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The Role of Generative Artificial Intelligence in Transforming Learning and Instructional Processes from an Educational Psychology Perspective: A Scoping Review

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ABSTRACT

Generative artificial intelligence, as one of the emerging technologies of the twenty-first century, holds substantial potential for redefining learning and instructional processes. From an educational psychology perspective, this technology can transform teaching learning practices by influencing cognitive, motivational, and affective dimensions. The purpose of this scoping review is to identify and conceptualize the roles, opportunities, and challenges of generative AI in education through the lens of educational psychology. This study was conducted based on the Arksey and O'Malley framework and in accordance with the PRISMA-ScR guidelines. A systematic search was performed in Web of Science, Scopus, PsycINFO, ERIC, and IEEE Xplore databases for studies published between 2019 and November 2025. Among 1,245 identified articles, after screening and assessing eligibility, 52 studies were selected for thematic analysis. The results indicated that generative AI can enhance learners' intrinsic motivation and cognitive engagement through personalized learning, cognitive load management, and the fulfillment of basic psychological needs including autonomy, competence, and relatedness. However, challenges such as cognitive dependency, ethical concerns regarding academic integrity, privacy issues, and algorithmic bias were also identified. The successful integration of generative AI in education requires instructional design grounded in the principles of educational psychology, the formulation of transparent ethical frameworks, the enhancement of AI literacy, and the responsible-use training of teachers and learners. By identifying existing gaps, this scoping review proposes directions for future research on the psychological and educational impacts of generative AI.

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Introduction

In the era of digital transformation, generative artificial intelligence has emerged as one of the most innovative educational technologies, opening a new horizon in the processes of learning and instruction. Possessing the ability to generate textual, visual, and multimedia content, this technology functions beyond a mere auxiliary tool and acts as a transformative agent within the architecture of education (Jauhiainen & Garagorry Guerra, 2024; Mulyani et al., 2025). The emergence of large language models such as ChatGPT and other generative systems has not only challenged traditional methods of instruction but has also redefined the fundamental nature of the relationship among the learner, the teacher, and knowledge itself (Creely & Carabott, 2025; Dai, Liu, & Lim, 2023). From an educational psychology perspective, generative artificial intelligence holds extensive potential for enhancing the cognitive, motivational, and affective processes involved in learning. Recent research indicates that AI-based systems can facilitate personalized learning on an unprecedented scale and, by adapting instructional content to each learner's prior knowledge and learning style, contribute to the optimization of cognitive load (Bauer et al., 2025; Jose et al., 2025; Tu, Chen, & Huang, 2025) . This capability aligns with cognitive theories such as Cognitive Load Theory and Multimedia Learning Theory, enabling the development of adaptive learning environments that dynamically adjust to learners' cognitive needs (AlShaikh, Al-Malki, & Almasre, 2024; As' ad, 2024).

However, the integration of generative artificial intelligence into educational systems also entails significant pedagogical challenges and considerations. Concerns related to cognitive dependency, diminished critical thinking, and the potential erosion of problem-solving skills when this technology is used inappropriately are among the issues that require careful examination from an educational psychology perspective (Ali et al., 2024; Habib et al., 2024; Monib et al., 2024). Moreover, the transformation of the teacher's role from a transmitter of knowledge to a facilitator and architect of learningand the shift in the learner's role from a passive recipient to an active agent necessitate new theoretical and practical frameworks capable of accurately describing and guiding these paradigmatic changes (Almashour, Aldamen, & Jarrah, 2025; Ghamrawi, Shal, & Ghamrawi, 2024; Zhai, 2024).

Existing research in the field of artificial intelligence in education has primarily focused on technical aspects and practical applications, while offering far less in-depth analysis of the psychological and pedagogical implications of this technology(Hwang et al., 2020; Zawacki-Richter et al., 2019) . There remains a substantial research gap in understanding how generative artificial intelligence influences learners' motivational processes, the development of self-efficacy, and emotional regulation. Moreover, although numerous studies have examined the effectiveness of adaptive learning systems, a comprehensive understanding of the psychological mechanisms through which generative AI affects learning outcomes is still incomplete (Gibson et al., 2023; Hwang & Wu, 2025; Yang, 2025).

The present study seeks to address this research gap by analyzing the role of generative artificial intelligence in transforming learning and instructional processes from an educational psychology perspective. It aims to answer several key questions: How does generative AI influence the cognitive, motivational, and affective dimensions of learning? What changes does this technology bring to the instructional roles of teachers and learners? And what ethical and pedagogical challenges must be considered to ensure its responsible integration into educational settings?

Drawing on theoretical frameworks in educational psychology including Self-Determination Theory, Cognitive Load Theory, and Social Cognitive Theory this article provides a comprehensive analysis of the multidimensional effects of generative AI and outlines practical implications for instructional designers, educators, and policymakers. The findings of this study may contribute to the development of evidence based educational approaches that not only capitalize on the opportunities offered by generative AI but also effectively manage its potential risks.

Theoretical Foundations and Review of the Literature

1. Theoretical Frameworks

1.1. Self-Determination Theory (SDT)

Self-Determination Theory, developed by Deci and Ryan, is one of the most influential theoretical frameworks for explaining learning motivation in technology-enhanced environments (Ryan & Deci, 2020, 2024). The theory emphasizes three fundamental psychological needs: autonomy, competence, and relatedness. In the context of generative artificial intelligence, research shows that AI-driven systems can support the fulfillment of these needs by personalizing the learning experience and providing immediate feedback (Dou & Sun, 2025; Zheng et al., 2024).

Chiu and colleagues, in a study on AI education in secondary schools, demonstrated that instructional designs grounded in Self-Determination Theory can meaningfully engage learners with diverse genders and ability levels, thereby reducing gender and performance related disparities (Xia et al., 2022). Similarly, Zhai and Li, by developing an AI Motivation Scale grounded in Self Determination Theory, showed that students' intrinsic motivation to use AI tools is shaped by supportive academic and learning environments(Li et al., 2025) . Recent findings indicate that students who use generative AI with high confidence tend to view it as a tool for enhancing creative thinking and increasing the enjoyment of learning, whereas students with higher levels of academic anxiety perceive AI primarily as a means to reduce stress(Pavone, 2025) . These individual differences in the acceptance and use of technology underscore the importance of designing systems that can accommodate and fulfill learners' diverse psychological needs.

1.2. Cognitive Load Theory (CLT)

Cognitive Load Theory, as articulated by Schneider and Sweller, emphasizes the importance of managing cognitive load in the design of learning environments (Schnotz & Kürschner, 2007; Sweller, Van Merrienboer, & Paas, 1998). The theory posits that working memory is limited, and excessive cognitive load can disrupt the learning process. In the context of generative artificial intelligence, adaptive systems can optimize cognitive load by dynamically adjusting the level of content complexity based on learners' moment-to-moment performance (Gkintoni et al., 2025; Jose et al., 2025).

Neuropsychological studies indicate that integrating artificial intelligence with educational neuroscience can lead to the development of adaptive learning systems capable of monitoring and managing cognitive load in real time (Huang, Fu, & Chen, 2021) . Ferguson and colleagues demonstrated in their study that instructional guidelines that adapt automatically and in real time based on learners' needs not only reduce cognitive load but also enhance narrative and spatial learning (Ferguson, van den Broek, & van Oostendorp, 2022) . However, researchers have pointed to a cognitive paradox associated with the use of artificial intelligence in education: while this technology can enhance cognitive processes, its inappropriate use may lead to reduced depth of cognitive processing and increased cognitive dependency (Bauer et al., 2025; Wang & Fan, 2025). Beier and colleagues identified three mechanisms through which artificial intelligence influences learning: substitution effects, augmentation effects, and inversion effects. The inversion effect occurs when learners become overly dependent on AI, leading to a reduction in deep cognitive processing (Bauer et al., 2025).

1.3. Zone of Proximal Development (ZPD)

Vygotsky's Zone of Proximal Development is a key concept for understanding how learning can be facilitated through appropriate scaffolding(Lantolf, Poehner, & Swain, 2018; Vygotsky, 1978) . In the context of generative artificial intelligence, this technology can function as a form of digital scaffolding that

supports learners in progressing from tasks they can perform independently to higher levels of competence with guided assistance (Sidorkin, 2025). Sidorkin, in his "leap effect" hypothesis, argues that generative AI can significantly expand students' Zone of Proximal Development by continuously scaffolding procedural tasks, thereby enabling earlier engagement with higher order cognitive activities (Sidorkin, 2025). This perspective suggests that artificial intelligence can help democratize access to advanced cognitive opportunities, particularly for learners who are disadvantaged or experience learning difficulties.

Empirical studies also confirm that AI-based systems that use biometric data such as heart rate variability and eye tracking to assess cognitive load and adjust instructional support can help keep learners within their optimal Zone of Proximal Development(Yuan, 2025) . This multifaceted approach to the design of adaptive learning systems highlights the potential of artificial intelligence to enable genuinely personalized learning experiences.

1.4. Constructivism

The constructivist approach, which emphasizes learners' active role in constructing knowledge through interaction with their environment, provides an important theoretical framework for understanding the educational applications of generative artificial intelligence(Benson, 2013; Fosnot, 2013) . According to this theory, knowledge is not passively received but is actively constructed by the learner an idea that aligns with principles of learner autonomy. Generative AI tools can reinforce this constructivist approach by providing personalized and interactive learning experiences. For example, in creative writing, AI-based tools can analyze a student's writing style and deliver real-time feedback on grammar, tone, and narrative structure, helping learners strengthen their skills and reflect critically on their ideas (Tan & Maravilla, 2024). However, researchers emphasize that to preserve academic integrity and uphold constructivist values, the use of generative AI must be undertaken with awareness and responsibility. Artificial intelligence should function as a tool that enhances rather than replaces the learner's own process of constructing knowledge (Richter et al., 2025).

2. Review of the Literature

2.1. Empirical Studies on the Effectiveness of Generative Artificial Intelligence

Recent meta-analytic studies indicate that the use of generative artificial intelligence can significantly and positively influence students' academic achievement. Sun and Zhou, in a comprehensive meta-analysis, examined the effects of generative AI on students' academic performance and found that this technology can enhance achievement through shared metacognition and cognitive offloading (Sun & Zhou, 2024). In the domain of language learning, numerous studies have investigated the impact of AI based tools on linguistic skills. Findings show that systems equipped with automatic speech recognition and natural language processing can provide environments for repeated, targeted practice with immediate and personalized feedback, leading to improved speaking performance (Qiao & Zhao, 2023). Jahiainen and Garagorry Guerra, in an experimental study involving 110 students in grades 4 to 6 across two Uruguayan schools, examined the use of ChatGPT for dynamically personalizing instructional content. Their findings showed that generative AI can effectively adapt learning materials to students' diverse knowledge levels and enhance both their motivation and performance (Jauhiainen & Garagorry Guerra, 2024).

2.2. Psychological and Motivational Effects

Recent research indicates that generative artificial intelligence can exert significant effects on key psychological constructs such as motivation, self-efficacy, and emotional regulation. Al Mofareh and

colleagues, in a study involving 455 students from four countries, found that AI based tools positively influence intrinsic motivation by enhancing autonomy, competence, and relatedness(Mohamed et al., 2025) . Wang and colleagues, drawing on reinforcement theory, examined the multifaceted relationship between generative artificial intelligence and key psychological constructs, including cognitive engagement, emotional engagement, learning retention, reward sensitivity, and motivation. Their findings showed that constructive feedback provided by AI can strengthen students' emotional attachment to learning tasks and enhance their motivation(Yang, 2025).

In the domain of creativity, Huang and Wu, using a chained mediation model, demonstrated that generative artificial intelligence can positively influence design students' creative cognition by enhancing self efficacy and reducing anxiety (Hwang & Wu, 2025). However, other studies have raised concerns about potential negative effects, including the risk of cognitive fixation and a decline in creative self-confidence when learners rely excessively on AI generated suggestions (Habib et al., 2024).

2.3. Transformation of Instructional Roles

The research literature has increasingly examined how the roles of teachers and learners are transforming within AI enhanced educational environments. Zhai, in a comprehensive study, demonstrated that the integration of generative AI is reshaping teachers' roles and agency, gradually shifting them from transmitters of knowledge to facilitators, collaborators, and reflective practitioners (Zhai, 2024). Namazian-Doust and colleagues, in their qualitative study of English language learners, explored students' perceptions of teacher identity in AI-enhanced classrooms. Their findings indicated that while artificial intelligence can provide real-time feedback and automated responses that enhance learner autonomy, it may also marginalize traditional teacher roles and call their importance into question (Almashour, Aldamen, & Jarrah, 2025). Ghamrawi and colleagues highlighted a paradox in which artificial intelligence can both strengthen and undermine teachers' leadership. On the one hand, AI can automate repetitive tasks, allowing teachers to focus on personal interactions and innovative instructional design; on the other hand, AI-driven algorithms may weaken teachers' autonomy in decision-making (Ghamrawi, Shal, & Ghamrawi, 2024).

2.4. Studies on Challenges and Ethical Considerations

The research literature has extensively addressed the ethical, pedagogical, and technical challenges associated with integrating generative artificial intelligence into education. Muneeb and colleagues, in their comprehensive review, identified numerous challenges including data bias, privacy concerns, information security, and the potential for generating inaccurate or misleading content (Monib et al., 2024). Kablos and colleagues, in their study on university teachers' beliefs regarding the use of generative artificial intelligence, found that instructors who adopt constructivist approaches are more aware of AI's positive potential to enhance active and reflective learning processes among students(Cabellos, De Aldama, & Pozo, 2024) . However, concerns regarding unethical use, overreliance, and the potential impact on the development of critical-thinking skills remain persistent. Norouzi and colleagues, in a conceptual study examining the pedagogical, theoretical, and methodological dimensions of generative AI in education, showed that although this technology can enhance learner engagement and motivation, strong ethical guidelines and sustained human oversight are essential due to potential issues related to privacy, bias, and accuracy(Noroozi et al., 2024) .

2.5. Research Gaps

Despite notable progress in understanding the role of generative artificial intelligence in education, several critical research gaps remain. Most existing studies have examined short-term effects, while longitudinal investigations into the long-term impacts of generative AI on cognitive development, critical thinking skills, and self regulated learning are still limited(Kasım & Deringöl, 2025) .

A comprehensive understanding of the precise psychological mechanisms through which generative artificial intelligence influences motivation, self-efficacy, and emotional regulation remains incomplete. There is a clear need for additional empirical studies that examine the mediating and moderating variables underlying these relationships (Bai & Wang, 2025; Huang, Lu, & Yang, 2023).

Research on individual differences in the acceptance and benefits of generative artificial intelligence remains limited. Understanding how personal factors such as learning styles, cultural background, and levels of digital literacy influence the effectiveness of AI-based interventions is essential for designing inclusive and equitable systems (Chiu & Chai, 2020; Tu, Chen, & Huang, 2025). While numerous studies have examined the applications of artificial intelligence in specific educational contexts, comparative research that evaluates the effectiveness of different instructional approaches using generative AI across various disciplines remains scarce. Additionally, research on how to prepare and support teachers for the effective integration of generative AI into their teaching including the development of necessary competencies and the mitigation of ethical concerns requires further expansion (Panke, 2025; Tan, Cheng, & Ling, 2024). The present study seeks to address these research gaps by offering a comprehensive analysis of the role of generative artificial intelligence in transforming learning and instructional processes from an educational psychology perspective, and by proposing a conceptual framework to facilitate a deeper understanding of the multidimensional impacts of this technology.

Research Methodology

Given the conceptual and methodological heterogeneity of studies related to generative artificial intelligence and the emerging nature of this field, a scoping review was selected as an appropriate approach for comprehensively mapping existing concepts, evidence, and research gaps. Unlike a systematic review, this type of review focuses on qualitative analysis and the identification of the breadth of topics and the relationships among them. The present study was conducted based on the Arksey and O'Malley framework and employed a mapping and interpretive approach to analyze the body of literature(Arksey & O'malley, 2005; Tricco et al., 2018), which consists of five stages: (1) defining the research question, (2) identifying relevant studies, (3) selecting studies, (4) extracting and charting the data, and (5) summarizing and reporting the findings. A targeted and structured search was conducted across major international academic databases, including Web of Science, Scopus, PsycINFO, ERIC, and IEEE Xplore, using a logical combination of keywords such as "generative artificial intelligence," "large language models," "learning processes," "educational psychology," "academic motivation," and "cognitive processes," covering the period from 2019 to November 2025.

The article selection process was conducted in accordance with the PRISMA-ScR guidelines (Preferred Reporting Items for Scoping Reviews) and proceeded through four stages: identification, initial screening, eligibility assessment, and final inclusion. In the first stage, 1,245 records were identified across the databases; after removing 328 duplicates, 917 records remained. During title and abstract screening, 683 records were excluded, and 234 articles were selected for full-text review. Ultimately, 52 studies met the eligibility criteria and were included in the final analysis.

The inclusion criteria consisted of publication in peer-reviewed scientific journals, direct relevance to the research topic, the presence of a clearly defined theoretical framework, and full-text availability. Given the exploratory nature of a scoping review, a quantitative quality assessment using standardized appraisal tools

was not conducted; however, all included studies were sourced from peer-reviewed journals, ensuring their scholarly credibility.

The analysis and synthesis of findings extracted from the selected studies were carried out using Braun and Clarke's thematic analysis method, employing a combined inductive–deductive approach. In this process, the data were organized into initial codes and subsequently grouped into five overarching thematic categories: cognitive influences, motivational and engagement-related dimensions, transformations in instructional roles, ethical concerns and pedagogical challenges, and practical strategies for instructional design (Braun & Clarke, 2006). To ensure the rigor and trustworthiness of the analyses, two researchers independently coded twenty percent of the articles, and inter coder agreement calculated using Cohen's kappa ($\kappa = 0.85$) confirmed a high level of reliability. In cases of disagreement, a consensus-based approach was adopted through discussion and deliberation(Popay et al., 2006) . The narrative synthesis of the findings considering the methodological diversity of the studies and the heterogeneity of research designs enabled the development of an integrated and holistic framework for understanding the multifaceted effects of generative artificial intelligence on teaching and learning processes. Since this study was based on the review and analysis of published sources and did not involve primary human data, it did not require ethical approval from research ethics committees.

Findings and Discussion

1. The Role of Generative Artificial Intelligence in Cognitive Learning Processes

The analysis of the selected studies indicates that generative AI based technologies exert a substantial influence on the cognitive architecture of the learning process. Research findings suggest that adaptive systems equipped with advanced algorithms have the capacity to manage cognitive load by dynamically adjusting the level of content complexity based on learners' moment to moment performance(Gkintoni et al., 2025) . This capability aligns with the core principles of Cognitive Load Theory and facilitates the optimization of working-memory capacity throughout the learning experience. Contemporary neuropsychological studies further emphasize that integrating biometric data such as heart rate variability and eye tracking patterns into intelligent learning systems enables real-time detection of cognitive strain and responsive instructional adjustment (Yuan, 2025).

Nevertheless, empirical evidence points to a cognitive paradox in the use of this technology. While generative AI based systems can strengthen cognitive processes, an unbalanced reliance on them may lead to reduced depth of information processing and the emergence of cognitive dependency (Jose et al., 2025). Multiple studies have identified three distinct mechanisms through which generative AI affects learning: the substitution effect, the augmentation effect, and the inversion effect. The inversion effect emerges when learners, instead of engaging actively with the material, merely rely on ready-made responses provided by the system (Bauer et al., 2025). In this regard, the leap effect hypothesis posits that generative artificial intelligence can substantially expand learners' Zone of Proximal Development by providing continuous digital scaffolds for procedural activities, thereby enabling earlier engagement with more complex cognitive tasks(Sidorkin, 2025) . This finding suggests that, when appropriately designed, the technology can contribute to the democratization of advanced cognitive opportunities particularly for learners who face learning limitations or educational disadvantage.

2. Effects on Learner Motivation and Engagement

The findings derived from the analysis of existing studies present a multifaceted picture of the effects of generative artificial intelligence on motivational constructs and academic engagement. Grounded in Self Determination Theory, AI enhanced tools positively influence learners' intrinsic motivation by satisfying their basic psychological needs namely autonomy, competence, and relatedness (Mohamed et al., 2025). Empirical studies indicate that personalized learning experiences and the immediate, constructive feedback provided by intelligent systems enhance learners' sense of self-efficacy and their perceived control over the learning process. Cross-cultural research conducted in multiple countries further confirms that these positive effects are observable across diverse cultural settings (Dou & Sun, 2025).

A noteworthy point concerns the individual differences in how learners interact with AI-based tools. Evidence indicates that learners with high self-confidence perceive this technology as a means to enhance creative thinking and enjoyment of learning, whereas students experiencing elevated academic anxiety tend to use it primarily as a mechanism for reducing psychological pressure(Pavone, 2025). These findings highlight the importance of designing systems capable of recognizing and responding to diverse psychological needs. Models grounded in reinforcement theory demonstrate that timely and constructive feedback provided by AI strengthens learners' emotional attachment to learning tasks and, by enhancing reward sensitivity, helps sustain their motivation to continue learning (Yang, 2025).

In the domain of creativity, the findings reveal a complex relationship between the use of generative artificial intelligence and creative cognition. Chained mediation analyses show that this technology can positively influence creative abilities by enhancing self-efficacy and reducing anxiety. However, in contrast, some studies raise concerns about the potential for cognitive fixation and diminished creative self-confidence when learners rely excessively on AI-generated suggestions (Habib et al., 2024). This duality underscores the necessity of adopting a balanced approach to integrating this technology one that leverages its capabilities while preserving learners' creative independence.

3. Transformation of Instructional Roles: Teacher and Learner

The integration of generative artificial intelligence into educational systems has brought about a fundamental transformation in the traditional roles and identities of teachers and learners. Research findings indicate that teachers' roles are gradually shifting from one-directional transmitters of knowledge to facilitators, mentors, and architects of learning experiences (Zhai, 2024). This paradigmatic shift requires the development of a new set of professional competencies that extend beyond traditional teaching skills, encompassing abilities related to creative instructional design, mastery of emerging technologies, and critical reflective practice. Qualitative studies on teachers' perceptions show that while many educators recognize the positive potential of this technology, they also express concerns about the weakening of their professional authority and the marginalization of their traditional roles (Zhai, 2024).

A paradox of empowerment and constraint is evident in relation to teachers' instructional leadership. On the one hand, the automation of repetitive and administrative tasks by intelligent systems frees up teachers' time and energy, enabling them to engage more deeply in personal interactions and the design of innovative learning experiences. On the other hand, AI driven algorithms may restrict teachers' autonomy in instructional decision-making, positioning them as implementers of predetermined policies rather than as active pedagogical agents (Ghamrawi, Shal, & Ghamrawi, 2024). Findings also indicate that teachers who adopt constructivist approaches are more likely than others to recognize and leverage the potential of generative AI to strengthen active and reflective learning processes among students.

On the other side of this dynamic, learners' roles have also undergone profound transformation. Learners are shifting from passive recipients of information to active, self-directed agents in the learning process (Dai, Liu, & Lim, 2023). AI based generative tools enable learners to pursue personalized learning pathways, regulate their own pace of progress, and receive instantaneous feedback that supports the development of metacognitive and self regulatory skills. However, this enhanced autonomy also introduces new

responsibilities, including the need to develop digital literacy, cultivate critical thinking toward AI-generated content, and maintain ethical awareness in the use of such tools(Noroozi et al., 2024) .

4. Ethical Considerations and Pedagogical Challenges

The analysis of the research literature reveals a wide range of ethical concerns and pedagogical challenges associated with the use of generative artificial intelligence in educational settings. One of the most prominent issues relates to academic integrity and the potential misuse of this technology for producing assignment-related content in unauthorized or dishonest ways (Tan & Maravilla, 2024). Evidence suggests that in the absence of clear ethical guidelines and adequate training, a substantial number of learners may use these tools not as aids to learning but as a means of bypassing the learning process itself. This situation necessitates a fundamental reconsideration of traditional assessment systems and the development of innovative evaluation approaches that emphasize the learning process rather than the final product (Monib et al., 2024).

Issues related to privacy, data security, and algorithmic bias also occupy a central place in the literature. AI based learning systems require extensive learner data, which can pose significant risks to students' privacy (Zawacki-Richter et al., 2019). Moreover, biases embedded within the training data of algorithms may reinforce existing inequalities and result in discrimination against particular groups. Empirical evidence shows that AI systems sometimes perform less accurately and less impartially when providing responses to learners from diverse cultural or linguistic backgrounds.

Another major challenge is the phenomenon of hallucination, or the generation of inaccurate or fabricated information by large language models, which can reinforce misconceptions and lead to the development of erroneous beliefs (As' ad, 2024). This issue further underscores the necessity of teaching learners media literacy and critical-thinking skills so that they can evaluate and verify AI generated content. In addition, concerns related to the digital divide and educational equity persist, as unequal access to advanced technologies may widen the gap between advantaged and disadvantaged learners (Chiu & Chai, 2020). Studies emphasize that ensuring the fair and responsible integration of artificial intelligence into education requires the development of comprehensive ethical frameworks, well-defined policies, and effective regulatory mechanisms.

5. Practical Implications for Instructional Design

The findings of this study carry significant implications for instructional designers, educators, and policymakers seeking to effectively integrate generative artificial intelligence into learning environments. A clear need emerges for adopting a learner-centered design approach, in which technology functions as a tool for enhancing cognitive and social learning processes rather than replacing them (Vygotsky, 1978). This approach requires careful attention to the principles of educational psychology in the design of user interfaces, interaction structures, and adaptive algorithms.

The findings emphasize the importance of maintaining a balance between automation and human control. While intelligent systems can optimize many aspects of the instructional process, preserving the central role of teachers in guiding, facilitating, and providing socio-emotional support to learners remains essential (Fosnot, 2013). Successful design approaches promote a collaborative relationship among the teacher, the learner, and the technology, enabling each to contribute its unique strengths to the learning process.

The development of AI literacy as a core competency for the twenty-first century is essential (Gibson et al., 2023). This encompasses not only the technical skills required to use AI tools, but also an understanding of how algorithms function, awareness of their limitations and potential biases, and the ability to employ these technologies ethically and responsibly. Educational programs should systematically work to cultivate these competencies among both teachers and learners.

Continuous and iterative evaluation is critically important in the process of integrating artificial intelligence. Due to the rapid pace of technological advancement and the complexity of its psychological and educational effects, assessment systems must regularly examine the effectiveness, equity, and unforeseen consequences of AI based interventions and revise instructional designs accordingly (Sun & Zhou, 2024). This adaptive, evidence-based approach helps ensure that the technology genuinely serves educational goals and contributes to improved learning outcomes.

Conclusion, Limitations, and Recommendations

1. Conclusion and Key Findings

This scoping review aimed to provide a comprehensive mapping of the role of generative artificial intelligence in transforming learning and instructional processes from an educational psychology perspective. The key findings indicate that this technology holds substantial potential for enhancing cognitive processes, increasing learner motivation and engagement, and personalizing learning experiences. Generative AI based systems can dynamically adapt to learners' individual needs, optimize cognitive load, and expand the Zone of Proximal Development by offering continuous digital scaffolding. Furthermore, by satisfying basic psychological needs autonomy, competence, and relatedness this technology can strengthen intrinsic motivation.

However, the findings also highlight several significant challenges and potential risks. Excessive or misaligned reliance on generative AI may lead to cognitive dependency, weakened critical-thinking abilities, and reduced problem solving skills. Ethical considerations related to academic integrity, data privacy, algorithmic bias, and educational equity represent additional major concerns that must be addressed to ensure responsible and effective implementation. Accordingly, the successful integration of generative artificial intelligence into education requires thoughtful instructional design, adherence to ethical principles, and the enhancement of teachers' professional competencies.

2. Research Limitations

This study is subject to several limitations that should be taken into account when interpreting its findings. Due to the emerging nature of generative artificial intelligence, most existing research is short-term, and longitudinal studies examining long term outcomes remain limited (Kasım & Deringöl, 2025). This restricts the ability to fully assess the enduring effects of generative AI on cognitive development, critical thinking skills, and self-regulated learning. Additionally, given the rapid pace of advancements in AI and the continual emergence of more sophisticated models, some findings may require revision or updating as new generations of technology are introduced. This dynamic nature of the field poses challenges for the stability and long-term reliability of research outcomes.

The considerable diversity in methodologies, study populations, and cultural–educational contexts across the selected studies made statistical synthesis (meta-analysis) and the derivation of definitive conclusions difficult. This research relied on secondary analysis of existing literature and was therefore unable to collect new primary empirical data to test specific hypotheses. Additionally, the potential for publication bias must be acknowledged, as studies reporting positive results are more likely to be published than those with neutral or negative findings an issue that may distort the overall picture and limit the completeness of the evidence base.

Restricted access to some specialized databases and to grey literature including technical reports, policy documents, and theses may also have influenced the comprehensiveness of the review. Most of the existing research has been conducted in technologically advanced, developed countries, and there is limited evidence from educational contexts in developing or resource-constrained settings. This limitation reduces the generalizability of the findings to diverse cultural and economic environments. Cultural differences in technology adoption, learning styles, and expectations of teachers and learners may lead to varying impacts across educational settings.

Despite these limitations, the findings of this study provide a valuable conceptual framework for understanding the role of generative artificial intelligence in education and outline clear directions for future research.

3. Recommendations for Future Research

Based on the findings and the identified limitations, several directions for future research are proposed. Long-term longitudinal studies are needed to track the effects of sustained use of generative artificial intelligence on cognitive development, critical thinking skills, creativity, and self-regulated learning over time. There is also a need for more rigorous empirical investigations that examine the mediating psychological mechanisms and moderating variables that shape the impact of generative AI. In particular, understanding how individual differences such as learning styles, cultural background, digital literacy, and personality traits influence the effectiveness of AI based interventions can support the design of more inclusive systems.

Comparative studies that evaluate the effectiveness of different instructional approaches using generative AI across diverse academic disciplines and educational levels could provide valuable insights into optimal applications of this technology. Further research is also required on teacher professional development, focusing on identifying the competencies needed for effective AI integration and designing appropriate training programs.

Interdisciplinary research that draws on educational psychology, cognitive neuroscience, computer science, and ethics can offer a more comprehensive understanding of the complexities involved in integrating artificial intelligence into education.

4. Practical Recommendations

Based on the findings of this study, a set of practical recommendations is proposed for the various stakeholders in the educational system. Instructional designers and technology developers should focus on learner centered design that places the principles of educational psychology at its core. Developing intuitive and accessible user interfaces, ensuring algorithmic transparency and users' control over their own data, and integrating mechanisms for continuous evaluation to enable the iterative improvement of systems are of paramount importance.

Teachers and educators should develop their AI literacy and digital competencies through professional learning opportunities. Key strategies include embracing the role of facilitator and architect of learning rather than a mere transmitter of knowledge, using AI as a tool for personalizing learning rather than as a substitute for human interactions, and encouraging learners to use technology in an ethical and critical manner.

Policymakers and educational administrators should develop clear ethical frameworks and policies for the use of AI in education. It is essential to allocate sufficient resources for technological infrastructure and teacher training, to ensure equitable access to advanced technologies for all learners, and to establish oversight systems for the continuous evaluation of the effectiveness and fairness of AI based interventions.

Learners, in turn, should develop critical thinking and information-evaluation skills. Awareness of the limitations and potential biases of AI systems, balanced use of technology as a tool to enhance learning rather than as a replacement for independent thinking, and adherence to ethical principles and academic integrity when using these tools are of particular importance.

Ultimately, successfully harnessing the potential of generative artificial intelligence to improve teaching and learning requires comprehensive collaboration among all stakeholders, an evidence-based and ethics driven approach, and a sustained commitment to continuous learning and adaptation to technological developments.

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