Beyond Technological Adoption: Aims, Benefits, and Challenges of Generative Artificial Intelligence in Education

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ABSTRACT

This study examines the aims, advantages, and challenges associated with the use of generative artificial intelligence in educational contexts spanning pre-K–12, K–12, and higher education. Given the rapid integration of generative artificial intelligence into teaching and learning environments, there is a growing need for comprehensive evidence regarding its pedagogical affordances and the challenges accompanying its adoption. Thus, the study aims to synthesize the existing empirical literature and provide a holistic understanding of how generative artificial intelligence is being utilized across educational settings. Employing a systematic review design, 182 empirical studies that met the inclusion criteria were analyzed. Data were collected through a structured review protocol and coded using a comprehensive analysis framework that captured the studies' aims, reported advantages, and identified challenges. The data were subjected to thematic content analysis to identify recurring patterns across the literature. The findings indicate that generative artificial intelligence is predominantly employed to enhance teaching and learning processes through increased instructional efficiency, personalized and differentiated instruction, improved assessment and feedback practices, instructional material generation, and support for teachers' professional practice. However, the literature simultaneously highlights important concerns regarding the reliability of artificial intelligence-generated outputs, ethical and privacy issues, academic integrity, over-reliance on artificial intelligence, insufficient professional preparedness, and pedagogical limitations. The findings suggest that the successful integration of generative artificial intelligence in education depends on maintaining a human-centered and pedagogically informed approach that balances technological capabilities with teachers' professional expertise and ethical considerations.

Keywords: *Generative Artificial Intelligence (GenAI), AI in Education, Teacher Professional Practice, Responsible AI*

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INTRODUCTION

The release of OpenAI's ChatGPT in November 2022 marked an important turning point in the development and use of generative artificial intelligence (GenAI) in education. Since then, GenAI has become increasingly visible and accessible across educational contexts, attracting growing attention from researchers and practitioners (Joseph & Areepattamannil, 2025; Qian, 2025; Yetişensoy, 2025b). Unlike traditional AI systems that primarily rely on pattern recognition, classification, and prediction, GenAI can

generate new content across multiple modalities, including text, images, audio, video, and code (Biton et al., 2025; Hu et al., 2025; Mena Octavio et al., 2024; Qian, 2025). This expanded generative capacity has contributed to the increasing integration of AI into teaching and learning processes.

Within educational practice, GenAI has been used across different stages of teaching and learning, including instructional planning, content development, assessment, feedback, resource creation, and learner support. In particular, teachers can interact with GenAI through iterative processes of prompting, reviewing, revising, and adapting generated content rather than simply receiving information from an automated system. Recent studies have documented the use of GenAI for lesson planning, instructional design, material development, and the adaptation of educational resources to particular teaching contexts (Davin et al., 2025; Garofalo & Farenga, 2025; Konakbayeva et al., 2025). Similarly, empirical studies have examined the use of ChatGPT and other GenAI tools to support teachers and teacher candidates in planning and designing instructional activities (Luo & Tahir, 2025).

The growing range of applications has consequently expanded the ways in which teachers can engage with GenAI throughout the instructional process. Teachers may use these tools to generate instructional ideas, develop and adapt teaching materials, prepare assessment activities, provide feedback, and support differentiated learning. In this respect, GenAI can function as a collaborative resource that contributes to teachers' professional work while leaving pedagogical decisions and contextual adaptation to the teacher (Joseph & Areepattamannil, 2025; Leahy et al., 2025; Louis et al., 2025). Rather than being limited to the production of educational content, GenAI can therefore become part of teachers' processes of planning, designing, evaluating, and refining instructional practices.

Recent evidence further suggests that teachers' engagement with GenAI involves not only experimentation with new technologies but also the evaluation and adaptation of AI-generated outputs in relation to instructional purposes and contextual requirements. Teachers' professional knowledge remains important in determining how generated content is interpreted, revised, and incorporated into teaching practices (Levy-Nadav et al., 2026). This perspective highlights that the educational use of GenAI is not determined solely by the capabilities of the technology; it is also shaped by teachers' pedagogical goals, professional knowledge, beliefs, and the contexts in which the technology is used.

Accordingly, understanding GenAI in education requires attention not only to what these technologies can generate but also to how teachers incorporate them into their professional practices and instructional decision-making. Although GenAI is increasingly used across different educational activities, its purposes, forms of use, and implications may vary across subjects, educational levels, and teaching contexts. Overall, GenAI represents both an emerging opportunity and a source of new challenges in education, making its effective use dependent on a human-centered and collaborative approach that maintains pedagogical integrity, equity, and responsible practice (Dornburg & Davin, 2025; Jang & Choi, 2025; Joseph & Areepattamannil, 2025; Sabouni et al., 2025). Examining teachers' engagement with GenAI is therefore important for understanding the emerging roles, practices, and professional dimensions associated with its use in education.

Benefits and Challenges of GenAI in Education

In the field of education, artificial intelligence (AI) has rapidly evolved from a specialized technological innovation into a transformative force shaping educational research and practice. Recent advances in generative AI, large language models, and multimodal AI systems have significantly expanded the ways in which educators design instruction (Biton et al., 2025; Mena Octavio et al., 2024), develop learning materials (Lan et al., 2025; Orozova & Angelova, 2025), assess student performance (ElSayary et.al., 2025; Mulyani et.al., 2025) and support individualized learning (An & James, 2025; Chang & Sun, 2026; van den Berg, 2024; Williams & Ingle, 2025). Unlike earlier educational technologies that primarily served as information delivery tools, contemporary GenAI systems increasingly function as collaborative partners capable of generating content (Alqarni, 2026; Bai et al., 2024; Lan et al., 2025), providing instructional recommendations (Morgan, 2025), automating complex tasks (Karakaya Özyer & Aydın, 2026; Mena Octavio et al., 2024), and facilitating data-informed educational decision-making. Consequently,

GenAI has attracted substantial attention from researchers, educators, policymakers, and educational institutions seeking to harness its potential to improve teaching and learning while responding to the rapidly changing demands of twenty-first-century education. Despite the growing enthusiasm surrounding GenAI, its educational value extends far beyond technological innovation alone. The literature increasingly portrays GenAI as an enabling technology capable of augmenting teachers' professional practice by reducing routine workload (Alqarni, 2026; Kokoç, 2024; Lee et al., 2025; Li et al., 2025; Navío-Inglés et al., 2025; Wang et al., 2024;), supporting lesson planning (Aldemir et.al., 2025; Davin et al., 2025; Garofalo & Farenga, 2025; Konakbayeva et al. 2025), generating instructional materials and promoting instructional creativity (Du et al. 2026; Jin et al. 2025; Romero-Garcia et al. 2025; Żammit, 2025), facilitating personalized learning (Jang & Choi, 2025; Nadelson et al., 2025), and enhancing assessment and feedback processes (Lee et al., 2024; Mulyani et al., 2025; Williams & Ingle, 2025). These affordances have the potential to improve teaching efficiency while allowing educators to devote greater attention to higher-order pedagogical responsibilities, including instructional decision-making, learner support, and classroom interaction. As GenAI systems become more sophisticated and accessible, they are also beginning to influence teachers' professional development by encouraging reflective practice, providing pedagogical recommendations, and expanding opportunities for instructional innovation. Collectively, these developments suggest that GenAI is reshaping not only how educational tasks are performed but also how teachers conceptualize and enact their professional roles.

Nevertheless, alongside these opportunities, the rapid adoption of GenAI has generated substantial academic debate regarding its responsible and sustainable use in education. Concerns have been raised about the accuracy and reliability of GenAI-generated content, including factual inaccuracies (Choi, 2025; Joseph & Areepattamanni, 2025; Tang et al., 2026), fabricated references (Han et al., 2025; Rodrigues et al., 2025), and inconsistent responses (Choi et.al., 2026; Lin et al., 2025) that may compromise instructional quality if used without appropriate human verification. Equally important are ethical issues involving data privacy, security, copyright, intellectual property, transparency, and accountability, all of which have become central considerations in educational GenAI governance. Researchers have also expressed concern that excessive reliance on GenAI may diminish teachers' professional autonomy (Du et al., 2026; Tang & Zhong, 2026) and students' critical thinking (Aydeniz, 2025), while creating new challenges related to academic integrity, plagiarism, and the authenticity of student learning. On the side of instructors as GenAI users; disparities in GenAI literacy (Ba et al., 2026; Goyal et al., 2025), limited professional preparation, technological infrastructure (Kim, 2026; Pham, 2025; Rutatola et al., 2025; Tongchai & Malakul, 2026), and algorithmic bias (Kılıçkaya & Kic-Drgas, 2025; Yetişensoy, 2025a) continue to hinder equitable and effective GenAI implementation across diverse educational contexts. These multidimensional challenges indicate that successful GenAI integration depends not only on technological advancement but also on the development of ethical frameworks, institutional support, and teachers' professional competencies. Ultimately, balanced understanding of both the benefits and the challenges, the two different sides of the coin, associated with GenAI seems essential for informing evidence-based policy, guiding professional development initiatives, and supporting the responsible further integration of GenAI into educational environments.

Purpose of the Study

The rapid advancement of artificial intelligence, particularly GenAI, has substantially influenced educational research and practice in recent years. Following the public release of ChatGPT and the emergence of other large language model (LLM)-based applications, GenAI has become increasingly accessible to educators and learners for a wide range of educational purposes. Recent studies have demonstrated that GenAI is being used to support lesson planning, instructional design, content generation, assessment, feedback, personalized learning, academic writing, problem-solving, and student support across diverse educational settings (Garzón et al., 2025). Consequently, research examining the educational use of GenAI has increased rapidly across different educational levels, disciplines, and learning environments. Existing studies have highlighted the potential of GenAI to improve learning experiences, enhance instructional efficiency, facilitate personalized learning, and support both teachers and students in

various educational tasks (Samala et al., 2025). At the same time, concerns regarding academic integrity, bias, transparency, reliability, privacy, copyright, and the responsible use of GenAI have become increasingly prominent within the educational literature (Soleimani et al., 2025).

Despite the rapidly growing body of research, the literature on GenAI use in education remains fragmented. GenAI has been implemented for a variety of educational purposes, and the reported benefits and challenges vary considerably across educational contexts, participant groups, learning activities, and GenAI applications. While many studies emphasize the benefits of GenAI in supporting teaching and learning processes, improving productivity, enhancing creativity, facilitating feedback, and promoting personalized learning, others report challenges related to inaccurate or fabricated outputs, overreliance on AI, diminished critical thinking, ethical concerns, privacy and security, copyright issues, and academic integrity (Farooqi et al., 2024). Consequently, existing evidence provides valuable insights into individual applications of GenAI but offers a less comprehensive understanding of the educational purposes for which GenAI is being used together with the benefits and challenges reported across empirical studies.

Recent review studies have synthesized GenAI research from various perspectives. Existing reviews have primarily examined specific GenAI tools, particularly ChatGPT, or focused on particular educational contexts such as higher education, teacher education, language learning, or medical education. Other reviews have concentrated on issues including technology adoption, users' perceptions, ethical concerns, learning outcomes, or specific instructional applications (Gökçearslan et al., 2025). Although these reviews have made important contributions to understanding GenAI in education, they generally focus on particular tools, educational settings, stakeholder groups, or research topics. As a result, there remains limited synthesized evidence regarding the educational purposes of GenAI use together with the reported benefits and challenges across empirical studies. Examining these dimensions collectively may provide a broader perspective on how GenAI is currently being integrated into educational practice and reveal common trends across different educational contexts.

The present systematic review aims to synthesize empirical research on the use of GenAI in education by examining the primary aims of GenAI implementation together with the reported benefits and challenges. In doing so, the study provides a systematic overview of the existing literature and identifies the main patterns emerging from empirical research. Accordingly, the following research questions were addressed:

RQ1. What the primary aims of GenAI use in education are reported in the reviewed studies?

RQ2. What benefits of GenAI use in education are reported in the literature?

RQ3. What challenges of GenAI use in education are reported in the literature?

RESEARCH METHOD

Research Model

This study employed a systematic review methodology to examine the use of artificial intelligence in education, with a particular focus on its aims, advantages, and challenges. Systematic reviews provide a rigorous and transparent approach to identifying, evaluating, and synthesizing existing evidence, enabling a comprehensive understanding of a research field (Gough et al., 2017; Oakley, 2012).

The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines (Page et al., 2021). The review process consisted of three stages: planning, conducting, and reporting.

During the planning stage, the research questions, search strategy, databases, and eligibility criteria were defined. In the conducting stage, studies were identified, screened, and selected through title, abstract, and full-text assessment based on the predetermined criteria. Finally, the reporting stage involved synthesizing the findings using descriptive and thematic analyses to provide an integrated overview of the

literature (Petticrew & Roberts, 2006).

Inclusion and Exclusion Criteria

In this study, inclusion and exclusion criteria were established to identify and select eligible studies from the search results. Table 1. presents the inclusion and exclusion criteria used to select studies for this systematic literature review. It specifies which studies were considered eligible and which were excluded to ensure the review focused on a well-defined body of evidence.

Table 1. *Inclusion and Exclusion Criteria*

Inclusion Criteria	Exclusion Criteria
Only articles indexed in Web of Science (WoS) Core Collection and the Education Resources Information Center (ERIC)	The other databases except the Education Resources Information Center (ERIC) and Web of Science (WoS) Core Collection
Original and empirical research articles	Systematic Review, Meta-analysis, bibliometric analysis, or commentary articles
Full text articles	Conference papers or similar studies
Peer reviewed articles	
Published in English	Non-English articles
K-12 and higher education settings	Other educational settings except K-12 and higher education
GenAI applications integrated in K-12 settings and higher education settings	AI applications integrated in other learning environments
GenAI, Large Language Models (LLMs)	Traditional AI (static algorithms), non-generative systems
Use of GenAI by teachers and instructors	Only student use of GenAI

Overall, the review included only original, empirical, peer-reviewed, full-text articles published in English and indexed in either the Web of Science (WoS) Core Collection or ERIC databases. Studies conducted in pre-K-12, K-12 and higher education settings were eligible only if they examined the use of generative AI technologies, particularly LLMs, by teachers or instructors. In contrast, studies were excluded if they were published in other databases, written in languages other than English, or represented non-empirical publication types such as systematic reviews, meta-analyses, bibliometric analyses, commentaries, or conference papers. Research conducted in educational contexts other than pre-K-12, K-12 or higher education, studies focusing on traditional (non-generative) AI systems, AI applications in other learning environments, or investigations that examined only students' use of generative AI were also excluded.

These criteria ensure that the review concentrates on high-quality empirical evidence regarding teachers' and instructors' use of generative AI in formal pre-K-12, K-12 and higher education contexts.

Search Procedure

The literature search was conducted following the principles of systematic review methodology to identify empirical studies examining the use of GenAI in educational settings. Two major databases, the Web of Science (WoS) Core Collection and the Education Resources Information Center (ERIC), were selected because of their comprehensive coverage of peer-reviewed research in education and educational technology.

A comprehensive search strategy was developed by combining terms related to generative artificial intelligence with terms describing educational contexts, teacher and instructor use. The search included

keywords associated with GenAI technologies (e.g., *"generative artificial intelligence"*, *"GenAI"*, *"large language model"*, *"LLM"*, *"ChatGPT"*, *"Gemini"*, *"Claude"*, *"Copilot"*) together with educational terms (e.g., *"education"*, *"teaching"*, *"teacher"*, *"instructor"*, *"K-12"*, *"school"*, *"higher education"*). Boolean operators (AND, OR) were used to combine the search terms, and database-specific search syntax was applied where necessary.

The searches were conducted using the advanced search functions of each database. Database filters were applied to retrieve only peer-reviewed journal articles published in English. The publication year zone to capture the full scope of empirical research on GenAI use in education was from the beginning of 2023 up to March 2026. Following the database searches, all retrieved records were exported, duplicate records were removed, and the remaining studies were screened according to the predefined inclusion and exclusion criteria.

Selection Process

The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines (Page et al., 2021). The searches were conducted in March 2026. As presented in Figure 1, a total of 537 records were identified through database searching, including 365 records from the Web of Science Core Collection and 172 records from ERIC. After removing 11 duplicate records, 526 unique records remained for title and abstract screening. During the screening process, 18 studies were excluded because their full texts could not be accessed. Consequently, 508 full-text articles were assessed for eligibility according to the predefined inclusion and exclusion criteria.

Following the full-text assessment, 326 studies were excluded. The majority of excluded studies did not meet the review scope because they focused on traditional AI systems rather than generative AI technologies, investigated only students' use of GenAI, or were conducted in educational contexts other than K–12 or higher education. Additional studies were excluded because they were non-empirical publications (e.g., systematic reviews, meta-analyses, bibliometric analyses, commentaries, or conference papers), were not peer-reviewed journal articles, were not published in English, or were not indexed in the selected databases. As a result, 182 empirical studies met all eligibility criteria and were included in the final systematic review.

Data Extraction and Analysis

During the data analysis phase, the selected articles were systematically allocated among the researchers, with each researcher responsible for analyzing a designated subset of the studies. To ensure a consistent approach aligned with the research questions, a structured coding framework was developed to support both the extraction and analysis of data.

The coding framework comprised of variables such as aims of GenAI, advantages of GenAI use in education, and challenges of GenAI use in education. Microsoft Excel was used to organize the extracted data and conduct the coding process. Following data extraction, the studies were independently coded by the researchers according to their assigned subsets. Each researcher then examined the coded studies to identify recurring patterns, emerging themes, and overarching trends concerning aims of GenAI and advantages of GenAI use in education, and challenges of GenAI use in education.

FINDINGS

Now that artificial intelligence is gradually gaining ground in each and every field of education and rapidly transforming teachers' professional practice, many a study have been conducted searching over the balance between technological capability and human pedagogical expertise. In this respect, the three main research questions that form the basis of this systematic review were addressed in light of the data obtained.

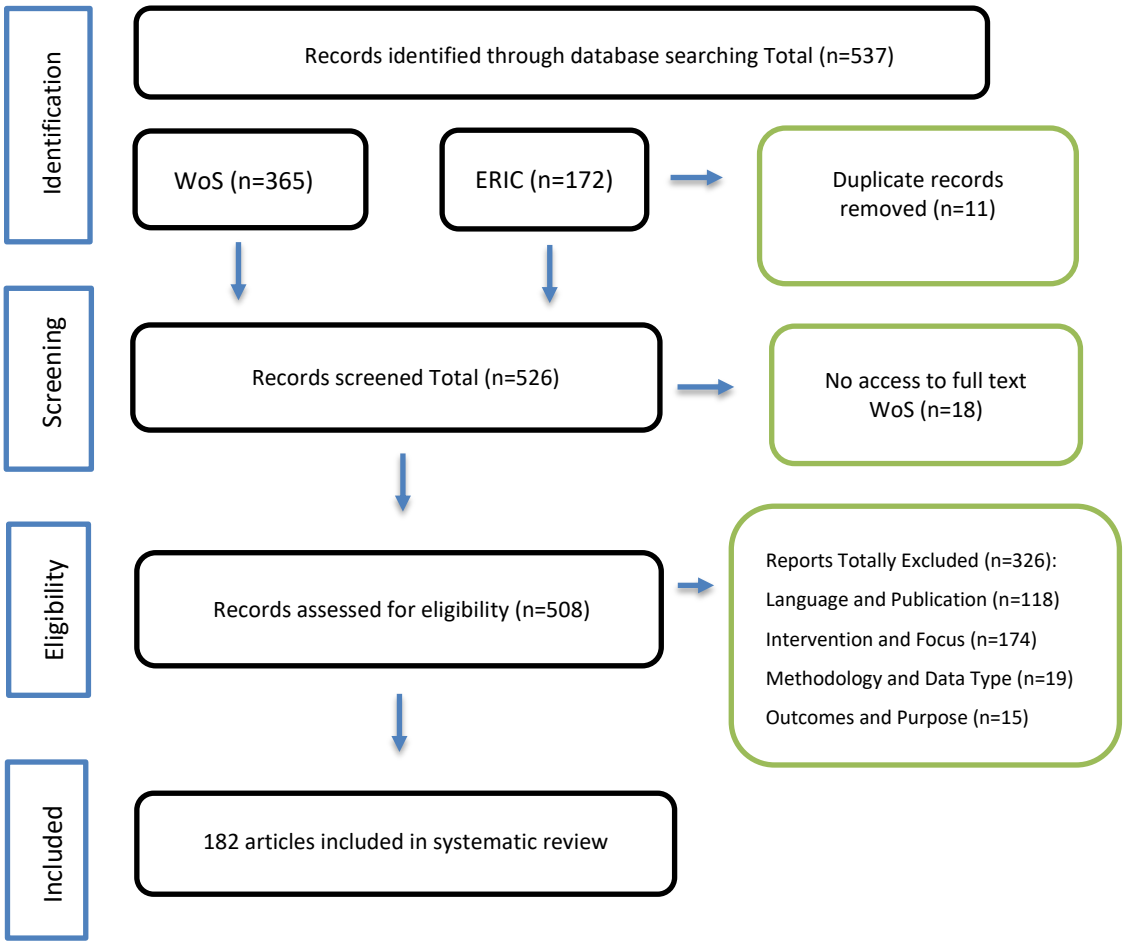

Figure 1. *PRISMA flow chart of article identification and screening (Page et al., 2021)*

What primary aims of AI use in education are reported in the reviewed studies?

According to the results, the most frequently reported purpose of GenAI was instructional planning and lesson/material generation (*f* = 112) (see Table 2). This theme encompasses the use of GenAI to support teachers in planning, designing, and organizing instruction, as well as generating educational resources. Teachers and instructors used GenAI for activities such as lesson planning, curriculum design, developing learning objectives, unit planning, creating performance tasks, generating rubrics, developing instructional materials, designing assessments, differentiating instruction, creating learning scenarios, adapting open educational resources (OERs), designing inquiry-based activities, preparing 5E lesson plans, and planning reading interventions. In addition, teachers and instructors used GenAI to generate teaching materials, including worksheets, PowerPoint presentations, quizzes, tests, images, songs, stories, diagrams, case studies, read-aloud prompts, English language teaching (ELT) materials, mathematical problems, fractal learning resources, and presentations.

The second most frequently reported purpose of GenAI was assessment and personalized feedback (*f* = 49). This theme encompasses the use of GenAI to support formative and summative assessment through automated and personalized feedback. Teachers and instructors used GenAI for automated grading, rubric development, formative assessment, writing feedback, thesis feedback, corrective feedback, pronunciation feedback, oral assessment, peer feedback, lesson plan evaluation, assessment question generation, performance-based assessment, and the evaluation of open-ended responses.

The third most frequently reported purpose of GenAI was teacher workload reduction and efficiency (*f* = 42). This theme refers to the use of GenAI to improve teacher productivity by automating routine instructional and administrative tasks. Teachers and instructors used GenAI for administrative automation, grading, drafting emails, instructional planning support, workload reduction, time-saving, project acceleration, improving work–life balance, and automating routine tasks.

Table 2. *Aims of GenAI in Education*

Aims of GenAI	f
Instructional planning and lesson/material generation	112
Assessment and personalized feedback	49
Teacher workload reduction and efficiency	42
Personalized learning	38
Teacher professional development and AI literacy	30
Student engagement and learning enhancement	27
Language teaching and writing support	25

The fourth most frequently reported purpose of GenAI was personalized learning (*f* = 38). This theme focuses on tailoring instruction and feedback to meet individual learners' needs. Teachers and instructors used GenAI to create personalized learning pathways, individualized instructional materials, differentiated learning experiences, customized tutoring, tailored practice problems, accessibility support, multilingual instruction, and personalized reading support.

Another frequently reported purpose was teacher professional development and AI literacy (*f* = 30). This theme relates to enhancing teachers' AI literacy, digital competence, and professional growth. Teachers and instructors used GenAI to develop AI literacy, strengthen GenAI competencies, improve educator readiness, support professional development, promote the responsible and ethical use of AI, facilitate scripted workshops, foster instructional innovation, encourage reflective teaching, and enhance pedagogical development.

Student engagement and learning enhancement (*f* = 27) was another reported purpose of GenAI in education. This theme encompasses the use of GenAI to improve student motivation, participation, higher-order thinking, and learning outcomes. Teachers and instructors used GenAI to promote student engagement, collaborative learning, learner autonomy, critical thinking, inquiry-based learning, motivation, emotional engagement, higher-order thinking skills, reflective thinking, and conceptual understanding.

Finally, the reported purpose was language teaching and writing support**.** This theme focuses on the application of GenAI in language education and academic writing. Teachers and instructors used GenAI for English as a Foreign Language (EFL) and English as a Second Language (ESL) instruction, vocabulary learning, grammar correction, conversational practice, writing assistance, proofreading, translation, academic writing support, oral English practice, and the development of communicative competence.

What benefits of GenAI use in education are reported in the literature?

To address the second research question, "What benefits of AI use in education are reported in the literature?", the advantages identified across the 182 empirical studies were subjected to a thematic analysis. The terminology varied considerably among studies; nevertheless, the reported benefits converged around several recurring themes. The findings suggest that artificial intelligence is predominantly viewed as a pedagogical support tool that augments teachers' professional practices rather than replacing them. The analysis suggests that the reported benefits fundamentally be organized into several overarching themes: (1) increased efficiency and workload reduction, (2) personalized and differentiated instruction, (3) lesson planning and instructional design support, (4) assessment and feedback enhancement, (5) instructional material generation, (6) professional development and pedagogical support, (7) improved student engagement and learning, and (8) creativity and instructional innovation (see Table 3).

Table 3. *Benefits of GenAI use in Education*

Theme	Typical findings reported in the studies	Prevalence
1. Increased efficiency and reduced workload	Automating repetitive tasks, saving time, reducing administrative burden, streamlining workflows, improving productivity	126 studies
2. Personalized and differentiated instruction	Adapting instruction to learner needs, individualized learning, differentiated materials, adaptive teaching	75 studies
3. Improved lesson planning and instructional design	Creating lesson plans, curriculum alignment, activity design, instructional resources, planning support	69 studies
4. Enhanced assessment and feedback	Automated grading, formative assessment, detailed feedback, feedback generation, assessment support	65 studies
5. Content and material generation	Producing worksheets, quizzes, exercises, teaching materials, summaries, examples, multimedia resources	63 studies
6. Professional support and teacher development	Reflection, pedagogical guidance, decision support, professional learning, instructional improvement	50 studies
7. Student learning and engagement support	Increasing motivation, engagement, participation, learning outcomes, classroom interaction	44 studies
8. Creativity and innovation	Brainstorming ideas, creative lesson design, instructional innovation, inspiration	40 studies

Across the reviewed studies, GenAI was consistently described as reducing teachers' administrative and routine instructional responsibilities by automating repetitive tasks, organizing information, generating teaching resources, and streamlining instructional workflows. Teachers reported considerable time savings in lesson preparation, material adaptation, document preparation, and classroom management tasks. Thus, the most frequently reported advantage concerned increased efficiency and workload reduction.

A second dominant theme involved personalized and differentiated instruction. Numerous studies emphasized GenAI's capacity to help teachers address learner diversity by adapting instructional content, generating differentiated learning materials, and providing individualized recommendations according to students' proficiency levels, learning preferences, and educational needs.

Another frequently identified advantage related to lesson planning and instructional design. Many studies highlighted GenAI's ability to support teachers during the planning phase by generating lesson plans, suggesting classroom activities, aligning instructional objectives with curriculum standards, organizing lesson sequences, and producing examples appropriate for different educational contexts.

The literature also consistently reported GenAI's contribution to assessment and feedback practices. Teachers benefited fromGen AI-supported formative assessment, automated grading, instant feedback generation, rubric development, and monitoring of student progress.

The fifth recognised theme, instructional material and content generation, can be related to instructional planning. Many studies described GenAI as an effective resource-generation tool capable of producing worksheets, quizzes, reading passages, discussion questions, summaries, presentations, examples, and instructional materials within a short period.

Another important theme involved professional development and pedagogical support. Beyond supporting day-to-day teaching activities, GenAI was frequently reported to facilitate teachers' professional

growth through instructional reflection, pedagogical guidance, decision support, and continuous learning opportunities.

Although the present review focused on advantages offered to teachers, many studies also emphasized improvements in student engagement and learning that indirectly benefited instructional practice. Considering that learning and teaching interaction is based on mutual interests, GenAI occurs to have a considerable impact on the process of building an effective education experience.

Finally, the reviewed literature highlighted creativity and instructional innovation as an emerging benefit of GenAI integration. The findings illustrate the fact that teachers frequently used GenAI to brainstorm instructional ideas, design innovative classroom activities, generate authentic learning scenarios, and explore alternative explanations of complex concepts.

In a nutshell, the findings indicate that GenAI is primarily perceived as an enabling technology that strengthens teachers' pedagogical capacity rather than replacing professional expertise.

What challenges of GenAI use in education are reported in the literature?

Regarding the third research question, "*What challenges of* Gen*AI use in education are reported in the literature?*", the data reveals the fact that the challenges reported extend beyond technological limitations and encompass pedagogical, ethical, organizational, and professional dimensions. Eight overarching themes emerged from the analysis: (1) ethical, privacy, and security concerns; (2) accuracy, reliability, and quality of GenAI-generated outputs; (3) over-reliance on GenAI and diminished human agency; (4) insufficient GenAI literacy and professional preparedness; (5) academic integrity and inappropriate student use; (6) technological and infrastructural limitations; (7) bias, fairness, and transparency; and (8) pedagogical and instructional concerns.

In almost two out of every three studies concerned ethical, privacy, and security issues, which is the most frequently reported challenge. Numerous studies identified concerns related to data privacy, confidentiality, intellectual property, copyright, informed consent, and the protection of sensitive educational information.

Another dominant theme involved the accuracy, reliability, and quality of GenAI-generated information. Across educational contexts, studies reported instances of factual inaccuracies, fabricated references, outdated information, superficial explanations, and inconsistent outputs.

A third major challenge related to over-reliance on GenAI and the erosion of teacher or learner agency. Many studies expressed concern that excessive dependence on GenAI could reduce teachers' professional judgment, critical decision-making, and instructional creativity.

The analysis also revealed widespread concern regarding insufficient GenAI literacy and professional preparedness. Many studies reported limited knowledge of GenAI technologies, uncertainty about effective classroom implementation, and insufficient professional development opportunities.

Another recurring theme focused on academic integrity and inappropriate educational use. Numerous studies discussed plagiarism, unauthorized AI-assisted assignments, cheating during assessments, fabricated academic work, and diminished originality as important challenges.

The reviewed studies also identified technological and infrastructural limitations as important implementation barriers. Teachers reported challenges associated with limited access to GenAI technologies, insufficient digital infrastructure, unreliable internet connectivity, software limitations, financial constraints, and unequal institutional resources.

A further concern involved bias, fairness, and transparency within GenAI systems. Researchers highlighted algorithmic bias, culturally inappropriate outputs, linguistic inequalities, opaque decision-making processes, and limited transparency regarding how GenAI systems generate responses.

Table 4. *The Challenges of GenAI Use in Education*

Theme	Typical findings reported in the studies	Prevalence
1. Ethical, privacy, and security concerns	Data privacy, confidentiality, copyright, intellectual property, informed consent, ownership of GenAI-generated content, responsible AI use, ethical governance	118
2. Accuracy, reliability, and quality of Gen**AI-generated outputs**	Hallucinations, factual inaccuracies, fabricated references, inconsistent responses, outdated information, superficial content, need for human verification	102
3. Over-reliance on Gen**AI and diminished human agency**	Dependency on GenAI, reduced critical thinking, weakened problem-solving, loss of teacher autonomy, diminished creativity, excessive reliance on GenAI-generated content	82
4. Insufficient Gen**AI literacy and professional preparedness**	Limited GenAI knowledge, inadequate training, lack of confidence, insufficient digital competence, uncertainty regarding classroom implementation	76
5. Academic integrity and inappropriate educational use	Plagiarism, cheating, unauthorized AI-assisted assignments, reduced originality, assessment challenges, misuse of GenAI by students	71
6. Technological and infrastructural limitations	Limited access to GenAI tools, insufficient infrastructure, unreliable internet, financial constraints, unequal institutional resources, technical difficulties	56
7. Bias, fairness, and transparency	Algorithmic bias, cultural bias, discrimination, lack of explainability, opaque decision-making, fairness concerns	48
8. Pedagogical and instructional limitations	Lack of empathy, limited contextual understanding, inability to replace teacher judgment, reduced human interaction, inappropriate instructional suggestions	44

Finally, many studies reported pedagogical and instructional concerns associated with AI integration. Although AI offers considerable instructional support, researchers cautioned that it cannot fully replicate teachers' pedagogical expertise, emotional intelligence, classroom management skills, or interpersonal relationships with learners (See Table 4 for all the emerging challenges in this review study).

Overall, the reviewed literature portrays GenAI-related challenges as multidimensional and interconnected. As a final note, understanding these challenges will not only help identify or resolve potential issues but also suggest different perspectives and areas of focus for more effective use of GenAI in education.

DISCUSSION

Aims of GenAI Use in Education

The following discussion summarizes the findings of the systematic review for the instructional, administrative, and developmental goals of Generative AI (GenAI) use in K-12 and higher education.

A systematic analysis of the current literature shows that the integration of GenAI is leading to a structural transformation of educational environments, from technology as a peripheral tool to a functional third player in a new 3D pedagogical model (Okulich-Kazarin & Artyukhov, 2025). This combination has

several key objectives that include the following: Operational efficiency to the fundamental restructuring of cognitive engagement.

The most reported purpose found in the review data is instructional planning and multimodal material development. GenAI tools assist educators in decreasing the time it takes to design lessons, map curriculum, and develop specific frameworks such as 5E models (Meegan & Young, 2025). This category has a critical pedagogical goal: the move to the multimodal content generation. Tools like DALL-E are supposed to be used in K-12 contexts to visualize abstract ideas such as students' future dreams in social studies to make theoretical ideas more tangible (Yetişensoy, 2025b). Higher education aims to develop complex clinical or mathematical scenarios that simulate real-world professional challenges (Jang & Choi, 2025; Mavrych et al., 2025).

One of the key goals of GenAI is to offer customized educational experiences that align with the proficiency of individual learners (Yin et al., 2026). In higher education, this has led to the deployment of Intelligent Teaching Assistants (ITAs) like ChatZJU for engineering and AnatomyGPT for medicine (Qian, 2025; Yang et al., 2025). Such systems aim to offer a "Dual-Teacher" model, delivering 24/7 instant Q&A support and customized learning paths often missing in traditional human-led, large-scale online courses (Yang et al., 2025). For K-12 educators, personalization goals are often connected to inclusive education, in which GenAI provides a scaffold to enhance the engagement and participation of inclusive students who may struggle in traditional teacher-centered settings (Yetişensoy, 2025b).

GenAI aims to change assessment practices from static outcomes to growth-oriented processes (Joseph & Areepattamannil, 2025). One of the main objectives is to provide immediate, actionable and detailed feedback on open-ended written responses. It reduces evaluator fatigue and allows a continuous development cycle (Jauhiainen & Garagorry, 2025). The goal of this integration is to shift assessment from policing to design, where the tool reveals the student's thinking process and reasoning and not just the final answer (Joseph & Areepattamannil, 2025). In discipline-specific contexts like medical education, GenAI is employed to automate the grading of essays and clinical reflections, offering structural and linguistic critiques that would otherwise be resource-prohibitive for human faculty (Sabouni et al., 2025).

An emerging pedagogical goal is to frame GenAI as a thought partner or co-intelligence partner (Louis et al., 2025; Qian, 2025; Smith et al., 2025). Rather than simply giving direct answers, the goal is to encourage a Socratic dialogue with students and to prompt them to consider their own reasoning and to critique the outputs produced by GenAI (Meegan & Young, 2025; Yang et al., 2025). Additionally, the review underscores the goal of developing prompt literacy, which refers to the capacity to strategically interact with and assess GenAI interactions (Qian, 2025; Yu et al., 2026). This is to empower students as critical consumers of information who are able to identify algorithmic biases and hallucinations (Rovira-Esteva, 2025; Zhang et al., 2025). Besides teaching students, a major goal of GenAI is to improve the work environment for teachers (Yang & Banks, 2025). GenAI is employed in teacher education programs to enable scenario-based learning (SBL) via the development of realistic, low-risk virtual classroom vignettes to enhance pre-service teachers' self-efficacy and classroom readiness (Meegan & Young, 2025). The review also emphasizes the "i-TPACK" framework as a developmental objective, urging teachers to integrate GenAI knowledge with pedagogical and content knowledge to foster more effective and ethics-based teaching (Aldemir et al., 2025; Yu et al., 2026). The incorporation of GenAI into higher education is for the purpose of workforce readiness (Ellis et al., 2025). Since most industries consider GenAI literacy a critical graduate attribute, universities are trying to incorporate these skills into curricula so that graduates can effectively work with non-human elements in complex professional systems (Ellis et al., 2025).

A useful distinction that comes out of the categorization of aims of GenAI is that K–12 goals are more strongly oriented toward pedagogical support, inclusion, developmental appropriateness, and teacher-mediated learning, whereas higher education goals are more oriented toward learner autonomy, disciplinary applications, academic productivity, and workforce readiness. This can be explained by the different developmental and educational purposes of the two sectors. K–12 learners are still developing foundational cognitive, social, and self-regulatory skills and therefore need more scaffolding, differentiated support, and teacher guidance in their use of GenAI. In addition, teachers in K–12 contexts have a critical

role in monitoring students' development, promoting appropriate technology use, and mediating learning experiences, which may clarify the stronger focus on pedagogical and inclusive applications. Conversely, in higher education students are more responsible for managing their own learning and are engaged in ever more specialized disciplinary and professional contexts. Therefore, the use of GenAI at this level is more likely to support independent learning, subject-specific work, research and academic productivity, and the development of competencies relevant to future employment. Thus, the identified differences show that the purposes of GenAI use are defined not only by the capabilities of the technology, but also by the developmental needs of learners, the role of teachers, and the overall educational and professional goals of each educational sector.

The results of systematic review show that the aims of GenAI in education have evolved from merely task automation to a complete reengineering of the learning experience. While high use in instructional planning can enhance efficiency, the end pedagogical goal is to develop a collaborative relationship in which GenAI supports personalized growth, transforms assessment into a conversation, and equips students and teachers alike for the critical literacies of a technology-driven future (Okulich-Kazarin & Artyukhov, 2025; Qian, 2025; Yang & Banks, 2025).

Benefits and Challenges of GenAI Use in Education

By systematically examining the reported benefits and challenges of GenAI across the reviewed studies, this review puts forward the dominant patterns emerging from the literature, highlights areas of consensus and concern, and provides evidence-based implications for researchers, teacher educators, practitioners, and policymakers, hence providing a comprehensive overview. Given that the use of Gen-AI will become much more prevalent and take on various forms in education over time, research is crucial in terms of both enhancing the benefits and effectiveness, and improving the quality of education by transforming its challenges into opportunities.

First and foremost, rather than replacing teachers, GenAI is consistently portrayed as reducing low-value, time-taking repetitive work; thus, teachers can devote more attention to many other performances such as instructional decision-making and student interaction. The research of many scholars (Kokoç, 2024; Özmen & Aydın, 2025) has revealed the fact that when viewed in terms of the current applications, GenAI plays an integral role as a helper and support tool, particularly during lesson creation—by offering opportunities for collaboration with teachers, providing support in lesson plan development, or assisting with the preparation of activities and materials to be used in class. From a macro perspective, one of the greatest benefits of using GenAI for educators is that processes which do not require high cognitive effort but are time-consuming can be completed much more quickly with the help of GenAI.

From the teaching point of view, if the action of education is fundamentally divided into three phases -before, during, and after- it could be proclaimed that the contributions AI offers to educators in all three phases are highly invaluable and significant, and that they yield effectiveness in various ways. With reference to the preparation phase, several studies (Chen et al., 2025; Chen et al., 2026; Li et al., 2025) show that GenAI increasingly functions as an instructional design assistant that supports teachers throughout the planning phase, which eases the workload of the teachers while getting prepared for their teachings. In the same vein, GenAI is widely perceived as an instructional assistant capable of rapidly producing adaptable educational materials (Chatzichristofis et al., 2025; Jin et al., 2025; Mulyani et al., 2025; Song et al. 2025). In both inferences, GenAI proves to be an effective aid or mechanic collaborator to save time and increase the effectiveness of preparation, a process which precedes teaching practice yet escalates the effectiveness of the teacher performance. Thinking of the throughout teaching phase, what GenAI comfortably enables for the educators is that teachers can implement instructional differentiation more efficiently than would otherwise be possible, especially in large classes. It should also be noted that teachers perceive GenAI as indirectly benefiting them by making classroom instruction more engaging and responsive. GenAI, moreover, accelerates assessment processes while allowing teachers to provide richer and more timely feedback, which proves GenAI to be supportive after the teaching sessions.

Beyond classroom tasks, GenAI is increasingly viewed as a tool that contributes to teachers' ongoing professional development. From reflection over teachings or any education-based actions to pedagogical guidance, or from decision support to instructional improvement, GenAI serves as a professional learning provider. Furthermore, GenAI is often witnessed to serve as a collaborative ideation partner that expands teachers' repertoire. When used correctly, GenAI, supposedly, would take an educator's creativity to a whole new realm. Collectively, these findings indicate that GenAI is primarily valued for augmenting teachers' pedagogical capacity, enabling them to allocate more time and cognitive resources to complex instructional and interpersonal aspects of teaching.

The review, additionally, projected over the challenges that instructors face whilst utilising GenAI for educational purposes. While these challenges highlight shortcomings and gaps in the use of GenAI, they also point to areas for improvement in GenAI adoption and situations where investment is needed in an educational context. To begin with, teachers expressed uncertainty regarding how GenAI systems collect, store, and utilize personal data, while researchers emphasized the need for robust institutional policies and ethical guidelines governing GenAI implementation. In addition, several studies highlighted concerns regarding accountability, ownership of GenAI-generated content, and the responsible use of learners' personal information. These findings suggest that ethical governance remains one of the primary prerequisites for sustainable GenAI integration in education. Secondly, research highlights false and/or fictitious sources, empirical inaccuracies, oversimplified interpretations, out-of-date -if not totally irrelevant- information, and conflicting outputs. Several researchers noted that GenAI-generated content often requires careful human verification before classroom use, particularly when preparing instructional materials or providing academic guidance. Thus, the literature consistently emphasizes that GenAI should function as a supportive resource rather than an unquestioned authority. The third major challenge in the face of the use of GenAI related to over-reliance on GenAI (Kasap & Babayiğit, 2026) and the erosion of teacher or learner agency. Many studies expressed concern that excessive dependence on AI could reduce teachers' professional judgment, critical decision-making, and instructional creativity. Similarly, researchers warned that students who rely heavily on GenAI-generated solutions may experience diminished critical thinking, problem-solving ability, independent learning, and writing competence. Several studies further argued that overdependence on GenAI risks transforming teachers into passive users rather than reflective educational professionals. Fourth challenge is insufficient AI literacy meaning limited knowledge of GenAI technologies, uncertainty about effective classroom implementation, and insufficient professional development opportunities. Studies consistently identified inadequate training, lack of technical competence, and uncertainty regarding appropriate pedagogical integration as significant barriers to successful GenAI adoption. In a similar manner, GenAI users frequently expressed concern that unrestricted GenAI use may encourage superficial learning and reduce students' engagement in authentic cognitive processes. That sort of learning in no way equals long term internalisation, and accordingly, educational and academic integrity is to be prioritised to overcome that shortcoming. Also, the lack of explainability should also be considered another but dangerous challenge, a true problem, particularly in educational contexts where teachers are expected to justify instructional decisions and evaluate learning fairly. Conclusive information without any logical referencing system or a format to verify it makes the use of GenAI a case under question. A rather serious challenge to bear in mind is that educational institutions vary considerably in their technological readiness, creating disparities in teachers' opportunities to adopt GenAI effectively. These findings indicate that successful GenAI integration depends not only on technological availability but also on adequate institutional support and infrastructure. Lastly, a significant challenge which might have adverse effects on the authentic teacher-student interaction in the long term is the excessive reliance on GenAI-generated lesson plans or instructional materials for they may reduce pedagogical flexibility and limit opportunities for such an interaction.

Conclusion

The findings of this systematic review indicate that GenAI is predominantly employed to support teaching and learning processes, with instructional planning and the creation of lessons/materials being the most frequently reported uses. Teachers are heavily utilizing GenAI to assist with lesson design, content

creation, assessment development and instructional differentiation. Other key applications are assessment and personalized feedback, reducing teacher workload, supporting individualized instruction, improving teachers' AI literacy and professional development, improving students' engagement and supporting language teaching and writing. This wide perspective of GenAI use with its increasingly influential position in contemporary education practices plainly yet thoroughly suggests that the literature has gradually moved away from asking whether GenAI should be used in education toward asking how it should be integrated responsibly and pedagogically.

The results of the reviewed studies suggest that GenAI provides significant opportunities for improving the efficiency of teaching, personalizing learning experiences, and improving educational practices. Accordingly, three key points emerge that educators should keep in mind when evaluating the contributions and opportunities that GenAI brings to the field of education in terms of improving the quality of education. The very first level is the necessity for the teachers to advance their technical capabilities so as to make use of GenAI as efficiently and effectively as possible in their teachings. These findings emphasize the need for ongoing research on the effective, ethical and sustainable implementation of GenAI in education. As for the third matter, in a similar direction, concerns regarding the reliability of GenAI-generated outputs, ethical and privacy considerations, academic integrity, algorithmic bias, over-reliance on GenAI, and insufficient teacher preparedness underscore that successful GenAI integration cannot be, again, understood merely as a technological endeavor. Rather, the findings suggest that GenAI should be conceptualized as a human-centered pedagogical partner whose educational value depends largely upon how teachers critically, ethically, and purposefully employ its affordances within teaching and learning processes.

Overall, it would be plausible to foresee that the future of AI in education will be determined not by what GenAI is capable of doing, but by how responsibly and pedagogically educators choose to integrate its capabilities into human-centered teaching and learning environments. Furthermore, it is to be noted that , the most salient advantages, such as efficiency, personalization, and instructional support, and challenges, namely accuracy, ethics, AI literacy, and over-reliance, are not opposing findings but rather complementary dimensions of and the greatest contributors to the same phenomenon.

Limitations

Several limitations should be considered when interpreting the findings of this systematic review. The first limitation is the restriction of the search to the WoS and ERIC databases. Although these databases provide substantial coverage of peer-reviewed research, relevant studies indexed elsewhere may have been excluded, particularly those published in regional or interdisciplinary outlets. This may have limited the comprehensiveness and generalizability of the findings and introduced a potential degree of selection bias. Future reviews could address this limitation by incorporating additional bibliographic databases and complementary search strategies.

Second, only peer-reviewed journal articles published in English were included. Consequently, potentially relevant evidence reported in other languages or disseminated through conference proceedings, book chapters, dissertations, and other forms of gray literature was excluded.

Third, given the rapidly evolving nature of generative artificial intelligence, the body of literature continues to expand at an exceptional pace. As a result, studies published after the review period or those under review or in press at the time of the search could not be incorporated into the analysis. Accordingly, the findings should be interpreted as reflecting the state of the literature during the specified review period.

Finally, the reviewed studies represented diverse educational contexts, disciplines, learning environments, and GenAI applications. While this diversity provides a comprehensive picture of the current research landscape, differences across studies should be considered when interpreting and comparing the findings.

Recommendations

There are several practical implications of the results of this review for educational policy and practice. The use of GenAI should be primarily as a tool to support instructional planning, material development, assessment, and personalized learning but as a complement, not a replacement, for the professional expertise of teachers. Systematic professional development should be provided by educational institutions to support successful integration and strengthen teachers' AI literacy and pedagogical competencies. There is a need for clear policies and ethical guidelines at the institutional level to address issues of privacy, data security, copyright and the responsible use of AI. Teachers should critically review and crosscheck the content generated by AI before using it as part of instructional or assessment practices and adapt assessment approaches to promote academic integrity within AI-supported learning environments. Furthermore, policymakers must invest in digital infrastructure and guarantee equitable access to AI technologies to enable sustainable implementation. Finally, the successful integration of GenAI hinges on preserving human oversight and instructional judgment, positioning AI as an ancillary tool that augments, rather than replaces, teaching and learning.

DECLARATIONS

Ethics approval and consent to participate

Ethical approval and participant consent were not required for this study because it is a systematic review based exclusively on previously published studies and does not involve human participants or identifiable personal data.

Consent for publication

The authors declare consent this manuscript to publish at Malaysian Online Journal of Educational Technology

Availability of data and materials

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

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Authors' contributions

OC: Project administration, Formal analysis, Writing – review & editing, Validation, Data curation, Resources, Writing – original draft, Conceptualization, Investigation, Revision, Methodology. **TA:** Visualization, Methodology, Data curation, Writing – original draft, Formal analysis, Conceptualization, Resources, Validation, Writing – review & editing, Revision, **DMB:** Investigation, Data curation, Methodology, Writing – review & editing, Conceptualization, Validation, Visualization, Formal analysis, Writing – original draft, Revision.

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Declaration of the use generative AI or AI assisted technologies

The author(s) declared that generative AI was used in the creation of this manuscript. GenAI has been used to visualize a group of data. Also, during the preparation of this manuscript, generative AI tools were used for language editing support. The authors take full responsibility for the content of this publication.

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