

Artificial Intelligence in Classroom Learning: Building Students' Growth Mindset and Critical Thinking in the Age of AI

¹Mar'atul Khusna Srikusuma, ¹Salsabilla Noorfriska, ¹Ulfach Oktaviani Nurhikmah, ¹Dian Artha Kusumaningtyas*

Corresponding Author: *dian.artha@pfis.uad.ac.id

¹ Ahmad Dahlan University, Indonesia

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ABSTRACT

The rapid advancement of artificial intelligence (AI) technologies has significantly influenced contemporary educational practices worldwide. Generative AI tools are increasingly accessible to students and can instantly provide explanations, summaries, problem-solving assistance, and complete written responses. Although these technologies offer important opportunities for improving access to information and supporting learning efficiency, they also create challenges related to students' cognitive engagement, analytical ability, and critical thinking development. Many educators are concerned that students may rely excessively on AI-generated outputs and gradually reduce their independent intellectual effort. This study aims to examine the role of AI in classroom learning and explore how the concept of growth mindset can support responsible and reflective AI usage in educational contexts. The research employs a qualitative literature review and conceptual analysis of recent academic studies and classroom practices related to AI integration in education. The findings indicate that students require clear guidance regarding the strengths and limitations of AI systems. AI should be positioned as a cognitive support tool rather than a replacement for human reasoning and problem-solving processes. The study also highlights that AI systems may generate inaccurate or contextually inappropriate responses, emphasizing the importance of critical evaluation. A practical example involving AI recommendations for short-distance travel demonstrates how AI may fail to fully understand situational context despite producing logically structured responses.

Based on these findings, the study proposes a conceptual framework integrating AI literacy, growth mindset orientation, critical evaluation, and reflective learning practices.

Keywords

AI Literacy
Artificial Intelligence
Classroom Learning
Critical Thinking
Digital Education
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Introduction

Artificial intelligence has rapidly become an influential force in modern education. The emergence of generative AI technologies such as large language models allows students to access explanations, generate essays, and obtain solutions to complex problems within seconds. Recent research shows that AI-powered tools are increasingly integrated into learning environments, enabling students to engage with knowledge in new and innovative ways [1], [2].

Educational institutions have begun to explore how these technologies can enhance teaching and learning processes. AI systems can support personalized learning, assist with language development, and provide instant feedback to learners [3], [4]. For example, students can use AI tools to clarify difficult concepts, summarize academic articles, or brainstorm ideas for writing assignments.

However, the growing presence of AI in classrooms also raises important pedagogical concerns. Some educators worry that students may become overly dependent on AI-generated responses, reducing their motivation to engage in deep thinking or problem-solving [5]. If students rely on AI to generate answers automatically, they may lose opportunities to develop essential cognitive skills such as analysis, synthesis, and evaluation.

The concept of growth mindset provides a valuable perspective for addressing these challenges. A growth mindset refers to the belief that intelligence and abilities can be developed through effort, persistence, and learning experiences [6]. In contrast, a fixed mindset assumes that abilities are static and cannot significantly improve. When students adopt a growth mindset, they are more likely to embrace challenges, learn from mistakes, and persist in difficult tasks.

In the context of AI-assisted learning, cultivating a growth mindset is essential. Students must understand that AI is not a replacement for thinking but rather a tool that can

support intellectual exploration. AI-generated outputs should be treated as starting points for further analysis rather than final answers.

Another critical issue is the potential for AI systems to produce inaccurate or misleading responses. Because generative AI relies on probabilistic language models rather than true understanding, it may occasionally generate information that appears plausible but is factually incorrect or contextually inappropriate [7]. This phenomenon highlights the importance of critical thinking when interacting with AI systems.

A simple example illustrates this challenge. Consider the following question posed to an AI system: "I want to wash my car. The car wash is 100 meters from my house. Should I walk or drive?" An AI system may respond that walking is more efficient due to the short distance. However, this answer ignores the practical context that the user intends to bring the car to the car wash. Without recognizing this contextual requirement, the AI produces a logically flawed recommendation. This example demonstrates why students must develop the ability to evaluate AI-generated responses critically. Rather than accepting AI outputs as authoritative, learners should analyze the reasoning behind them and identify potential errors.

Therefore, this article aims to examine how growth mindset principles can guide responsible AI usage in classroom learning. The study also explores strategies for integrating AI literacy and critical thinking into educational practices. The emergence of generative AI tools has also transformed how students interact with knowledge sources. Traditionally, students relied on textbooks, teachers, and academic articles to construct understanding. The learning process required them to read, interpret, compare sources, and synthesize information independently. However, with the introduction of AI-powered conversational systems, students can now obtain synthesized answers within seconds. While this technological convenience improves efficiency, it may also reduce the cognitive effort involved in the learning process.

Several scholars have warned that excessive reliance on automated knowledge systems may weaken students' metacognitive skills. Metacognition refers to an individual's ability to monitor and regulate their own thinking processes [8]. When students simply accept AI-generated answers without questioning them, they may fail to develop the analytical habits necessary for deep learning. Therefore, educators must ensure that AI tools are integrated into classroom learning in ways that promote reflective thinking rather than passive consumption of information.

Another critical concern involves the reliability of AI-generated knowledge. Unlike traditional academic sources, AI systems generate responses dynamically based on probabilistic language patterns rather than verified references. As a result, AI-generated information may appear convincing even when it contains inaccuracies or logical

inconsistencies [9]. This issue is particularly problematic in educational contexts where students may not yet possess the expertise needed to evaluate information credibility.

In addition, the increasing accessibility of AI technologies has also created new ethical challenges in education. Students may use AI tools to complete assignments automatically, raising questions about academic integrity and originality [10]. Some educators argue that banning AI tools entirely is unrealistic because these technologies are becoming embedded in everyday digital environments. Instead, the focus should shift toward teaching students how to use AI responsibly and critically.

This perspective aligns with the concept of digital literacy, which emphasizes the ability to evaluate, interpret, and create information using digital technologies. In the context of AI-assisted learning, digital literacy includes understanding how AI systems operate, recognizing their limitations, and using them to support meaningful learning activities [11].

Therefore, the integration of AI into education should not be viewed solely as a technological issue but also as a pedagogical challenge. Teachers must design learning experiences that encourage students to interact with AI tools in ways that strengthen cognitive engagement rather than replace it.

Material and Methods

A. Research Method and Literature Review Approach

This study employs a qualitative literature review combined with a conceptual analysis to examine the integration of artificial intelligence (AI) in educational settings. The research focuses on academic publications, policy documents, and scholarly articles published between 2021 and 2025 in order to capture recent developments in AI technologies and digital learning practices. The selected literature was obtained from major academic databases such as Google Scholar, Scopus, and Web of Science. Sources discussing AI-assisted learning, digital literacy, critical thinking, and technology-supported classroom instruction were prioritized to provide a comprehensive understanding of how AI influences contemporary educational practices. The literature review explored several interconnected themes, including the role of AI technologies in supporting classroom learning, the relationship between growth mindset and learning outcomes, and the educational challenges associated with AI-generated information. Through qualitative conceptual analysis, the study identified recurring patterns and theoretical perspectives related to responsible AI integration in schools and higher education contexts.

The analysis revealed that AI technologies increasingly function as cognitive support tools capable of assisting students in information retrieval, idea generation, language support, and problem-solving activities. However, the literature also highlighted concerns regarding overreliance on AI systems, superficial understanding, reduced cognitive effort, and declining originality in student work. These findings demonstrate the importance of designing

educational approaches that encourage students to interact critically and reflectively with AI-generated outputs. Consequently, the study emphasizes that AI should not be viewed merely as an automated answer provider but rather as a learning support system that requires active human interpretation and evaluation. By synthesizing current scholarly discussions, this research proposes a conceptual framework aimed at promoting responsible AI usage while maintaining students' intellectual engagement, critical thinking skills, and reflective learning practices in technology-supported educational environments.

B. Conceptual Framework for AI-Assisted Learning

To analyze the relationship between AI use and student learning behavior, this study proposes a conceptual framework consisting of several interconnected components that guide how AI technologies should be introduced and utilized in classroom instruction. The framework begins with AI awareness, which emphasizes the importance of helping students understand how AI systems generate responses and why these outputs may sometimes contain inaccuracies, biases, or contextual misunderstandings. Through this awareness, students learn that AI-generated information should not automatically be considered authoritative knowledge. Instead, AI outputs must be approached critically and verified through comparison with reliable academic sources. The framework also incorporates growth mindset orientation, encouraging students to perceive learning as a continuous process involving effort, reflection, revision, and intellectual development. Within this perspective, AI is positioned as a supportive learning partner rather than a shortcut for obtaining instant answers.

The framework further emphasizes critical evaluation and reflective learning practices. In the critical interaction stage, students are encouraged to analyze, critique, and improve AI-generated responses instead of passively accepting them. For instance, students may compare AI explanations with textbooks or scholarly references, identify inaccuracies, and revise unclear information. This process transforms AI into a stimulus for analytical thinking and deeper understanding. The final stage focuses on reflective learning and knowledge consolidation, where students evaluate their experiences using AI technologies and discuss both the strengths and limitations of AI-generated outputs. Teachers facilitate reflective discussions that encourage students to recognize that AI systems operate through computational patterns rather than genuine comprehension. Through orientation, critical interaction, and reflection, the framework aims to transform AI usage in education into a structured learning experience that promotes higher-order thinking skills, intellectual curiosity, digital literacy, and responsible technology use. Overall, the proposed framework positions AI as a cognitive support tool capable of enhancing learning while preserving students' active intellectual engagement and independent reasoning abilities.

Results and Discussions

A. AI Integration in Classroom Learning

The integration of artificial intelligence into classroom environments has expanded rapidly in recent years. Many students now use AI tools to support learning activities such as summarizing texts, generating explanations, and solving academic problems [8], [9]. These technologies can improve learning efficiency by providing quick access to information and enabling students to explore topics independently. However, the increasing availability of AI also creates new pedagogical challenges. Without proper guidance, students may treat AI systems as authoritative sources of knowledge rather than tools for exploration.

Table 1. Benefits and Potential Risks of Artificial Intelligence Applications in Learning Activities

AI Application	Learning Benefit	Potential Risk
Text generation	Idea exploration	Overreliance on AI
Summarization tools	Faster information processing	Superficial understanding
Problem-solving assistance	Concept clarification	Reduced cognitive effort
Language support	Improved writing quality	Loss of originality
Content explanation	Accessibility of knowledge	Passive learning behavior

Research suggests that AI integration must be accompanied by instructional strategies that encourage active learning [10], [11]. Teachers should design tasks that require students to analyze, interpret, and critique AI-generated information rather than simply copying it. Furthermore, AI can support collaborative learning when students discuss and evaluate AI outputs together. Classroom discussions allow students to identify strengths and weaknesses in AI-generated explanations, fostering deeper engagement with the learning material.

B. Growth Mindset and Critical Thinking Development

Growth mindset theory emphasizes the importance of effort, persistence, and learning from mistakes. When applied to AI-assisted learning, this concept encourages students to view AI responses as starting points for further analysis rather than final answers [12], [13]. Students with a growth mindset are more likely to experiment with different approaches, revise their work, and reflect on their learning processes.

Table 2. Integration of Growth Mindset Practices in AI-Assisted Learning Activities

Growth Mindset Practice	Student Activity	Learning Outcome
Reflection	Reviewing AI responses	Critical awareness
Revision	Improving AI-generated text	Analytical skills
Comparison	Checking multiple sources	Information literacy
Discussion	Debating AI outputs	Collaborative reasoning
Iteration	Refining prompts	Problem-solving ability

Studies indicate that integrating growth mindset principles into digital learning environments can improve students' resilience and academic motivation [14], [15]. When students understand that mistakes are part of the learning process, they become more willing

to engage with complex tasks and evaluate AI outputs critically. Teachers can encourage this mindset by designing assignments that require students to analyze AI-generated content, identify weaknesses, and propose improvements. Such activities shift the focus from answer retrieval to knowledge construction.

C. AI Misinterpretation and the Importance of Critical Awareness

Although AI systems can generate impressive responses, they are not infallible. Because these systems rely on probabilistic language patterns rather than true comprehension, they may occasionally produce incorrect or misleading information [16], [17]. The earlier example of the car-washing scenario illustrates how AI can misunderstand contextual meaning. When asked whether someone should walk or drive to wash a car located 100 meters away, the AI suggested walking due to the short distance. However, this recommendation ignored the practical requirement of bringing the car to the car wash.

Table 3. Critical Reflections on AI-Generated Responses in Learning Contexts

Scenario	AI Response	Critical Reflection
Short-distance travel	Suggest walking	Ignore practical goal
Essay generation	Produce full essay	Reduce student thinking
Homework solution	Instant answer	Limit problem-solving
Research summary	Simplify argument	Lose analytical depth
Idea generation	Provide quick suggestions	Encourage superficial thinking

This example demonstrates the importance of teaching students that AI-generated responses must always be evaluated critically. When interacting with AI technologies, learners should develop the habit of questioning the reliability and completeness of the information they receive. Instead of accepting AI outputs at face value, students need to consider whether the response truly addresses the full context of the question, whether alternative explanations or perspectives might exist, and whether the information can be verified through reliable academic or authoritative sources. By engaging in this process of questioning and verification, students become more active participants in their own learning rather than passive recipients of information. Developing such habits is essential for maintaining intellectual independence while still benefiting from the efficiency and accessibility offered by AI technologies. Through critical evaluation and reflective thinking, students can use AI as a supportive learning tool while ensuring that their own reasoning and analytical abilities remain central to the learning process [18], [19].

D. Pedagogical Implications for Teachers

The findings of this study highlight several important implications for educators who wish to integrate AI technologies into classroom learning environments. Rather than viewing AI as a threat to education, teachers can harness its capabilities to support deeper learning when used strategically. One key implication is the importance of designing learning tasks that require students to engage with AI outputs critically. For example, teachers may assign

activities in which students must identify weaknesses in AI-generated explanations or compare AI responses with academic sources. These tasks encourage students to treat AI-generated information as material for analysis rather than final answers. Another important strategy involves incorporating collaborative learning activities. When students work together to evaluate AI responses, they are exposed to diverse perspectives and reasoning processes. Collaborative discussion also allows students to recognize the limitations of AI systems collectively. Teachers should also emphasize the role of questioning in AI-assisted learning. The quality of AI responses often depends on the clarity and specificity of the prompts provided by users. Therefore, teaching students how to formulate effective questions becomes an essential skill in the age of AI. Finally, it is important for educational institutions to develop clear policies regarding the ethical use of AI in academic work. Such policies should emphasize transparency, encouraging students to acknowledge when AI tools are used during the learning process. By implementing these strategies, teachers can ensure that AI technologies enhance rather than diminish the quality of learning experiences.

Conclusion

Artificial intelligence is transforming classroom learning by providing new tools that enhance access to knowledge and support academic tasks. However, the increasing use of AI also raises concerns about students' critical thinking and intellectual independence. This study highlights the importance of cultivating a growth mindset in AI-assisted learning environments. Students must understand that AI is a supportive tool rather than a replacement for human reasoning. Educators play a crucial role in guiding students to evaluate AI-generated responses critically and reflect on their learning processes. The findings suggest that integrating AI literacy, growth mindset principles, and reflective learning practices can help ensure that AI strengthens rather than weakens students' cognitive engagement. By encouraging students to analyze, critique, and improve AI-generated outputs, educators can transform AI from a passive answer generator into an active learning partner. Future research should explore practical classroom strategies for implementing these approaches across different educational contexts.

Conflict of Interest

The authors should declare that there is no conflict of interest.

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Authors



Mar'atul Khusna Srikusuma is a student in the Professional Teacher Education Program (PPG) at Universitas Ahmad Dahlan, Yogyakarta, Indonesia, specializing in Pancasila and Civic Education. Her research interests include civic education, critical thinking, and the integration of artificial intelligence in education. (email: maratulkhusnaa07@gmail.com).



Salsabilla Noorfriska is a student in the Professional Teacher Education Program (PPG) at Universitas Ahmad Dahlan, Yogyakarta, Indonesia, specializing in Pancasila and Civic Education. Her research interests include civic education, growth mindset development, and innovative learning strategies. (email: ssabillanfriska@gmail.com).



Ulfach Oktaviani Nurhikmah is a student in the Professional Teacher Education Program (PPG) at Universitas Ahmad Dahlan, Yogyakarta, Indonesia, specializing in Pancasila and Civic Education. Her research interests include civic education, political practice, democratic citizenship, and character education. (email: ulfa.oktaviani789@gmail.com).



Prof. Dr. Dian Artha Kusumaningtyas, M. Pd. Si is a professor in the Physics Education Program at Universitas Ahmad Dahlan, Yogyakarta. Currently, she serves as the Program Coordinator for Character Education and Academic Advisor at the same institution. With a strong commitment to education, Dian's research interests lie in science learning, learning assessment, and school development in suburban areas. For inquiries or collaboration, she can be contacted at (email: dian.artha@pfis.uad.ac.id).