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APPLICATIONS OF GENERATIVE ARTIFICIAL INTELLIGENCE ACROSS BLOOM'S TAXONOMY A SYSTEMATIC REVIEW OF EDUCATIONAL EVIDENCE (2020-2026)

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ABSTRACT

The rapid advancement of Generative Artificial Intelligence (GenAI) has transformed educational practices by providing innovative tools capable of supporting teaching, learning, assessment, and knowledge construction. Among the various educational frameworks, Bloom's Taxonomy remains one of the most widely adopted models for classifying cognitive processes, ranging from lower-order thinking skills, such as remembering and understanding, to higher-order skills, including analyzing, evaluating, and creating. This study investigates the potential contributions of Generative Artificial Intelligence to the development of cognitive skills across Bloom's Taxonomy levels in educational environments. A systematic literature review was conducted to identify, analyze, and synthesize recent research on the application of Generative AI technologies, particularly large language models, in educational contexts. Studies published between 2020 and 2026 were examined using predefined inclusion and exclusion criteria. The findings indicate that Generative AI can effectively support learning activities across all cognitive levels, with particularly strong evidence reported for Understanding, Analyzing, Evaluating, and Creating activities., with particularly strong contributions to higher-order thinking skills. AI-driven systems facilitate personalized feedback, adaptive learning pathways, content generation, problem-solving assistance, and creative task development. However, concerns remain regarding overreliance on AI tools, academic integrity, critical thinking reduction, and ethical implications. The results suggest that Generative Artificial Intelligence has significant potential to enhance educational outcomes when integrated through pedagogically sound approaches aligned with Bloom's Taxonomy. The study contributes to the growing body of knowledge on AI-enhanced learning and provides recommendations for educators, researchers, and policymakers seeking to maximize the educational benefits of emerging AI technologies.

Keywords: Generative Artificial Intelligence, Bloom's Taxonomy, Higher-Order Thinking Skills, Educational Technology, Personalized Learning, Artificial Intelligence in Education

INTRODUCTION

The emergence of Generative Artificial Intelligence (GenAI) has introduced unprecedented opportunities and challenges within educational systems worldwide. Recent advancements in large language models and generative technologies have enabled the creation of intelligent systems capable of producing human-like text, generating educational content, providing personalized feedback, and supporting complex problem-solving tasks. As educational institutions increasingly adopt these technologies, understanding their pedagogical implications has become a critical area of academic inquiry.

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Artificial Intelligence in Education (AIED) has evolved significantly over the last decade, moving beyond traditional intelligent tutoring systems toward more sophisticated and adaptive learning environments. The introduction of Generative AI tools such as ChatGPT, Gemini, Claude, and other large language models has accelerated discussions regarding the role of artificial intelligence in supporting student learning and cognitive development. These technologies offer the potential to transform educational practices by providing immediate feedback, personalized learning experiences, and enhanced opportunities for knowledge construction.

One of the most influential frameworks for understanding learning outcomes is Bloom's Taxonomy, originally proposed by Bloom et al. (1956) and later revised by Anderson and Krathwohl (2001). The revised taxonomy categorizes cognitive processes into six hierarchical levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating. This framework continues to guide curriculum development, instructional design, and educational assessment across diverse learning contexts.

The integration of Generative AI into educational environments raises important questions regarding its capacity to support each cognitive level of Bloom's Taxonomy. While AI tools can facilitate information retrieval and content explanation, their potential influence on higher-order cognitive skills such as critical analysis, evaluation, and creative production remains a subject of ongoing debate. Some researchers argue that Generative AI can enhance cognitive engagement and foster deeper learning, whereas others express concerns about dependency, reduced intellectual effort, and challenges related to academic integrity.

Given the rapid expansion of Generative AI technologies and their increasing adoption in educational settings, a comprehensive examination of their relationship with Bloom's Taxonomy is necessary. Understanding how these tools contribute to different cognitive processes may provide valuable insights for educators, instructional designers, and policymakers seeking to implement AI responsibly and effectively.

Therefore, this study aims to analyze the contributions of Generative Artificial Intelligence to the development of cognitive skills across the levels of Bloom's Taxonomy through a systematic review of recent literature. Specifically, the study seeks to identify the educational applications of Generative AI, evaluate its impact on cognitive development, and discuss opportunities and challenges associated with its implementation in educational contexts.

LITERATURE REVIEW

Artificial Intelligence (AI) has experienced remarkable growth over the last decade, driven by advances in machine learning, deep learning, and natural language processing. More recently, Generative Artificial Intelligence (GenAI) has emerged as one of the most influential technological developments, attracting significant attention from researchers, educators, policymakers, and industry professionals. Unlike traditional AI systems that primarily focus on classification, prediction, or decision support, Generative AI is capable of producing new content, including text, images, audio, video, and computer code, based on patterns learned from extensive datasets.

The emergence of large language models (LLMs) has accelerated the adoption of Generative AI across various sectors. These models are trained on vast amounts of textual information and are designed to generate coherent, contextually relevant responses to user prompts. As a result, tools powered by Generative AI can assist users in tasks ranging from information retrieval and content creation to problem-solving and creative production.

Within educational contexts, Generative AI has quickly become a topic of growing interest Kasneci et al. (2023), Tlili et al. (2023). Its ability to provide immediate feedback, explain complex concepts, generate instructional materials, and support personalized learning experiences has positioned it as a potentially transformative educational technology Moorhouse et al. (2023), UNESCO (2023). Students can interact with AI systems as learning assistants, while educators may use these tools to develop teaching resources, design assessments, and facilitate differentiated instruction.

Despite these opportunities, concerns regarding the educational use of Generative AI remain prevalent. Questions related to reliability, bias, misinformation, ethical use, data privacy, and academic integrity continue to generate debate within the academic community. The challenge, therefore, is not merely determining whether Generative AI should be used in education but understanding how it can be integrated in ways that genuinely enhance learning while minimizing potential risks.

As educational institutions increasingly experiment with AI-driven technologies, the discussion has shifted from simple adoption toward the development of pedagogical frameworks capable of guiding meaningful implementation. In this regard, Bloom's Taxonomy offers a useful perspective for examining how Generative AI may contribute to different levels of cognitive development.

ARTIFICIAL INTELLIGENCE IN EDUCATION

The field of Artificial Intelligence in Education (AIED) has evolved considerably since its emergence in the late twentieth century. Early applications focused primarily on intelligent tutoring systems designed to replicate certain aspects of human instruction. These systems aimed to provide individualized guidance, adaptive feedback, and automated assessment based on predefined learning pathways.

Over time, advances in computational power and data analytics enabled the development of more sophisticated educational technologies capable of adapting to learners' needs. Contemporary AI-based educational systems can analyze learning patterns, identify knowledge gaps, recommend personalized content, and support decision-making processes for both students and educators.

The introduction of Generative AI represents a significant expansion of the AIED landscape. Unlike previous educational technologies that largely relied on structured responses and predefined instructional paths, Generative AI facilitates dynamic interactions. Students can engage in open-ended conversations, request explanations tailored to their level of understanding, and explore alternative perspectives on a given topic.

Research suggests that AI-supported learning environments may contribute to increased student engagement, greater accessibility, and improved learning outcomes Luckin et al. (2016), Zawacki-Richter et al. (2019). Personalized support can be particularly beneficial in large classrooms where individualized attention from instructors may be limited. Furthermore, AI tools can provide immediate feedback, allowing learners to identify and correct misconceptions during the learning process.

Nevertheless, scholars have also highlighted potential challenges associated with excessive dependence on AI systems Dwivedi et al. (2023), Kasneci et al. (2023). Critics argue that overreliance on automated assistance may reduce opportunities for independent thinking and self-regulated learning. Additionally, concerns regarding transparency and accountability have become increasingly relevant, particularly when AI-generated responses influence academic decision-making or knowledge construction.

Consequently, current discussions within AIED emphasize the importance of viewing AI as a complement rather than a replacement for human instruction. Effective educational practices require a balanced integration of technological innovation and pedagogical expertise, ensuring that AI serves as a tool for cognitive development rather than a substitute for meaningful learning experiences.

BLOOM'S TAXONOMY AND COGNITIVE DEVELOPMENT

Bloom's Taxonomy remains one of the most influential frameworks in educational research and practice Bloom et al. (1956), Anderson and Krathwohl (2001). Originally introduced by Bloom and colleagues in 1956 and later revised by Anderson and Krathwohl (2001), the taxonomy provides a hierarchical classification of cognitive processes involved in learning.

The revised taxonomy consists of six cognitive levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating. These levels are generally organized from simpler forms of knowledge acquisition to more complex forms of cognitive engagement.

Remembering involves the ability to recall facts, concepts, and previously learned information. Understanding requires learners to interpret, explain, and summarize knowledge in meaningful ways. Applying refers to the use of acquired knowledge in practical situations or problem-solving contexts. Analyzing involves examining relationships, identifying patterns, and distinguishing relevant information from irrelevant information. Evaluating requires critical judgment based on criteria and evidence. Finally, Creating represents the highest cognitive level, involving the generation of new ideas, products, or solutions.

The taxonomy has been widely adopted across educational levels because it provides a structured approach to curriculum design, instructional planning, and assessment development. Educators frequently use Bloom's framework to align learning objectives with teaching strategies and evaluation methods.

In the context of emerging technologies, Bloom's Taxonomy offers a valuable lens through which the educational impact of Generative AI can be examined. Rather than focusing exclusively on technological capabilities, the framework allows researchers to investigate how AI influences specific cognitive processes. This perspective shifts attention from what AI can do to how AI affects learning itself.

The continued relevance of Bloom's Taxonomy in contemporary education suggests that it remains an appropriate framework for evaluating the pedagogical contributions of Generative AI. As AI becomes increasingly integrated into learning environments, understanding its relationship with different cognitive levels becomes essential for ensuring educational effectiveness.

GENERATIVE AI AND HIGHER-ORDER THINKING SKILLS

One of the most significant debates surrounding the educational use of Generative AI concerns its potential influence on higher-order thinking skills. These skills, commonly associated with the upper levels of Bloom's Taxonomy, include analysis, evaluation, and creation. They are considered fundamental for critical thinking, problem-solving, innovation, and lifelong learning.

Supporters of Generative AI argue that these technologies can stimulate deeper cognitive engagement when used appropriately Kasneci et al. (2023), Moorhouse et al. (2023). By providing access to diverse perspectives, generating alternative solutions, and facilitating exploratory discussions, AI systems may encourage students to analyze information more critically and develop more sophisticated arguments. Furthermore, Generative AI can serve as a cognitive partner that supports brainstorming, reflection, and creative production.

For example, students may use AI-generated responses as starting points for critical evaluation rather than as final answers. In such cases, the learning process requires learners to assess the quality, accuracy, and relevance of the information provided. This interaction may promote analytical reasoning and evidence-based judgment.

Similarly, Generative AI can contribute to creative activities by assisting learners in generating ideas, organizing content, and exploring novel approaches to problem-solving Bubeck et al. (2023), OpenAI (2023). Rather than replacing creativity, AI may function as a catalyst that expands opportunities for innovation and knowledge creation.

However, concerns persist regarding the possibility that AI could undermine higher-order thinking when used passively. If students rely exclusively on AI-generated content without engaging in reflection, critique, or independent analysis, learning outcomes may be compromised. The ease with which information can be obtained may discourage intellectual effort and reduce opportunities for cognitive struggle, a process often associated with meaningful learning.

Therefore, the educational value of Generative AI appears to depend largely on instructional design. Learning activities that require critical evaluation, justification of decisions, and original production are more likely to promote higher-order thinking than activities focused solely on content consumption.

OPPORTUNITIES AND CHALLENGES OF GENERATIVE AI IN EDUCATION

The rapid integration of Generative AI into educational environments presents both significant opportunities and important challenges UNESCO (2023), Dwivedi et al. (2023). On one hand, these technologies have the potential to democratize access to knowledge, support personalized learning, increase student engagement, and enhance educational efficiency. Students can receive immediate assistance regardless of time or location, while educators can benefit from automated support in content development and assessment design.

Generative AI may also contribute to educational inclusion by providing alternative explanations, adapting content to different learning needs, and reducing barriers faced by learners with diverse backgrounds. Such capabilities align with contemporary educational goals centered on equity and accessibility.

On the other hand, several challenges must be carefully addressed. Ethical concerns related to bias, misinformation, privacy, and transparency continue to raise important questions regarding responsible implementation. Additionally, the increasing use of AI-generated content has intensified debates surrounding academic integrity, originality, and authorship.

Another challenge involves the preparation of educators UNESCO (2023), Moorhouse et al. (2023). Effective integration of Generative AI requires not only technological familiarity but also pedagogical competence. Teachers must understand both the possibilities and limitations of these tools in order to design learning experiences that foster genuine cognitive development.

Ultimately, the educational impact of Generative AI will depend on how these technologies are incorporated into teaching and learning practices. When guided by sound pedagogical principles and aligned with established educational frameworks such as Bloom's Taxonomy, Generative AI has the potential to become a powerful instrument for supporting meaningful learning and cognitive growth.

METHODOLOGY

This study adopted a Systematic Literature Review (SLR) approach to examine the contributions of Generative Artificial Intelligence (GenAI) to the development of cognitive skills across the levels of Bloom's Taxonomy in educational contexts. A systematic review was considered appropriate because it enables the identification, evaluation, and synthesis of existing evidence through a transparent and replicable process.

The review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework Page et al. (2021), which provides methodological procedures for conducting rigorous literature reviews. The objective was to map current research trends, identify educational applications of Generative AI, and analyze how these technologies support different cognitive processes associated with Bloom's Taxonomy.

RESEARCH QUESTIONS

The review was structured around the following research questions:

RQ1: How has Generative Artificial Intelligence been applied in educational contexts?

RQ2: Which levels of Bloom's Taxonomy are most frequently supported by Generative AI tools?

RQ3: What benefits have been reported regarding the use of Generative AI for cognitive development?

RQ4: What challenges and limitations have been identified in the educational implementation of Generative AI?

SEARCH STRATEGY

The literature search was conducted using four widely recognized academic databases: Scopus; Web of Science; ERIC (Education Resources Information Center) and Google Scholar.

These databases were selected due to their extensive coverage of educational technology, artificial intelligence, and interdisciplinary research. The search process considered publications from January 2020 to March 2026, a period corresponding to the rapid expansion of Generative AI technologies and their adoption within educational settings.

The following search string was adapted according to the requirements of each database: ("Generative Artificial Intelligence" OR "Generative AI" OR "Large Language Models" OR "ChatGPT") AND ("Bloom's Taxonomy" OR "Higher-Order Thinking Skills" OR "Cognitive Skills") AND ("Education" OR "Teaching" OR "Learning"). Additional searches were conducted using related keywords to ensure comprehensive coverage of the literature.

Figure 1

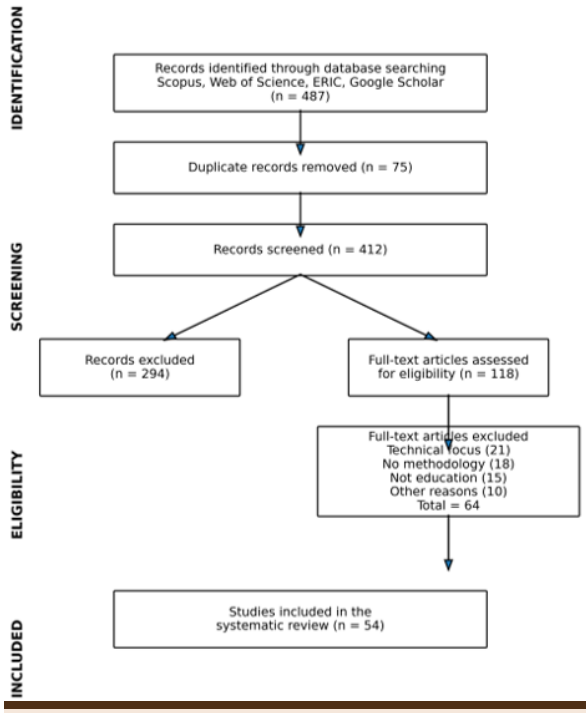

Figure 1 PRISMA Flow Diagram of Study Selection

INCLUSION AND EXCLUSION CRITERIA

Studies were included if they:

(a) were published between 2020 and 2026; (b) focused on Generative AI in educational contexts; (c) were peer-reviewed and (d) were written in English.

Studies were excluded if they:

(a) focused exclusively on technical AI development; (b) lacked methodological description and (c) were duplicate records.

DATA EXTRACTION AND ANALYSIS

A structured data extraction form was developed to collect relevant information from each selected study. The extracted variables included: Author(s); Publication year; Country of study; Educational level; Type of Generative AI technology; Educational application; Bloom's Taxonomy level(s) addressed; Reported benefits and Reported challenges.

Each study could be classified into more than one Bloom's Taxonomy level when multiple cognitive processes were reported. Therefore, the total frequencies presented in Table 2 exceed the total number of included studies.

Classification of Bloom's Taxonomy levels was based on the primary educational outcomes reported in each study. Studies were coded according to explicit evidence describing how Generative AI supported remembering, understanding, applying, analyzing, evaluating, or creating activities. Multiple classifications were allowed when more than one cognitive level was identified.

The collected data were analyzed using thematic content analysis. Similar findings were grouped into categories representing educational applications, cognitive outcomes, opportunities, and limitations associated with Generative AI. Author (2025)

To improve reliability, studies were reviewed multiple times, and coding categories were refined throughout the analysis process. The final dataset consisted of 54 studies that satisfied all eligibility criteria and were subsequently analyzed through thematic coding procedures.

Table 1

Table 1 Representative Studies Included in the Review

Author	Year	Country	Educational Level	AI Tool	Bloom Level
Kasneci et al.	2023	Germany	Higher Education	ChatGPT	Analyze, Evaluate
Tlili et al.	2023	China	Higher Education	ChatGPT	Create
Moorhouse et al.	2023	Hong Kong	Higher Education	ChatGPT	Evaluate
Cotton et al.	2025	United Kingdom	Higher Education	ChatGPT	Analyze
Baidoo-Anu and Ansah	2023	Ghana	Higher Education	ChatGPT	Understanding, Create
Lo	2023	Hong Kong	Higher Education	ChatGPT	Evaluate
Sallam	2023	Jordan	Higher Education	ChatGPT	Understanding
Rudolph et al.	2024	Australia	Higher Education	ChatGPT	Analyze, Evaluate
Rahman and Watanobe	2024	Japan	Computer Education	LLMs	Apply
Holmes and Tuomi	2022	Finland	Educational Policy	AI Systems	Evaluate
Su and Yang	2023	China	Language Learning	ChatGPT	Create
Kohnke et al.	2023	Hong Kong	Language Education	ChatGPT	Understanding
Chan and Hu	2023	China	Higher Education	ChatGPT	Analyze
Farrokhnia et al.	2024	Netherlands	Higher Education	ChatGPT	Evaluate
Yan et al.	2024	China	STEM Education	Generative AI	Apply

Table 2

Table 2 Distribution of Included Studies

Category	Frequency
Higher Education	36
Secondary Education	9
Primary Education	5
Professional Training	4
ChatGPT Studies	41
Other Generative AI Tools	13

Table 2 indicates that most studies were conducted in higher education settings (n = 36), representing approximately two-thirds of the reviewed literature. Furthermore, ChatGPT was the predominant Generative AI tool, appearing in 41 studies. These findings suggest that current research has focused primarily on university contexts and large language models, reflecting the rapid adoption of these technologies after 2022.

RESULTS

The final sample consisted of 54 studies published between 2020 and 2026. Representative examples of these studies are presented in Table 1, while their distribution across educational contexts is summarized in Table 2. Analysis of publication trends

revealed a substantial increase in research output after 2022, coinciding with the widespread adoption of large language models and the growing accessibility of Generative AI tools in educational settings. Das (2025)

The selected studies represented a diverse range of educational contexts, including primary education, secondary education, higher education, and professional training programs. Higher education was the most frequently investigated setting, accounting for approximately two-thirds of the studies. This trend may be explained by the rapid integration of AI technologies into universities and the increasing interest in understanding their impact on academic learning and assessment.

The reviewed studies employed a variety of research methodologies, including experimental designs, surveys, case studies, mixed-methods approaches, and systematic reviews. Such methodological diversity reflects the emerging nature of the field and the broad range of questions currently being explored by researchers.

Regarding technological applications, ChatGPT and other large language models were the most frequently examined tools. However, several studies also investigated AI-powered tutoring systems, content generation platforms, automated feedback systems, and adaptive learning environments.

Overall, the findings indicate that Generative AI is being adopted across multiple educational levels and disciplines, demonstrating its versatility as a learning support technology. Although several Generative AI tools were identified, the reviewed literature was heavily dominated by studies involving ChatGPT.

GENERATIVE AI APPLICATIONS ACROSS BLOOM'S TAXONOMY

One of the primary objectives of this review was to identify how Generative AI contributes to different cognitive levels within Bloom's Taxonomy. The findings suggest that Generative AI can support learning activities associated with all six cognitive levels. Of the 54 analyzed studies, 48 (88.9%) reported applications associated with Understanding, 42 (77.8%) with Analyzing, 40 (74.1%) with Evaluating, and 39 (72.2%) with Creating. Lower-order cognitive processes such as Remembering were reported in 38 studies (70.4%). However, the intensity and nature of these contributions vary according to the complexity of the learning task.

At the remembering level, Generative AI was frequently used to assist students in retrieving information, reviewing concepts, and reinforcing previously acquired knowledge.

The evidence suggests that AI systems could provide quick access to definitions, explanations, examples, and factual information. Students often used these tools as supplementary resources for revision and exam preparation.

Although these applications primarily support lower-order thinking skills, researchers noted that immediate access to information may increase learning efficiency and reduce cognitive barriers during the initial stages of knowledge acquisition.

The reviewed literature revealed significant evidence supporting the role of Generative AI in promoting understanding. Students frequently used AI systems to obtain simplified explanations, alternative examples, and step-by-step descriptions of complex topics. This functionality was particularly beneficial when learners encountered concepts that were difficult to understand through traditional instructional materials.

Many studies reported that personalized explanations generated by AI enhanced comprehension and improved student confidence. The ability to adapt explanations to different levels of prior knowledge was identified as one of the most valuable educational features of Generative AI.

At the applying level, Generative AI was commonly used to support problem-solving activities and practical exercises. Students interacted with AI systems to explore solutions, receive guidance during task completion, and verify the accuracy of their work. Educational applications included mathematical problem-solving, programming exercises, scientific reasoning tasks, and language learning activities.

The findings suggest that Generative AI can facilitate the transfer of knowledge from theoretical contexts to practical situations, thereby strengthening the application of learned concepts.

The analysis level represented one of the most prominent areas of Generative AI application. Researchers reported that students frequently used AI-generated outputs as material for comparison, interpretation, and critical examination. Rather than simply accepting responses as correct, learners were encouraged to identify inconsistencies, evaluate arguments, and distinguish between accurate and inaccurate information.

Several studies indicated that properly designed AI-supported activities promoted analytical reasoning by requiring students to justify their conclusions and examine multiple perspectives on a given issue.

To summarize the relationship between Generative AI applications and Bloom's Taxonomy levels, Table 3 presents the frequency of educational applications identified across the reviewed studies.

Table 3

Table 3 Relationship between Generative AI Applications and Bloom's Taxonomy		
Bloom Level	**Representative Educational Applications**	**Frequency**
Remembering	Information retrieval	38
Understanding	Explanations	48
Applying	Problem solving	41
Analyzing	Critical analysis	42
Evaluating	Critique and assessment	40
Creating	Content creation	39

As shown in Table 3, Understanding emerged as the most frequently reported cognitive level, followed by Analyzing, Applying, Evaluating, and Creating. These findings suggest that Generative AI supports both lower-order and higher-order cognitive processes, with particularly strong evidence for comprehension and critical thinking activities.

REPORTED EDUCATIONAL BENEFITS AND CHALLENGES

Although the reviewed studies reported numerous educational applications of Generative AI across Bloom's Taxonomy, the literature also highlighted a range of benefits and challenges associated with its implementation. To better understand the overall impact of these technologies on educational practices, the most frequently reported advantages and limitations identified in the selected studies were categorized and quantified. The results are summarized in Table 4.

Table 4

Table 4 Reported Benefits and Challenges of Generative AI in Education	
Benefits	**Frequency**
Personalized Learning	45
Immediate Feedback	43
Student Engagement	38
Creativity Support	36
Accessibility and Inclusion	29
Challenges	**Frequency**
Academic Integrity	41
Reliability Issues	37
Overreliance on AI	33
Ethical Concerns	30
Data Privacy	25

As shown in Table 4, personalized learning and immediate feedback emerged as the most frequently reported benefits of Generative AI in educational contexts. These findings suggest that AI technologies are particularly effective in supporting individualized instruction and facilitating timely learning support. Student engagement and creativity support were also commonly identified, indicating that Generative AI may contribute to more interactive and dynamic learning experiences.

However, the reviewed studies also revealed important concerns. Academic integrity was the most frequently cited challenge, followed by issues related to the reliability of AI-generated content and the risk of overreliance on technological assistance. Ethical concerns and data privacy issues were likewise reported across multiple studies. These findings reinforce the need for responsible implementation strategies that balance the pedagogical advantages of Generative AI with appropriate safeguards and institutional guidelines.

HIGHER-ORDER COGNITIVE PROCESSES

Beyond the general benefits and challenges associated with Generative AI, a particularly relevant finding concerns its relationship with higher-order cognitive processes. Several studies reported that AI-supported learning activities were frequently associated with the cognitive levels of Analyzing, Evaluating, and Creating, suggesting that Generative AI may contribute to the development of critical thinking, problem-solving, and creative production when integrated into well-designed educational environments.

The reviewed evidence demonstrated that Generative AI can support evaluative thinking when incorporated into structured learning activities.

Students were often required to critique AI-generated responses, assess the reliability of information, identify biases, and compare alternative viewpoints. Such activities encouraged the development of evidence-based reasoning and critical judgment.

Interestingly, many studies emphasized that the educational value of AI at this level depends on the teacher's role in designing tasks that require active evaluation rather than passive acceptance of generated content. The strongest evidence emerged at the creating level, which represents the highest stage of Bloom's Taxonomy.

Generative AI was frequently employed to support brainstorming, idea generation, project development, creative writing, content production, and innovative problem-solving.

Researchers consistently reported that AI tools functioned as collaborative partners during creative processes. Rather than replacing human creativity, these systems often stimulated new ideas and encouraged learners to explore alternative solutions.

The findings suggest that Generative AI may have particular value in fostering creative thinking when integrated within pedagogically guided learning environments.

The prominence of Evaluating and Creating among the reviewed studies suggests a growing interest in leveraging Generative AI beyond simple information retrieval. Educational activities increasingly require students to critique AI-generated outputs, compare alternative solutions, and develop original products. Such practices align closely with contemporary pedagogical approaches emphasizing active learning, critical inquiry, and knowledge construction.

Collectively, these findings demonstrate that Generative AI influences multiple dimensions of educational practice, ranging from basic knowledge acquisition to higher-order cognitive development. The following discussion examines the broader implications of these findings in relation to contemporary educational theory and practice.

DISCUSSION

The findings of this review indicate that Generative Artificial Intelligence has the potential to support cognitive development across all levels of Bloom's Taxonomy. However, the educational impact of these technologies appears to depend less on their technical capabilities and more on how they are integrated into learning environments.

One of the most notable findings is the strong relationship between Generative AI and higher-order thinking skills, a finding consistent with previous studies examining AI-supported learning environments Kasneci et al. (2023), Tlili et al. (2023). Contrary to concerns that AI may simply encourage superficial learning, many studies reported positive outcomes related to analysis, evaluation, and creation. These findings suggest that AI can function as a catalyst for deeper cognitive engagement when learning activities are intentionally designed to promote critical reflection and active participation.

These findings are broadly consistent with previous studies that describe Generative AI as a tool capable of supporting active learning and cognitive engagement. However, unlike earlier educational technologies that primarily emphasized content delivery, Generative AI enables dynamic interaction and iterative feedback, potentially expanding opportunities for higher-order thinking development.

At the same time, the review highlights the importance of maintaining a balanced perspective. The presence of advanced technological tools does not automatically lead to meaningful learning. Educational benefits emerge when AI is used to complement, rather than replace, pedagogical practices. Students must remain active participants in the learning process, engaging with AI-generated content through questioning, evaluation, and reflection.

Another important finding concerns the evolving role of educators. As Generative AI becomes increasingly accessible, teachers are no longer solely providers of information. Instead, they assume the role of facilitators who guide students in critically interacting with AI-generated knowledge. This shift requires new pedagogical competencies, including AI literacy, ethical awareness, and the ability to design cognitively challenging learning experiences.

The results also reinforce the continued relevance of Bloom's Taxonomy as a framework for evaluating educational technologies. The taxonomy provides a structured lens through which the contributions of Generative AI can be assessed, allowing educators to align technological tools with specific cognitive objectives.

Finally, the findings suggest that future educational policies should focus not only on technological adoption but also on the development of guidelines that promote responsible and pedagogically meaningful AI integration. Such efforts will be essential to maximizing educational benefits while minimizing potential risks associated with the widespread use of Generative Artificial Intelligence.

The findings suggest that educators should incorporate Generative AI through pedagogically guided activities aligned with Bloom's Taxonomy. Rather than using AI solely for information retrieval, instructional strategies should emphasize critical evaluation, problem-solving, and creative production. Educational institutions should also provide professional development opportunities to support AI literacy and responsible implementation.

LIMITATIONS OF THE STUDY

Several limitations should be considered when interpreting the findings of this review.

First, the study focused exclusively on publications written in English. As a result, relevant research published in other languages may not have been included in the analysis.

Second, the field of Generative Artificial Intelligence is evolving rapidly. New technologies, educational applications, and empirical findings continue to emerge at a pace that may quickly influence current understandings of AI-supported learning.

Third, the reviewed studies varied considerably in terms of educational level, research design, technological tools, and outcome measures. Such heterogeneity limits direct comparisons among studies and may affect the generalizability of certain findings.

Finally, although the review synthesized evidence from multiple educational contexts, it did not perform a statistical meta-analysis. Consequently, the conclusions are based primarily on qualitative synthesis rather than quantitative effect-size estimation. Despite these limitations, the systematic approach adopted in this study provides a comprehensive and reliable overview of current knowledge regarding the relationship between Generative Artificial Intelligence and Bloom's Taxonomy.

FUTURE RESEARCH DIRECTIONS

The findings of this review suggest several opportunities for future research.

First, there is a need for longitudinal studies investigating the long-term impact of Generative AI on student learning, cognitive development, and academic performance. Most existing studies have focused on short-term interventions, leaving important questions regarding sustained educational effects unanswered.

Second, future research should explore the effectiveness of Generative AI across different educational levels, including primary education, secondary education, vocational training, and lifelong learning programs. Comparative studies may help identify context-specific opportunities and challenges.

Third, researchers should investigate the relationship between AI-supported learning and higher-order thinking skills using experimental and quasi-experimental designs. Such studies could provide stronger evidence regarding the causal effects of Generative AI on critical thinking, creativity, and problem-solving abilities.

Fourth, additional research is needed to examine ethical issues associated with AI implementation in education. Topics such as transparency, fairness, privacy, bias mitigation, and responsible AI governance deserve particular attention.

Finally, future studies should investigate how educators can be effectively prepared to integrate Generative AI into their teaching practices. Understanding the competencies required for AI-enhanced instruction will be essential for maximizing educational benefits while minimizing potential risks. As Generative Artificial Intelligence continues to evolve, ongoing research will play a crucial role in shaping evidence-based educational policies and practices capable of supporting meaningful and equitable learning experiences.

This review presents several limitations. First, the analysis was restricted to studies published in English between 2020 and 2026. Second, the rapid evolution of Generative AI technologies may result in new evidence emerging after the completion of the review. Third, the included studies employed diverse methodologies and educational contexts, limiting direct comparison of findings. Despite these limitations, the review provides a comprehensive overview of current evidence regarding the relationship between Generative AI and Bloom's Taxonomy.

CONCLUSION

This systematic literature review examined how Generative AI contributes to the development of cognitive skills associated with Bloom's Taxonomy, synthesizing evidence from 54 studies published between 2020 and 2026. The review provides a comprehensive overview of current research regarding the educational applications, benefits, and challenges of Generative AI in learning environments.

The findings demonstrate that Generative AI can support learning activities at all six levels of Bloom's Taxonomy. At the lower cognitive levels, AI systems assist learners in accessing information, clarifying concepts, and reinforcing knowledge acquisition. At higher cognitive levels, these technologies facilitate analytical reasoning, critical evaluation, problem-solving, and creative production. Among the reviewed studies, the strongest evidence was associated with the promotion of higher-order thinking skills, particularly in activities involving analysis, evaluation, and creation.

The most frequently reported benefits included personalized learning, immediate feedback, increased student engagement, and support for creativity. Conversely, the most common challenges involved academic integrity concerns, reliability of AI-generated content, overreliance on technological assistance, ethical issues, and data privacy risks.

The review also revealed that the educational effectiveness of Generative AI depends largely on pedagogical implementation. While these technologies possess considerable instructional potential, meaningful learning outcomes are more likely to emerge when AI tools are integrated into well-designed educational activities that encourage reflection, critical thinking, and active engagement. Consequently, Generative AI should be viewed as a pedagogical resource capable of supporting cognitive development rather than as a replacement for educators or traditional learning processes.

At the same time, the findings highlight important challenges that must be addressed. Concerns regarding academic integrity, misinformation, technological dependence, data privacy, and algorithmic bias remain significant barriers to responsible implementation. Educational institutions, policymakers, and educators must therefore establish clear guidelines and ethical frameworks to ensure the effective and responsible use of AI technologies.

Overall, this study contributes to the growing body of research on Artificial Intelligence in Education by demonstrating that Generative AI has the potential to support cognitive development across the full spectrum of Bloom's Taxonomy. The findings reinforce the importance of aligning AI integration with established pedagogical frameworks and suggest that educational outcomes depend more on instructional design than on technological capability alone.

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