conducted by Huang et al. (2025) indicates that generative AI tools are not merely instruments that provide quick answers, but are also capable of managing students' cognitive loads and supporting their self-regulation skills. It is noted that generative AI-supported virtual tutors used in distance education environments are efficient in collaborative and project-based processes (McLaughlin et al., 2025). On the other hand, it is emphasized that the oversight of human experts remains essential during the use of these tools in distance learning (McLaughlin et al., 2025). In a study by Martinez et al. (2025), it is stated that while generative AI tools used in distance education can pose a threat to critical thinking skills, they can also serve as a catalyst for developing such skills. Achieving this requires metacognitive awareness and pedagogical innovation (Martinez et al., 2025). Additionally, it is stated that generative AI is a significant tool that can be used to enhance students' pedagogical skills and possesses dynamics that support students' cognitive processes in developing critical thinking (Lubbe et al., 2025). In this context, it is emphasized that human supervision is necessary to balance the cognitive load that may occur in students' mental processes (Aydemir & Kır, 2025).

Studies on the use of generative AI in distance education environments emphasize significant theories such as the community of inquiry and the theory of equivalence of interaction (Aydemir & Kır, 2025).

The importance of enhancing student-content interaction in distance learning settings through personalized elements by utilizing generative AI tools is discussed. Within the context of the community of inquiry, it is emphasized in studies that deep cognitive engagement can be facilitated by generative AI tools, provided that expert supervision is consistently maintained (Aydemir & Kır, 2025). It is also stated that generative AI tools can be utilized in the learning process from the perspective of a social constructivist approach (Lubbe et al., 2025). A study conducted by Lubbe et al. (2025) argues that beyond being a technology that merely provides answers, generative AI tools serve as social instruments with which students can communicate in distance education environments. Rather than being defined strictly as technical tools, it is noted that these instruments allow students to build knowledge, establish connections among digital resources, and create environments where pedagogical approaches such as constructivism and connectivism can be applied (Ruiz-Rojas et al., 2023). Due to features such as providing students with learning partners, offering scaffolding in learning processes, and supporting social interactions, it is emphasized that generative AI tools are significant technologies for implementing constructivist approaches in distance education (Zhang & Wang, 2025). Furthermore, it is stated that students can utilize generative AI tools to enrich learning materials, support their self-regulated learning processes, and establish scaffolding at their convenience (Bai et al., 2025).

Aim of the Study

The primary objective of this research is to systematically review SSCI-indexed publications regarding the use of generative AI in distance education. In alignment with this overarching goal, the study aims to utilize the Web of Science (WoS) database to identify current trends concerning which generative AI tools are employed in these publications and for what specific purposes. Accordingly, this study seeks to answer the following research questions:

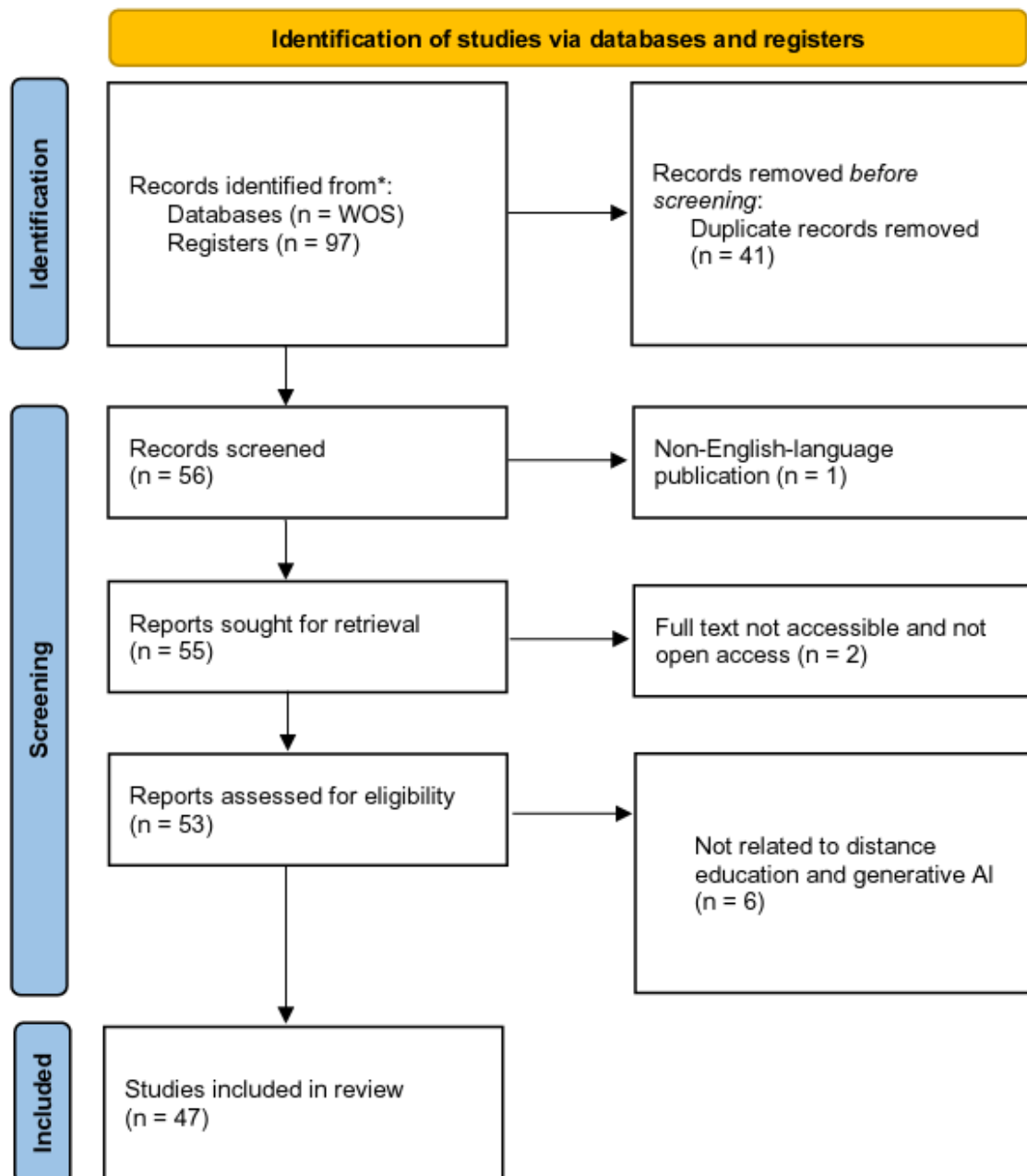
- What is the distribution of the relevant studies in terms of publication year, journal, and authors' country of origin?
- What are the prominent trends identified within the keywords and abstracts of these studies?
- What are the most frequently employed research methodologies, sample groups, and data collection tools in the examined literature?
- What are the most predominantly utilized generative AI tools in distance education and for what pedagogical or instructional purposes are they employed?

Methodology

Research Design

This study constitutes a systematic literature review designed to identify the current trends in academic research involving generative AI tools in distance education environments, thereby providing a comprehensive roadmap for future investigations. Each phase of this review was executed in strict adherence to a predefined protocol. Specifically, the study adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, a widely recognized standard in the literature (Figure 1). The PRISMA guidelines were deliberately chosen to mitigate potential biases during the screening process and to transparently visualize the rationale for study inclusion and exclusion (Page et al., 2020). The Social Sciences Citation Index (SSCI) is a prestigious index known for its high level of quality assurance. Therefore, publications indexed in the SSCI, retrieved via the Web of Science (WoS) database, were utilized as the primary data source for this systematic review.

Figure 1. PRISMA review process flowchart.



Data Collection Process

To retrieve high-quality literature concerning the use of generative AI in distance education, specific methodological strategies were formulated. These strategies were designed with a strong emphasis on academic rigor and depth. During the initial phase of the data collection process, open-access articles published in English and indexed SSCI via the Web of Science (WoS) database were designated as the primary data source to ensure scholarly excellence. The search terms and conceptual criteria applied during the database querying process are outlined below:

[("Distance Education" AND "Generative AI") OR ("Distance Learning" AND "Generative AI") OR ("Distance Teaching" AND "Generative AI") OR ("Open Learning" AND "Generative AI") OR ("Open

Teaching" AND "Generative AI") OR ("Open Education" AND "Generative AI") OR ("Online Learning" AND "Generative AI") OR ("Online Teaching" AND "Generative AI") OR ("Online Education" AND "Generative AI") OR ("e-learning" AND "Generative AI") OR ("Electronic Learning" AND "Generative AI") OR ("Electronic Teaching" AND "Generative AI") OR ("Distance Education" AND "{Gen AI} OR {Gen-AI} OR {GenAI}") OR ("Distance Learning" AND "{Gen AI} OR {Gen-AI} OR {GenAI}") OR ("Distance Teaching" AND "{Gen AI} OR {Gen-AI} OR {GenAI}") OR ("Open Learning" AND "{Gen AI} OR {Gen-AI} OR {GenAI}") OR ("Open Teaching" AND "{Gen AI} OR {Gen-AI} OR {GenAI}") OR ("Open Education" AND "{Gen AI} OR {Gen-AI} OR {GenAI}") OR ("Online Learning" AND "{Gen AI} OR {Gen-AI} OR {GenAI}") OR ("Online Teaching" AND "{Gen AI} OR {Gen-AI} OR {GenAI}") OR ("Online Education" AND "{Gen AI} OR {Gen-AI} OR {GenAI}") OR ("e-learning" AND "{Gen AI} OR {Gen-AI} OR {GenAI}") OR ("Electronic Learning" AND "{Gen AI} OR {Gen-AI} OR {GenAI}") OR ("Electronic Teaching" AND "{Gen AI} OR {Gen-AI} OR {GenAI}") OR ("Distance Education" AND "Generative Artificial Intelligence") OR ("Distance Learning" AND "Generative Artificial Intelligence") OR ("Distance Teaching" AND "Generative Artificial Intelligence") OR ("Open Learning" AND "Generative Artificial Intelligence") OR ("Open Teaching" AND "Generative Artificial Intelligence") OR ("Open Education" AND "Generative Artificial Intelligence") OR ("Online Learning" AND "Generative Artificial Intelligence") OR ("Online Teaching" AND "Generative Artificial Intelligence") OR ("Online Education" AND "Generative Artificial Intelligence") OR ("e-learning" AND "Generative Artificial Intelligence") OR ("Electronic Learning" AND "Generative Artificial Intelligence") OR ("Electronic Teaching" AND "Generative Artificial Intelligence") OR ("Distance Education" AND "Large Language Models") OR ("Distance Learning" AND "Large Language Models") OR ("Distance Teaching" AND "Large Language Models") OR ("Open Learning" AND "Large Language Models") OR ("Open Teaching" AND "Large Language Models") OR ("Open Education" AND "Large Language Models") OR ("Online Learning" AND "Large Language Models") OR ("Online Teaching" AND "Large Language Models") OR ("Online Education" AND "Large Language Models") OR ("e-learning" AND "Large Language Models") OR ("Electronic Learning" AND "Large Language Models") OR ("Electronic Teaching" AND "Large Language Models")].

The application of these search criteria to the WoS database on April 5, 2026, yielded an initial pool of 97 studies. Subsequently, the retrieved articles were screened in accordance with the predefined inclusion and exclusion criteria (Table 1).

Table 1. Inclusion and exclusion criteria

Inclusion	Exclusion
English-language publication	Non-English-language publication
Open access	Not open access
Published article	Other non-article types
Indexed in SSCI	Not indexed by SSCI
It includes topics both distance education and generative AI.	It only includes distance education topics.
Full text is accessible	It only includes topics related to generative AI.
	Full text not accessible

Regarding document types, peer-reviewed journal articles were included, whereas book chapters and conference proceedings were excluded. Out of the 97 articles identified in the initial search, duplicate records, studies falling outside the scope of the research context, and non-open access publications were systematically removed. Consequently, a final dataset comprising 47 studies was established for in-depth analysis.

Data Analysis

The analysis of the selected articles was conducted using descriptive tables and data visualization tools to examine their publication years, publishing journals, research methodologies, keywords, and abstracts. Bibliometric data were systematically presented through these descriptive tables, while the VOSviewer software was utilized for network visualization. The data screening and coding processes were conducted jointly by the first and second authors. All data were coded and organized by both authors together. In case of any disagreement during the coding process, both authors discussed and reached a consensus together. Furthermore, the theoretical frameworks underlying the studies, the specific generative AI tools employed, and their intended pedagogical purposes were examined through content analysis. Overall, this systematic literature review aims to elucidate the current landscape and future potential of generative AI tools utilized in distance education environments.

Strengths and Limitations of the Study

A primary strength of this study lies in its systematic examination of SSCI-indexed publications within the WoS database, conducted in strict adherence to a predefined protocol. Furthermore, the identification of the specific purposes for which generative AI tools are utilized, alongside the articulation of their theoretical foundations, constitutes a distinct and robust aspect of this research. Conversely, the study presents certain limitations. The scope is restricted exclusively to articles published in English. Additionally, the deliberate selection of only SSCI-indexed articles means that potentially relevant publications from other indices were not incorporated, which must be acknowledged as a methodological constraint.

Results

The findings of this study are presented under three main frameworks: descriptive and bibliometric findings, methodological trends, and generative AI focused findings.

RQ1: Descriptive Trends in Generative AI Research within Distance Education

Figure 2. The distribution of studies focusing on Generative AI in distance education over the years

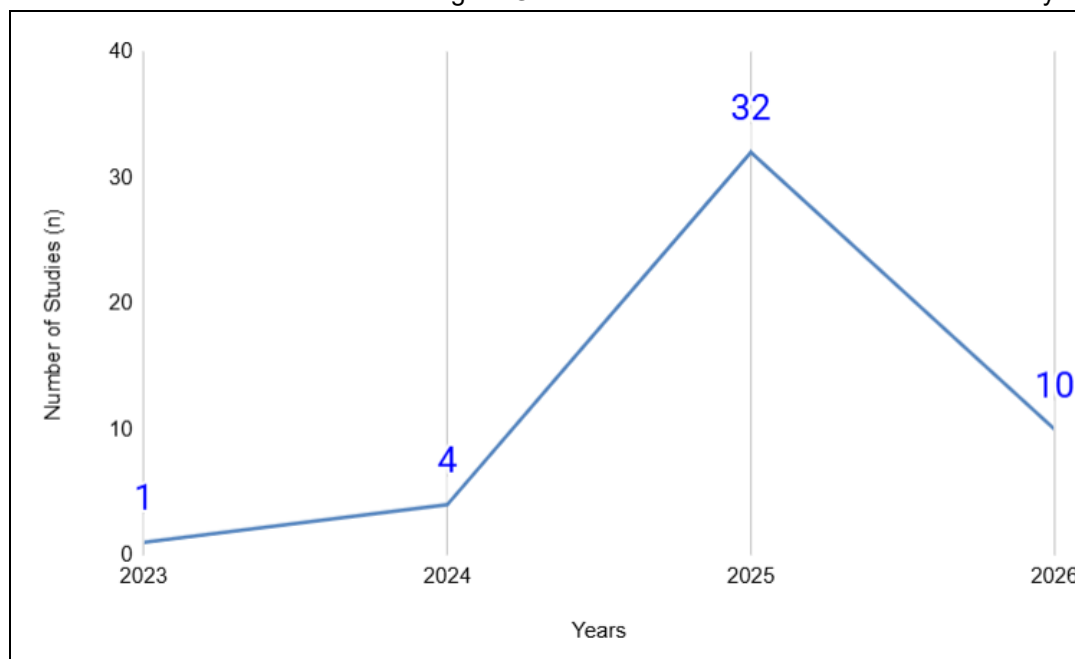


Figure 2 illustrates the annual distribution of the studies focusing on generative AI in distance education. The analysis reveals that the initial literature was limited, with only 1 study identified in 2023 and 4 studies in 2024. However, a significant surge in scholarly interest is observed in 2025, which marks the peak with 32 published studies. Although 10 studies were identified for 2026, it is crucial to note that this figure only accounts for the publications retrieved up to the data collection date of April 5, 2026.

Table 2. Journals publishing studies on Generative AI tools in distance education

Journal Name	Number of Publications (n)
British Journal of Educational Technology	4
IEEE Transactions on Learning Technologies	4
Sustainability	4
Computers & Education	3
Education and Information Technologies	3
International Journal of Human–Computer Interaction	3
Distance Education	2
Education Tech Research Dev	2
Interactive Learning Environments	2
International Review of Research in Open and Distributed Learning	2
Nurse Education Today	2
The Internet and Higher Education	2
Asia Pacific Journal of Education	1
Assessment & Evaluation in Higher Education	1
BMC Medical Education	1
Cognitive Systems Research	1
Discourse: Studies in the Cultural Politics of Education	1
Educational Technology & Society	1
Frontiers in Psychology	1
Higher Education	1
Higher Education Research & Development	1
International Journal of Educational Research	1
Journal of English for Academic Purposes	1
Journal of Science Education and Technology	1
Language Learning & Technology	1
RIED-Revista Iberoamericana de Educación a Distancia	1

Table 2 presents the distribution of the selected studies across various academic journals. The analysis reveals that the highest number of articles on this subject were published in the British Journal of Educational Technology (n=4), IEEE Transactions on Learning Technologies (n=4), and Sustainability (n=4). These leading venues are closely followed by Computers & Education (n=3), Education and Information Technologies (n=3), and the International Journal of Human–Computer Interaction (n=3). Additionally, several other journals contributed to the literature with two publications each, including Distance Education (n=2), Educational Technology Research and Development (n=2), Interactive Learning Environments (n=2), the International Review of Research in Open and Distributed Learning (n=2), Nurse Education Today (n=2), and The Internet and Higher Education (n=2). Consequently, it can be deduced that research on generative AI in distance education is gaining broad acceptance across a diverse array of scientific journals.

Table 3. Countries of origin for publications on Generative AI tools in distance education

Country	Number of Publications (n)
China	19
United States	6
United Kingdom	5
Taiwan	3
Türkiye	3
Hong Kong	2
Croatia	1
Spain	1
Canada	1
Pakistan	1
Portugal	1

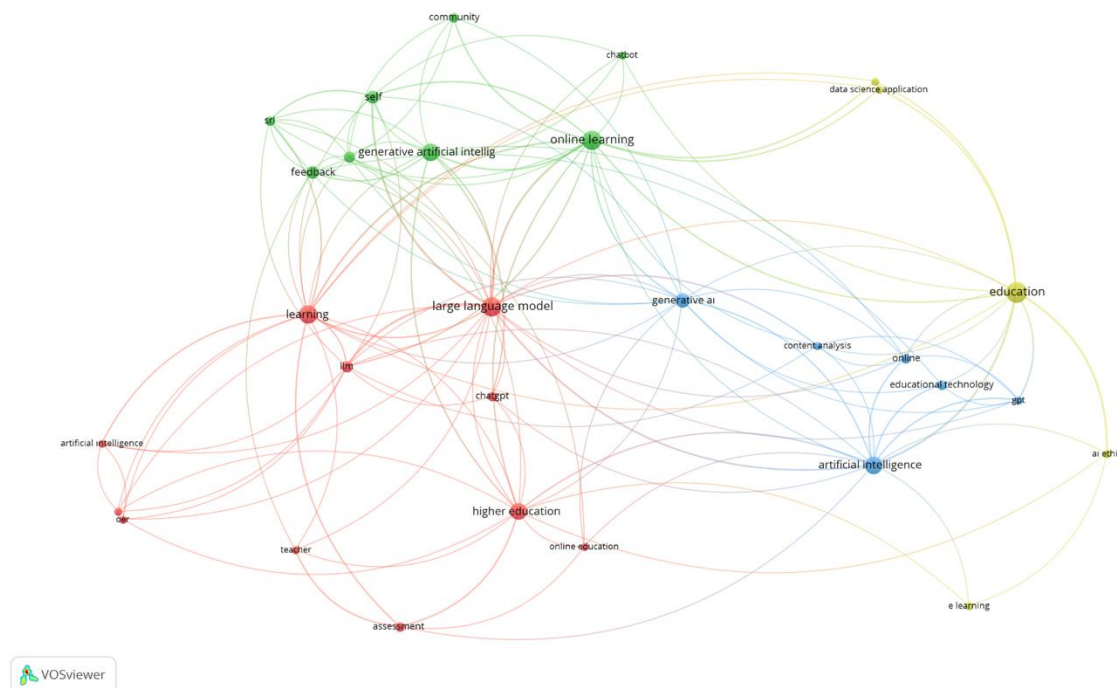
South Korea	1
Switzerland	1
Oman	1
Not specified	1

An analysis of the countries of origin for the publications reveals that China (n=19), the United States (n=6), and the United Kingdom (n=5) are the leading contributors to the literature (Table 3). These are followed by Taiwan (n=3), Türkiye (n=3), and Hong Kong (n=2). Additionally, several other countries have contributed a single publication each (n=1), namely Croatia, Spain, Canada, Pakistan, Portugal, South Korea, Switzerland, and Oman (Table 2). Overall, these findings elucidate that research on the use of generative AI in distance education is being actively pursued across diverse geographic regions on a global scale.

RQ2: Mapping Keywords and Abstract Content: Themes in Generative AI and Distance Education

The keywords subjected to text mining analysis were categorized into four distinct clusters (Figure 3). These clusters are identified as follows: LLMs in Higher Education (red cluster), GenAI in Online Learning (green cluster), Generative AI in Educational Technologies (blue cluster), and Ethics in Generative AI (yellow cluster).

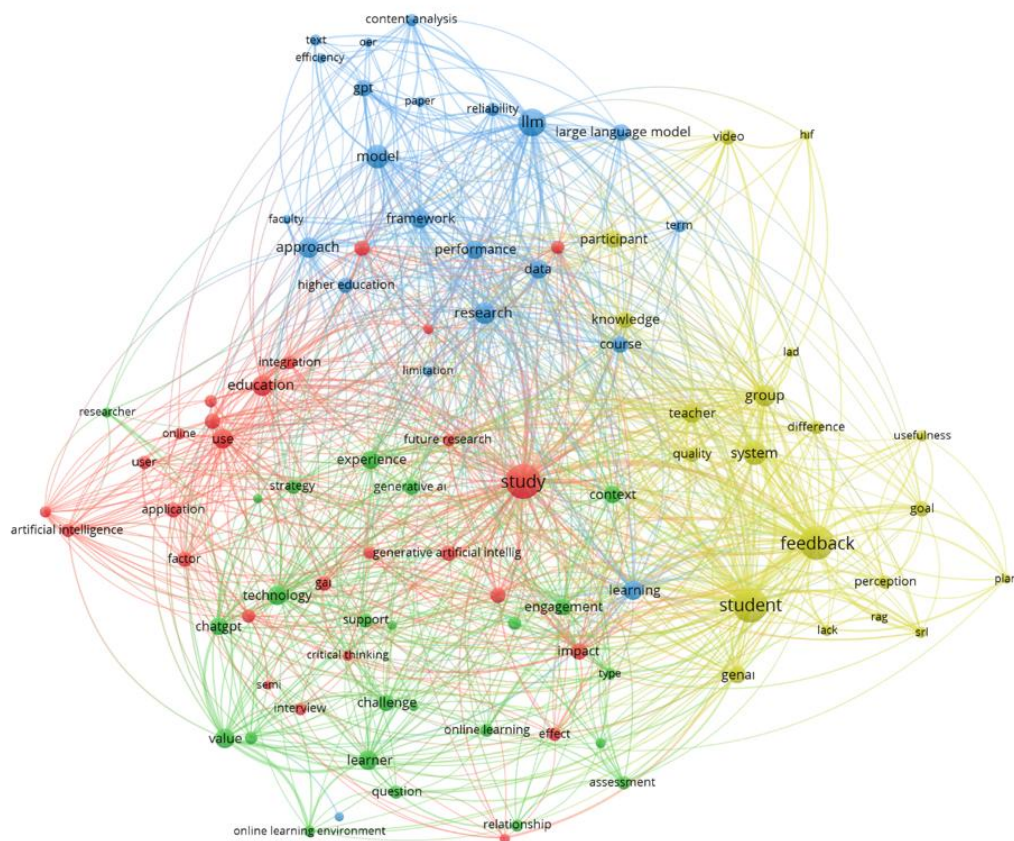
Figure 3. Text mining analysis results of keywords in publications on Generative AI tools in distance education



An examination of the "LLMs in Higher Education" cluster reveals a prominent emphasis on the integration of generative AI technologies within higher education contexts. Specifically, this cluster predominantly features studies focused on assessment methodologies and the evolving roles and responsibilities of educators. Within the "Generative AI in Online Learning" cluster, student interaction emerges as the focal point. This group highlights the utilization of generative AI tools by students for feedback purposes and their deployment as chatbots. Furthermore, the "Generative AI in Educational

Technologies" cluster indicates that generative AI is increasingly being adopted as a foundational tool in distance education environments. Finally, the "Ethics in Generative AI" cluster underscores critical concerns surrounding ethical considerations and data privacy.

Figure 4. Text mining analysis results of abstracts in publications on Generative AI tools in distance education



The abstracts subjected to text mining analysis were categorized into four distinct clusters: Implementing Generative AI (red cluster), Student Engagement and Interaction (green cluster), Research with LLMs (blue cluster), and Feedback (yellow cluster) (Figure 4).

An analysis of the "Implementing Generative AI" cluster reveals a primary focus on the integration and utilization of these novel technologies within educational environments. The prominent concepts emerging in this cluster are study, education, use, application, artificial intelligence, impact, and integration. Within the "Student Engagement and Interaction" cluster, it is observed that generative AI tools, such as ChatGPT, are extensively employed in student-centered learning approaches. This student-centric focus encompasses providing learner support, enhancing engagement, and improving overall student experiences. The key terms associated with this cluster include technology, learner, ChatGPT, engagement, experience, challenge, online learning, and assessment.

Furthermore, the "Research with LLMs" cluster underscores the application of Large Language Models (LLMs) in the design and development of research studies, such as utilizing LLMs to measure student achievement or performance. The dominant concepts in this group are LLM, model, research, framework, performance, data, large language model, and content analysis. Finally, the "Feedback" cluster delineates the specific application areas emphasized in distance education studies. This group highlights the use of generative AI tools within educational settings, particularly focusing on feedback

systems. The standout terms in this cluster are student, feedback, system, teacher, group, GenAI, and knowledge.

In synthesis, an overarching evaluation of these four clusters reveals distinct trends in the current distance education literature. Specifically, the most prominent research themes center on the integration of generative AI tools, methodological implementations, and various aspects of student experiences and interactions.

RQ3: Methodological Trends: Research Designs, Sampling, and Instrumentation

An analysis of the reviewed articles reveals the utilization of mixed methods (n=16), quantitative methods (n=15), and qualitative methods (n=9), alongside systematic literature reviews and other approaches (n=6) (Table 4). Notably, one study did not explicitly specify any research method or design.

Table 4. Research methodologies employed in publications on Generative AI tools in distance education

Methodology	Research Design	Sample	Data Collection Instrument / Source
Quantitative (n=15)	Quantitative Research (n=6)	University students (n=8)	Questionnaire (n=11)
	Experimental study (n=5)	K-12 students (n=3)	Scale (n=5)
	Quasi-experimental design (n=2)	Nurses / Healthcare professionals (n=2)	Achievement test / Exam (n=3)
	Structural equation modeling (SEM) (n=2)	Teachers (n=1)	LMS Log data (n=2)
		Working adults (n=1)	Grades / Assignment data (n=1)
Qualitative (n=9)			Semi-structured interviews (n=5)
	Qualitative Research (n=6)	Teachers / Instructors (n=3)	Open-ended questions (n=2)
	Case study (n=1)	University students (n=3)	Logs / Diaries (n=2)
	Content analysis (n=1)	Experts (n=1)	Delphi / Workshop records (n=1)
	Comparative analysis (n=1)	Text / Forum data (n=2)	Self-reflection (n=1)
Mixed Methods (n=16)			Questionnaires (n=14)
			Interviews (n=12)
			Logs / Chat transcripts (n=6)
		Undergraduate / Graduate students (n=7)	Knowledge / Achievement tests (n=5)
		Teachers / Pre-service teachers (n=3)	Assignments / Reflective reports (n=2)
Literature Review and Other (n=6)	Mixed Methods (n=15)	K-12 students / Children (n=3)	Screen / Video recordings (n=2)
	Design-based research (n=1)	User reviews (n=3)	
	Review (n=2)		Web of Science (n=2)
	Conceptual framework (n=2)		Scopus (n=2)
	Systematic literature review (n=1)	Academic publications (n=3)	General databases (n=2)
	Evaluation (n=1)	EdTech (n=1)	Prompt (n=1)
		Not specified (n=2)	Not specified (n=2)

Within the mixed-methods research focusing on generative AI in distance education, specific design descriptions such as mixed methods (n=15) and design-based research (n=1) were identified. These studies involved participants across various educational levels, ranging from middle and high school to undergraduate and graduate students. Regarding data collection, questionnaires and interviews emerged as the most predominantly preferred instruments in these mixed-methods studies.

In the analysis of the quantitative research, categorizations were formulated based on the design descriptions explicitly stated by the authors. Accordingly, designs such as quantitative research (n=6),

experimental studies (n=5), quasi-experimental designs (n=2), and structural equation modeling (n=2) were employed. Similar to the mixed-methods approach, these quantitative studies engaged diverse participant groups. However, a distinct feature of this methodological category is the inclusion of healthcare professionals and nurses within the sample. Consistent with traditional quantitative paradigms, questionnaires and scales were the most frequently adopted data collection instruments.

As for the qualitative studies, the authors primarily adopted designs labeled as qualitative research (n=6), followed by qualitative case studies (n=1), content analysis (n=1), and comparative analysis (n=1). A notable distinction of the qualitative methodology, compared to the other approaches, is its exclusive focus on adult populations. Consequently, it can be inferred that qualitative investigations concerning generative AI in distance education are predominantly conducted with adult participants. The most prevalent data collection tools in this domain were semi-structured interviews and open-ended questions. Finally, several studies employed literature reviews and similar methodological approaches, including systematic reviews and conceptual overviews. While these studies inherently rely on existing academic publications as their primary data source, an intriguing finding emerged: one study uniquely organized its data collection process entirely through the use of generative AI prompts.

RQ4: Utilization and Pedagogical Purposes of Generative AI Tools in Distance Education

Table 5. Generative AI tools and their intended pedagogical purposes in distance education

Tools	Frequency (n)	Purposes of use
ChatGPT	14	Providing personalized feedback (n=3) Creating video transcripts (n=1) Analyzing group discussions (n=1) Creating a Zone of Proximal Development (n=1) Providing feedback appropriate to student performance (n=1) Identifying self-regulated learning skills (n=1) Supporting personalized learning (n=1) Grading assignments (n=1) Improving the development process of Open Educational Resources (OER) policy framework (n=1) Designing courses (n=1) An assistant to support human-computer interaction (n=1) Simulating student participation (n=1) Providing peer feedback (n=1) Educational assistant (n=1) Virtual tutor (n=1)
DeepSeek	3	Personalized course content (n=1) Dynamic content generation (n=1) Creating a learning environment with real-time interaction capability (n=1) Simulation agent (n=1)
Midjourney	1	Visual content creation (n=1)
Dall-E 2	1	Visual content creation (n=1)
Movio (HeyGen)	1	Avatar and voice generation (n=1)
Whisper	1	Transcribing audio for voice prompts (n=1)
SparkGrow	1	Providing mentor and mentee interaction (n=1)
Nolej AI	1	Creating H5P activities (n=1)
ERNIE-3.5	1	Providing personalized self-directed learning support (n=1)
Self-GT	1	Creating personalized content based on student preferences (n=1)

The analysis of generative AI tools utilized in distance education reveals that ChatGPT (n=14) is the most frequently employed tool, followed by DeepSeek (n=3). Other notable tools identified in the literature include Midjourney (n=1), Dall-E 2 (n=1), Movio (HeyGen) (n=1), Whisper (n=1), SparkGrow (n=1), Nolej AI (n=1), ERNIE-3.5 (n=1) and Self-GT (n=1). A significant finding is the clear dominance of ChatGPT and its iterations within the reviewed studies.

The purposes for which generative AI tools are employed in distance education environments are of critical importance. Research indicates that various AI tools are being actively integrated into educational settings (Table 5). In this context, ChatGPT and DeepSeek have been identified as the most frequently preferred tools. An examination of ChatGPT's usage reveals its multifaceted functionality. For instance, Netland et al. (2025) reported that ChatGPT serves as a support mechanism for generating scripts for video content produced by other AI tools. Furthermore, ChatGPT has been shown to be widely utilized for enhancing students' self-regulated learning skills (Yilmaz et al., 2026), as well as for managing automated and personalized feedback processes (Liu & Ldokova, 2026; Hew et al., 2025).

The integration of generative AI into educational processes aligns closely with constructivist learning approaches. In this regard, ChatGPT is employed to support students' learning journeys and to provide cognitive scaffolding (Chen et al., 2025). Similarly, the tool is leveraged to foster personalized learning experiences and to enhance interdisciplinary problem-solving skills through natural language interaction (Huang, Zhou, & Zhu, 2025). Beyond its role as a student-centered tool, ChatGPT also functions as a pedagogical assistant, supporting teachers in sustainable idea development (Hong et al., 2025) and assisting with administrative and educational tasks, such as the assessment of student assignments (Li et al., 2025).

It is evident that the application areas of generative AI tools are not limited to text generation or feedback processes. Research conducted with tools such as DeepSeek, Midjourney, and DALL-E, in particular, demonstrates the functional diversity of these technologies within educational settings. For instance, DeepSeek is effectively utilized for dynamic content production and real-time interaction (Jing & Mouhong, 2025), as well as for structural tasks such as organizing course materials and generating knowledge graphs (Tu et al., 2026). Furthermore, a study by Liu et al. (2025) emphasizes that DeepSeek can be employed as an 'instructional agent' within educational simulations. Similarly, visual-based generative AI tools such as Midjourney and DALL-E have been increasingly integrated into distance education processes. Beyond video content production (Netland et al., 2025), these tools address specialized pedagogical needs, such as the generation of realistic patient imagery, particularly in fields like medical education (Encarnação et al., 2025).

Discussion and Conclusion

It is noteworthy that China accounts for the vast majority of research and developments in generative AI. One potential explanation for this prominence is that China was the first nation to introduce comprehensive legal regulations governing generative AI (Migliorini, 2024). Furthermore, the Chinese government's proactive establishment of legal regulations, policies, and precautionary measures even prior to the market entry of generative AI tools by domestic firms and the global emergence of ChatGPT may be considered a primary driver of China's prominence in this field. A further significant development in this trajectory was the publication of the 'New Generation Artificial Intelligence Ethics Code' by the Chinese Ministry of Science and Technology on September 26, 2021 (Ministry of Science and Technology of the People's Republic of China, 2021). In contrast, ChatGPT, which served as the primary gateway to generative AI for the global public, was launched on November 30, 2022, while the European Union's 'AI Act' was only formally proposed on March 13, 2024 (European Parliament, 2024). The 2021 OECD report on national AI policies noted that many European Union member states had already formulated AI strategies (OECD, 2021). China's early regulatory positioning remains distinct.

Consequently, examining the rationale and methodologies behind China's intensified focus on generative AI within the context of distance education provides a significant area for further research.

In the examined studies, it has been determined that the most frequently preferred words in the keywords and abstracts are 'large language model', 'student', 'feedback', and 'study'. These findings distinguish the current study from other literature reviews and bibliometric studies in the field by specifically focusing on generative AI (Hebebcı, 2021; Artsın & Kahraman, 2024). On the other hand, a study conducted during the Covid-19 period emphasizes that the topic of 'feedback' was among the prominent issues at that time (Sudakova et al., 2022). Considering the text mining findings presented in this study, it can be stated that research on diverse topics and focus areas within the field of distance education has not been sufficiently conducted. No keywords or phrases related to topics such as 'open educational resources' or 'massive open online courses' (MOOCs) were identified. Consequently, the necessity to focus on different environments and applications of distance education in future studies concerning generative AI in this field has been highlighted.

The study reveals that ChatGPT is used more extensively compared to other tools. The literature indicates that ChatGPT is utilized for diverse purposes and needs in daily life (Adarkwah et al., 2023), features a user-friendly interface (Kayalı et al., 2023), provides personalized and rapid responses (Yigci et al., 2025), and maintains a fluent interaction (Liu, 2024). One of the reasons for this distinct preference may be ChatGPT's capacity to facilitate longer, more engaging, and sustainable dialogues with its users compared to other generative AI tools (Rane et al., 2024). When considered within the framework of Anderson (2003) "theory of equivalence of interaction", the long-term, satisfying interactions experienced by students can foster high-quality learning experiences. Furthermore, describing ChatGPT merely as a "tool" or an "environment for interaction" is no longer sufficient; these definitions are being replaced by the concept of "pedagogical scaffolding" (Hong et al., 2025). By going beyond simply providing information, ChatGPT serves as a cognitive teaching assistant and pedagogical aid, enabling distance education students to structure knowledge within their own cognitive frameworks. Considering the use of generative AI tools in distance education environments alongside various technologies and purposes, it is essential to evaluate the types of interactions that this integration may foster within the educational process.

Generative AI tools are evolving into a tutor role in distance education by enabling the implementation of pedagogical approaches (Evenstein Sigalov et al., 2025; Lubbe et al., 2025), facilitating student-content interactions (Aydemir & Kır, 2025), and providing scaffolding for student learning (Zhang & Wang, 2025; Bai et al., 2025). Although the "Community of Inquiry" and "Constructivist" are emphasized in the studies reviewed (Aydemir & Kır, 2025; Lubbe et al., 2025), it is clear that the potential support that generative AI can provide within the context of these theories needs to be examined in greater depth beyond such studies. Even though it is stated that generative AI increases student motivation (Bai & Wang, 2025; Rohana et al., 2024), captures their attention (Sibarani, 2025; Hlazunova et al., 2025), and improves their critical thinking skills (Lubbe et al., 2025) and metacognitive awareness (Martinez et al., 2025), it is also argued that, beyond these benefits, it poses threats regarding academic integrity (Cotton et al., 2024; Naidu & Sevnarayan, 2023; Rodríguez Chávez et al., 2023), ethics (Amin et al., 2025; Casas-Roma & Conesa, 2021), and both critical and creative thinking (Manousou, 2025; Baltà-Salvador et al., 2025). Consequently, there is scope for diverse research endeavors in generative AI-enhanced distance learning environments that extend beyond existing studies. An in-depth investigation into various dimensions, ranging from student motivation to ethical considerations, remains a critical area of inquiry.

The use of generative AI tools in distance education for various purposes is noteworthy. The study's findings indicate that, beyond simple text generation, AI frameworks capable of providing in-depth guidance to students have been developed. Although different distance education environments are not explicitly highlighted in the keywords or abstracts, it is evident from the examined studies that AI tools

are utilized for diverse purposes. The application of generative AI tools for various functions in distance education environments emerges as a critical issue. It is clear that further in-depth research is needed to clarify the ethical boundaries of generative AI in distance education and its effects on learning.

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Murat Artsin: Data curation, Investigation, Visualization, Writing-original draft, Resources, Software, Writing-review & editing, Conceptualization. Ebru Kılıç Çakmak: Conceptualization, Project administration, Formal Analysis, Methodology, Validation, Writing-original draft, Writing-review & editing, Conceptualization. All authors have read and agreed to the published version of the manuscript.

Sustainable Development Goals (SDGs)

This study is linked to the following SDGs: Quality education (SDG 4) and Partnerships for the goals (SDG 17).

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Data Accessibility Statement

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics and Consent

Formal ethical approval was not required for this study as it did not involve any living entities, interventions, or the collection of sensitive personal data.

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