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Artificial Intelligence as a Learning Companion in the Classroom

Fostering Growth Mindset and Critical Thinking in AI-Assisted Learning Environments

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Abstract

The rapid advancement of artificial intelligence (AI) has significantly transformed educational practices, particularly in classroom learning environments. AI-powered technologies such as intelligent tutoring systems and generative AI platforms provide new opportunities for personalized learning, knowledge exploration, and academic support. However, the integration of AI in education also raises critical concerns regarding the reliability of AI-generated information and the risk of students becoming overly dependent on automated tools. This study explores the role of artificial intelligence as a learning companion in classroom contexts and examines how educators can cultivate a growth mindset and critical thinking skills among students in AI-assisted learning environments. Using a qualitative literature-based approach, this study synthesizes recent research on AI in education, AI literacy, and growth mindset pedagogy published between 2022 and 2026. The study proposes a conceptual framework that integrates AI-assisted exploration, critical evaluation of AI-generated knowledge, and reflective learning practices aimed at developing a growth mindset among students. The findings indicate that AI should not be viewed as a definitive source of knowledge but rather as a cognitive partner that supports idea generation, information exploration, and collaborative learning. At the same time, students must be trained to critically evaluate AI outputs because AI systems may produce inaccurate or biased information. By integrating growth mindset principles and AI literacy into classroom pedagogy, teachers can help students use AI responsibly while maintaining active intellectual engagement. This study contributes to ongoing discussions about the ethical and pedagogical implications of AI in education and proposes strategies for balancing technological innovation with human cognitive development.

Keywords: *AI Literacy, Artificial Intelligence, Classroom Learning, Critical Thinking, Growth Mindset.*

Introduction

Artificial intelligence has rapidly become one of the most influential technologies shaping contemporary education systems [1], [2]. The integration of AI-based tools in learning environments has created new possibilities for personalized learning, adaptive instruction, and automated feedback systems. In recent years, educational institutions around the world have begun experimenting with AI technologies such as intelligent tutoring systems, generative AI platforms, and data-driven learning analytics to support student learning processes [3]. According to Holmes et al. [1], artificial intelligence in education offers the potential to transform traditional teaching models by enabling individualized learning experiences tailored to each student's needs. In many classrooms today, students interact with AI-powered tools to search for information, generate explanations, summarize content, or receive automated feedback on assignments. These technologies have the capacity to support students in

understanding complex concepts and accessing diverse sources of information more efficiently. Zawacki-Richter et al. [4] argue that AI systems can assist learners by providing scaffolding during problem-solving activities and offering real-time feedback that helps students refine their understanding of subject matter.

Despite these promising developments, the increasing use of AI in learning environments has also generated concerns among educators and researchers. One major concern is that students may begin to rely excessively on AI-generated information rather than engaging in independent thinking processes. Guo and Lee [5] emphasize that overreliance on AI dialogue systems may reduce students' motivation to engage in analytical reasoning and critical evaluation of information. Similarly, Martínez and Gómez [6] explain that generative AI systems can produce fluent and persuasive responses that may appear accurate even when the information is incomplete or incorrect. These concerns highlight an important pedagogical challenge: how to integrate artificial intelligence in education without weakening students' intellectual autonomy. Rather than treating AI as a replacement for human thinking, educators must design learning environments in which AI functions as a supportive tool that enhances cognitive engagement. According to Holmes et al. [1], AI technologies should be used to augment human intelligence rather than replace it.

In this context, the concept of AI as a learning companion or tutor has gained increasing attention in educational research. When used appropriately, AI can assist students in exploring new ideas, generating alternative explanations, and accessing additional resources that support deeper learning. Guo and Lee [5] describe AI systems as cognitive partners that can interact with learners during the knowledge construction process. In this role, AI helps students reflect on their understanding and explore different perspectives rather than simply providing ready-made answers. However, the educational benefits of AI depend heavily on students' ability to critically evaluate the information produced by AI systems. Because AI models generate responses based on patterns in large datasets, they may produce outputs that contain biases, inaccuracies, or outdated information [7]. If students accept AI-generated answers without questioning their validity, the learning process may become superficial and passive. As Long and Magerko [8] note, the development of AI literacy is therefore essential for ensuring that students use AI responsibly and effectively.

AI literacy refers to the ability to understand how artificial intelligence systems work, recognize their limitations, and critically evaluate the outputs they generate. Long and Magerko [6] argue that AI literacy should become a core component of modern education because students increasingly interact with AI technologies in their daily lives. Developing AI literacy enables learners to understand that AI tools are not infallible sources of knowledge but rather computational systems that require human interpretation and judgment. Another pedagogical approach that can support responsible AI use in education is the development of a growth mindset among students. Growth mindset, a concept introduced by Carol S. Dweck, emphasizes that intelligence and abilities can be developed through effort, persistence, and learning from mistakes [9]. When students adopt a growth mindset, they become more willing to explore challenges, reflect on their learning processes, and revise their understanding when new information emerges.

Integrating growth mindset principles into AI-assisted learning environments can help students develop a balanced relationship with technology. Instead of viewing AI-generated responses as final answers, students with a growth mindset see them as opportunities for further exploration and learning. In this sense, AI becomes a tool that stimulates curiosity and intellectual engagement rather than replacing human thinking. The intersection of artificial intelligence, growth mindset, and critical thinking, therefore, represents an important area of inquiry for contemporary education [10]. While AI technologies can support learning processes, they must be integrated into pedagogical frameworks that prioritize student agency, reflection, and intellectual independence.

This article aims to explore the role of artificial intelligence as a learning companion in classroom environments and to examine how educators can promote a growth mindset and critical thinking in AI-assisted learning contexts. Specifically, the study addresses three main questions: how AI can function as a tutor or learning companion in classroom learning, how educators can encourage students to critically evaluate AI-generated information, and how growth mindset pedagogy can support responsible AI use in education.

Material and Methods

This study adopts a qualitative research design using a literature-based analytical approach. The purpose of this method is to synthesize recent academic discussions regarding the role of artificial intelligence in education, the development of AI literacy, and the promotion of a growth mindset within technology-supported learning environments. The data sources for this study consist of scholarly publications indexed in academic databases and open-access journals published between 2022 and 2026. These sources include empirical studies, theoretical analyses, systematic reviews, and conceptual frameworks related to artificial intelligence in education, critical thinking development, and growth mindset pedagogy.

The research process involved several stages of analysis. The first stage consisted of identifying relevant literature through keyword searches using terms such as “artificial intelligence in education,” “AI literacy,” “growth mindset,” and “AI-assisted learning.” The second stage involved selecting studies that specifically addressed the pedagogical implications of AI technologies in classroom contexts. The final stage involved synthesizing the findings of these studies to identify emerging patterns and theoretical insights regarding AI-supported learning. Based on the synthesis of the literature, this study proposes a conceptual framework called the AI–Growth Mindset Learning Framework. This framework describes how artificial intelligence can be integrated into classroom learning while maintaining students’ intellectual autonomy and critical engagement.

The framework consists of three interconnected components. The first component emphasizes AI-assisted exploration, in which students use AI tools to generate ideas, clarify concepts, and explore alternative perspectives during the learning process. In this stage, AI functions as a tutor or learning companion that provides scaffolding and cognitive support. The second component focuses on the critical evaluation of AI outputs. Students are encouraged to examine the accuracy, reliability, and

relevance of AI-generated information by comparing it with credible academic sources. This stage promotes the development of analytical reasoning and information literacy skills.

The third component involves reflective learning practices that cultivate a growth mindset among students. Through reflection, students learn to view mistakes, uncertainties, and incomplete answers as opportunities for deeper learning rather than failures. By integrating these three components, the framework highlights the importance of balancing technological innovation with human cognitive development. Artificial intelligence becomes a tool that supports learning rather than replacing the intellectual processes that underpin meaningful education.

Results

A. Artificial Intelligence as a Tutor and Learning Companion in Classroom Learning

The integration of artificial intelligence into classroom learning environments has gradually transformed the role of educational technologies [1], [2]. Traditionally, digital technologies were primarily used as information delivery tools that provided access to learning materials. However, the development of generative artificial intelligence systems has shifted this paradigm significantly [7]. AI systems now have the capacity to interact with students through dialogue, provide explanations, generate examples, and assist learners in constructing knowledge [11]. Holmes et al. [1] explain that artificial intelligence in education can function as an adaptive support system that responds to students' individual learning needs and cognitive levels.

One of the most significant roles of AI in classroom learning is its potential to function as a learning companion or tutor. In this role, AI acts as a digital partner that accompanies students during the learning process. According to Chan [12], conversational AI systems can facilitate learning by engaging students in interactive discussions that encourage exploration of ideas and conceptual clarification. When students ask questions or request explanations, AI systems can provide immediate responses that help students navigate complex learning tasks [13]. This capability allows AI to support students who may require additional guidance during independent learning activities. For example, when students encounter difficulties understanding a particular concept, AI tools can provide simplified explanations, alternative examples, or step-by-step reasoning processes that help learners gradually develop their understanding [14]. In this sense, AI can function similarly to a tutoring system that provides scaffolding during the learning process [4].

However, it is important to emphasize that the educational role of AI should not be interpreted as replacing teachers. Instead, AI should be positioned as a supplementary tool that supports the instructional process. Zawacki-Richter et al. [4] argue that AI technologies are most effective when integrated into pedagogical frameworks that combine human guidance with technological support. Teachers remain responsible for guiding students in interpreting information, evaluating knowledge sources, and connecting learning activities with broader educational objectives [15]. Another important aspect of AI-assisted learning is the potential for AI systems to stimulate creativity and idea generation. Generative AI platforms can provide suggestions, examples, or alternative perspectives that help students explore topics more deeply. For instance, when students are asked to develop arguments or design projects, AI can provide preliminary ideas that serve as starting points for further exploration.

[6] notes that generative AI tools can function as brainstorming partners that help students expand their thinking and explore multiple possibilities. Research has also shown that AI-supported inquiry learning environments can improve student engagement and critical exploration of knowledge [16], [17].

Despite these benefits, educators must carefully guide students in understanding the limitations of AI-generated information. AI models do not possess a genuine understanding of knowledge; instead, they generate responses based on statistical patterns in large datasets. As a result, the information produced by AI systems may not always be accurate or complete [7], [11]. Holmes et al. [1] emphasize that AI outputs should be treated as provisional information that requires verification and critical reflection. When students understand that AI is not an infallible source of knowledge, they are more likely to use AI as a tool for exploration rather than as a substitute for thinking. This perspective encourages students to engage actively in the learning process while using AI to support their intellectual development [10], [18].

Table 1 presents the role of artificial intelligence as a learning companion in classroom learning, including its functions in personalized support, interactive tutoring, idea generation, student engagement, and cognitive scaffolding during learning activities.

Table 1. AI as a Learning Companion in Classroom Learning.

AI Function	Description	Educational Implication
Idea generation	AI helps students generate initial ideas and perspectives	Encourages creativity and exploration
Concept clarification	AI explains complex concepts in accessible ways	Supports conceptual understanding
Feedback assistance	AI analyzes responses and suggests improvements	Enhances reflective learning
Problem-solving support	AI guides reasoning processes and analytical thinking	Strengthens cognitive engagement
Resource recommendation	AI suggests additional references and learning materials	Expands knowledge exploration

Overall, the role of AI as a learning companion reflects a broader shift in educational practice toward interactive and student-centered learning environments. When implemented appropriately, AI systems can support students' intellectual development while maintaining the central role of human guidance in the learning process.

B. Critical Thinking and the Limitations of AI-Generated Knowledge

Although artificial intelligence offers powerful capabilities for generating information and assisting students in academic tasks, the reliability of AI-generated knowledge remains an important concern in educational contexts [7], [11]. AI systems are designed to produce responses based on patterns identified in large datasets, which means that they do not possess genuine understanding or awareness of the information they generate [2]. As a result, AI-generated responses may sometimes contain inaccuracies, outdated information, or misleading interpretations. Guo and Lee [3] argue that students who rely heavily on AI dialogue systems may gradually develop passive learning habits. When learners begin to accept AI-generated responses without questioning their accuracy, the learning process becomes less analytical and more dependent on automated systems. This phenomenon is particularly

concerning in educational environments that aim to cultivate critical thinking and independent reasoning skills [10].

Another challenge associated with AI-generated information is the potential presence of algorithmic bias. AI systems are trained using large datasets collected from various sources, and these datasets may contain cultural, social, or ideological biases. Holmes et al. [1] note that such biases may be reflected in the responses produced by AI models, which means that students must be trained to evaluate AI-generated information critically. In addition to bias, AI-generated responses may sometimes present information in a way that appears authoritative even when the content is uncertain or incomplete. Martínez and Gómez [6] explain that generative AI models are designed to produce fluent and coherent language, which can create an illusion of accuracy. Students who are unfamiliar with the limitations of AI may therefore assume that the information provided by AI systems is always reliable [19]. Researchers have also highlighted that AI literacy is essential to help students recognize the strengths and weaknesses of AI-generated content [8], [20].

Despite these limitations, AI technologies can also serve as valuable tools for developing critical thinking skills when used appropriately. Instead of accepting AI-generated responses as final answers, students can use AI outputs as starting points for deeper inquiry. By comparing AI-generated explanations with academic sources, students can develop stronger analytical skills and a more nuanced understanding of complex issues. Researchers have suggested that teachers can design learning activities that intentionally require students to evaluate AI-generated information [15]. For example, students may be asked to identify inaccuracies in AI responses, compare AI explanations with textbook materials, or analyze differences between multiple AI-generated perspectives. According to [7], such activities encourage students to engage in higher-order thinking processes that involve analysis, evaluation, and synthesis of information. Through these approaches, AI can become a catalyst for critical thinking rather than a threat to intellectual independence [17]. The key factor is how educators structure the learning environment and guide students in interacting with AI technologies [18].

Table 2 illustrates the role of critical thinking in AI-supported learning, highlighting students' abilities to evaluate AI-generated information, identify inaccuracies, compare sources, and engage in analytical and reflective learning processes.

Table 2. Critical Thinking in AI-Supported Learning.

Aspect	Challenge	Educational Strategy
Information accuracy	AI may produce incorrect or incomplete information	Encourage verification with credible sources
Algorithmic bias	AI responses may reflect biases from training data	Teach data and media literacy
Overreliance	Students may depend excessively on AI assistance	Design inquiry-based learning tasks
Passive learning	AI may reduce active engagement	Encourage questioning and discussion
Academic integrity	AI may facilitate plagiarism or shortcut learning	Promote ethical and responsible AI use

Developing critical thinking skills in AI-assisted learning environments, therefore, requires intentional pedagogical strategies that emphasize reflection, questioning, and evaluation of information sources.

C. Growth Mindset and Responsible AI Use in Education

The concept of growth mindset provides an important pedagogical foundation for integrating artificial intelligence into classroom learning environments [9], [15]. Growth mindset refers to the belief that intelligence and abilities can be developed through effort, persistence, and learning from mistakes. According to Carol S. Dweck [9], students who adopt a growth mindset tend to view challenges as opportunities for improvement rather than as obstacles to success. In the context of AI-assisted learning, a growth mindset plays a crucial role in shaping how students interact with technology. When students perceive AI-generated responses as definitive answers, they may become passive recipients of information [5]. However, when students adopt a growth mindset, they are more likely to treat AI outputs as opportunities for exploration and reflection. For example, students can analyze errors in AI-generated explanations and use these errors as learning opportunities. By identifying inaccuracies or inconsistencies in AI responses, learners develop stronger analytical skills and a deeper understanding of the subject matter [10]. Long and Magerko [8] argue that developing AI literacy enables students to recognize the strengths and limitations of AI systems, which in turn supports responsible technology use.

A growth mindset also encourages persistence in problem-solving activities. When students encounter challenges while working with AI tools, they learn to revise their questions, adjust their prompts, and explore alternative solutions. This process reinforces the idea that learning is an iterative process that involves experimentation and reflection [16]. Another important dimension of growth mindset in AI-assisted learning is the development of self-regulation. Students must learn to monitor their own use of AI tools and ensure that these technologies support rather than replace their thinking processes. [9] emphasizes that students who possess strong AI literacy skills are better able to regulate their use of AI technologies and maintain intellectual independence. Research on AI literacy has also shown that students who understand the mechanisms and limitations of AI systems are more likely to engage critically with AI-generated information rather than accepting it uncritically [11], [19].

Teachers can foster a growth mindset by encouraging reflective learning practices that involve evaluating AI outputs, discussing different perspectives, and revising initial ideas. Such practices help students understand that knowledge construction is a dynamic process that requires continuous engagement [5]. In addition, AI-supported learning environments can encourage student engagement and collaborative inquiry when guided appropriately by educators [21]. Teachers, therefore, play a central role in designing pedagogical strategies that combine AI technologies with reflective and inquiry-based learning approaches [2], [22]. Through these approaches, artificial intelligence can function not merely as a source of information but as a learning companion that supports intellectual growth, resilience, and responsible learning practices [1], [17].

Table 3 presents growth mindset strategies for AI-assisted learning, emphasizing persistence, reflective thinking, self-regulation, problem-solving, and students' active engagement in evaluating and improving AI-supported learning experiences.

Table 3. Growth Mindset Strategies for AI-Assisted Learning.

Growth Mindset Principle	Classroom Practice	Learning Outcome
Learning from mistakes	Students analyze incorrect AI responses	Deeper conceptual understanding
Curiosity and exploration	Students use AI to generate new ideas	Creative thinking
Reflection	Students compare AI outputs with academic sources	Critical evaluation skills
Persistence	Students revise prompts and solutions	Problem-solving abilities
Self-regulation	Students monitor their use of AI tools	Independent learning habits

In summary, integrating growth mindset pedagogy into AI-assisted learning environments helps ensure that artificial intelligence functions as a tool for intellectual development rather than a substitute for human thinking.

Conclusion

The integration of artificial intelligence into classroom learning environments has created both opportunities and challenges for contemporary education. AI technologies provide powerful tools for personalized learning, information exploration, and academic support. However, these technologies also raise concerns regarding the reliability of AI-generated information and the potential decline of critical thinking skills if students become overly dependent on automated systems. This study highlights the importance of redefining the role of AI in education. Instead of treating artificial intelligence as a source of definitive answers, educators should position AI as a learning companion or tutor that assists students in exploring ideas and developing their understanding of complex concepts.

The findings of this study also emphasize the need to integrate AI literacy and growth mindset pedagogy into classroom practices. By teaching students to critically evaluate AI-generated information and view learning as an ongoing process, educators can help students maintain intellectual autonomy in technology-rich learning environments. Ultimately, the successful integration of artificial intelligence in education requires a balanced approach that combines technological innovation with human-centered pedagogy. When used responsibly, AI can become a powerful tool that enhances learning while preserving the essential role of critical thinking and human creativity in education.

Conflict of Interest

The authors declare that there is no conflict of interest.

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