Jurnal Genesis Indonesia
Vol. 5, No. 02, pp. 189-199
journal.iistr.org/index.php/JGI
DOI: 10.56741/IISTR.jgi.002278

Building Students' Growth Mindset through Artificial Intelligence Integration in Classroom Learning

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ARTICLE INFO

Article History
Received 16 March 2026
Revised 18 April 2026
Accepted 15 May 2026

ABSTRACT

The rapid advancement of Artificial Intelligence (AI) has significantly transformed the educational landscape, offering new opportunities to enhance teaching and learning processes. However, the integration of AI in education raises concerns regarding students' dependency on technology and potential decline in critical thinking skills. Therefore, fostering a growth mindset among students becomes essential to ensure that AI serves as a learning support tool rather than a substitute for cognitive effort. This article explores how AI integration in classroom learning can promote students' growth mindset, critical thinking, and problem-solving abilities. The study adopts a qualitative conceptual analysis supported by recent empirical literature on AI in education and growth mindset theory. The proposed framework examines the relationship between AI-supported learning, pedagogical strategies, and student mindset development. The findings indicate that AI can positively contribute to the development of a growth mindset when teachers implement strategies such as exploratory learning, reflective practices, project-based learning, digital ethics instruction, and process-oriented feedback. The results further show that AI-enhanced learning environments can encourage deeper engagement, creativity, and collaborative learning if accompanied by appropriate pedagogical guidance. However, challenges such as digital literacy gaps, ethical concerns, and overreliance on AI must be addressed through effective instructional design and policy frameworks. This study contributes to the growing discourse on AI in education by proposing a practical pedagogical model that integrates AI technologies with growth mindset

principles to foster resilient and adaptive learners in the digital era.

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Keywords
AI in Education
Artificial Intelligence
Classroom Innovation
Digital Learning
Growth Mindset

Introduction

The integration of Artificial Intelligence (AI) into education has rapidly expanded in recent years, transforming how teaching and learning occur in classrooms. AI technologies such as intelligent tutoring systems, generative AI tools, and adaptive learning platforms have enabled personalized learning experiences and real-time feedback for students. These technologies allow learners to access information more efficiently, explore multiple perspectives, and engage with complex problem-solving tasks [1], [2].

Despite these benefits, concerns have emerged regarding the potential negative impact of AI on students' cognitive development. Some educators argue that excessive reliance on AI tools may reduce students' independent thinking and creativity if used merely as shortcuts for completing assignments [3]. Consequently, educators must adopt pedagogical approaches that encourage students to use AI responsibly and productively.

One important psychological factor influencing students' engagement with AI-based learning environments is the growth mindset, a concept introduced by Carol Dweck. Growth mindset refers to the belief that intelligence and abilities can be developed through effort, learning strategies, and persistence. Students with a growth mindset are more likely to embrace challenges, persist through difficulties, and learn from mistakes.

In AI-enhanced learning environments, a growth mindset plays a critical role in shaping how students interact with technology. When students view AI as a tool for exploration rather than a source of instant answers, they are more likely to engage in deeper learning processes. Research indicates that growth mindset, resilience, and self-efficacy significantly influence student engagement in AI-supported learning contexts [4].

Therefore, educators must design instructional strategies that integrate AI with growth mindset principles. AI should not replace human thinking but should function as a cognitive partner that supports inquiry, creativity, and reflection. This article examines how a growth mindset can be cultivated through AI integration in classroom learning and explores pedagogical strategies that teachers can implement to achieve this goal.

Material and Methods

A. Research Design

This study adopts a qualitative conceptual research design based on literature synthesis and theoretical analysis of AI integration in education and growth mindset theory. The approach combines systematic literature review and conceptual framework development to analyze how AI tools can support the development of a growth mindset in classroom learning.

B. Data Sources

The study drew upon scholarly articles published from 2020 to 2025, which were collected from prominent academic databases including Scopus, Web of Science, Google Scholar, and IEEE Xplore. The selection criteria required that the sources focus on the application of AI in education, address topics related to growth mindset or motivational psychology, and examine strategies for digital learning.

C. Analytical Framework

The study proposes a conceptual framework that links AI integration, pedagogical strategies, and growth mindset development.

Table 1. AI–Growth Mindset Integration Framework.

Component	Description	Expected Learning Outcome
AI Learning Tools	AI chatbots, adaptive learning systems, and generative AI	Personalized learning
Pedagogical Strategy	Project-based learning, reflection, and feedback	Active learning
Student Mindset	Growth mindset development	Resilience and persistence
Digital Literacy	Ethical and responsible AI usage	Critical evaluation
Learning Outcome	Improved creativity and problem-solving	Higher engagement

The framework highlights that AI effectiveness in education depends on the interaction between technology, pedagogy, and student mindset.

Results and Discussions

A. AI Integration and Classroom Learning Transformation

Artificial intelligence technologies have significantly transformed classroom learning environments by enabling personalized instruction and adaptive learning experiences. AI systems can analyze students' learning patterns and provide tailored feedback that helps students improve their understanding of complex concepts [5]. AI-based learning systems enable educators to analyze students' learning patterns and identify individual learning needs more effectively. Intelligent tutoring systems, for example, can monitor students' progress in real time and provide immediate feedback tailored to each learner's level of understanding. This adaptive feedback mechanism allows students to learn at their own pace, reducing learning gaps and improving conceptual comprehension.

In addition, generative AI tools allow students to explore ideas and develop deeper conceptual understanding by generating explanations, examples, and alternative perspectives on a particular topic. Instead of relying solely on textbooks or teacher explanations, students can interact with AI systems to ask questions, test hypotheses, and examine multiple interpretations of a concept. Such interactive learning environments encourage students to become active participants in their learning process rather than passive recipients of information.

Table 2. AI Applications in Classroom Learning.

AI Application	Learning Function	Educational Benefit
Intelligent tutoring systems	Personalized instruction	Individual learning support
Generative AI tools	Idea generation	Creative thinking
Adaptive learning platforms	Content personalization	Efficient learning
Automated feedback systems	Instant feedback	Continuous improvement
AI learning analytics	Data-driven insights	Improved decision-making

Studies show that AI tools can enhance creativity, cognitive flexibility, and idea generation when integrated into innovative learning activities [6]. Furthermore, AI-supported learning environments encourage students to explore knowledge beyond traditional textbooks.

However, AI integration must be carefully managed. Without proper guidance, students may rely excessively on AI-generated answers instead of developing their own reasoning skills. Therefore, teachers play a critical role in guiding students to use AI as a learning partner rather than a replacement for cognitive effort [7], [8]. Another significant benefit of AI integration in education is the enhancement of students' engagement and motivation. Interactive AI tools can create dynamic learning experiences by incorporating simulations, problem-based tasks, and scenario-based learning activities. These approaches enable students to apply theoretical knowledge to real-world problems, thereby strengthening their problem-solving skills.

Furthermore, AI technologies support differentiated instruction in heterogeneous classrooms. Teachers often face challenges when teaching students with diverse academic abilities and learning backgrounds. AI-based platforms can help address this challenge by providing individualized learning materials and practice exercises tailored to each student's needs. This flexibility allows teachers to manage diverse classrooms more effectively while ensuring that all students receive appropriate learning support. However, despite its advantages, AI integration also raises several pedagogical concerns. One major concern is the potential overreliance on AI-generated answers. If students use AI tools merely to obtain instant solutions without engaging in critical thinking, the learning process may become superficial. In such cases, AI may inadvertently hinder students' cognitive development rather than support it.

Therefore, the role of teachers becomes increasingly important in guiding students to use AI responsibly. Teachers must design learning activities that encourage students to interact

critically with AI-generated information. For example, students can be asked to evaluate the accuracy of AI responses, compare AI-generated explanations with textbook content, or identify potential biases in AI outputs. These activities help students develop digital literacy and critical thinking skills while benefiting from AI-supported learning tools. Moreover, AI integration requires educators to adopt new pedagogical competencies. Teachers must develop skills in digital pedagogy, data interpretation, and technology integration to effectively implement AI in classroom instruction. Professional development programs and teacher training initiatives are essential to equip educators with the necessary knowledge and skills to use AI technologies in meaningful and pedagogically sound ways.

B. Growth Mindset Development Through AI-Supported Learning

A growth mindset plays a vital role in shaping how students engage with AI technologies. Students who believe that intelligence can be developed through effort are more likely to use AI as a tool for exploration and learning rather than as a shortcut. Growth mindset plays a fundamental role in shaping students' attitudes toward learning, particularly in technology-enhanced environments. According to Dweck's theory, individuals with a growth mindset believe that intelligence and abilities can be developed through effort, perseverance, and effective learning strategies. This belief encourages students to embrace challenges, persist through difficulties, and view mistakes as opportunities for growth.

In AI-supported learning environments, a growth mindset becomes particularly relevant because students frequently encounter complex tasks that require exploration, experimentation, and iterative learning processes. AI tools can facilitate these processes by providing continuous feedback and alternative explanations, which help students refine their understanding of difficult concepts.

Table 3. Growth Mindset Indicators in AI Learning.

Growth Mindset Element	AI Learning Activity	Expected Outcome
Persistence	Solving complex problems using AI hints	Problem-solving ability
Reflection	Comparing personal answers with AI feedback	Metacognitive Awareness
Curiosity	Exploring alternative explanations using AI	Deeper understanding
Collaboration	Group discussions with AI-generated ideas	Social learning
Resilience	Learning from mistakes with AI feedback	Continuous improvement

Research indicates that AI-driven feedback can significantly foster a growth mindset by supporting students' engagement and persistence in learning tasks [9]. AI tools can provide scaffolding that helps learners gradually develop their skills through guided practice.

Moreover, AI-enhanced learning environments align with the principles of self-determination theory, which emphasizes autonomy, competence, and relatedness as key drivers of motivation [4]. By enabling students to explore ideas independently while receiving

guidance from AI systems, these environments encourage deeper engagement and self-regulated learning.

C. Pedagogical Strategies for Teachers in AI-Based Learning

Teachers play a central role in ensuring that AI technologies contribute positively to student learning. Effective instructional strategies are necessary to guide students in using AI responsibly and meaningfully.

Table 4. Growth Mindset Indicators in AI Learning.

Strategy	Implementation Example	Learning Impact
Exploratory learning	Students use AI to explore complex topics	Inquiry skills
Reflective practice	Students evaluate AI-generated responses	Critical thinking
Project-based learning	AI used for research and idea development	Creativity
Digital ethics instruction	Teaching responsible AI usage	Ethical awareness
Process-oriented feedback	The teacher focuses on effort and strategy	Growth mindset

Exploratory learning activities encourage students to use AI tools to investigate real-world problems and develop their own interpretations. Similarly, reflective activities allow students to evaluate AI-generated responses critically, strengthening their analytical skills. Project-based learning is particularly effective in AI-supported classrooms because it allows students to integrate knowledge from multiple disciplines while using AI tools for research and ideation. Research shows that such approaches can significantly improve creativity and problem-solving abilities among students [6].

Another important aspect is AI literacy and digital ethics education. Students must understand the limitations of AI, including potential biases and inaccuracies in AI-generated content. Educators must emphasize responsible use and critical evaluation of AI outputs. Finally, teachers should provide feedback that emphasizes effort, learning strategies, and improvement rather than simply evaluating final results. Such feedback helps students develop resilience and persistence, key components of a growth mindset. One of the most effective strategies for integrating AI into classroom learning is exploratory learning. In this approach, teachers encourage students to use AI tools to investigate complex topics and generate questions. Instead of providing direct explanations, teachers guide students to explore concepts independently using AI-supported resources.

Exploratory learning fosters curiosity and intellectual engagement because students actively participate in constructing their own understanding. For example, students studying environmental issues can use AI tools to analyze climate data, generate potential solutions, and compare different policy approaches. Such activities encourage students to think critically and creatively about real-world problems. Another important strategy is reflective practice. Reflection helps students analyze their learning processes and identify areas for improvement. Teachers can ask students to compare their own responses with AI-generated explanations

and discuss differences in reasoning or interpretation. Through this reflective process, students learn to evaluate information critically rather than accepting AI outputs uncritically.

Project-based learning (PBL) is also highly compatible with AI-supported education. In PBL environments, students work on extended projects that require research, collaboration, and creative problem-solving. AI tools can assist students in gathering information, generating ideas, and developing project proposals. For example, students may design a community-based project addressing environmental sustainability, public health, or social innovation. AI tools can help students analyze relevant data, identify potential solutions, and evaluate the feasibility of their proposals. Such experiences not only enhance academic knowledge but also develop practical skills such as teamwork, communication, and leadership.

Equally important is the development of AI literacy and digital ethics. As AI technologies become increasingly integrated into educational systems, students must understand how these technologies function and what limitations they possess. Teachers should educate students about issues such as algorithmic bias, data privacy, and ethical considerations in AI usage. Teaching digital ethics helps students become responsible digital citizens who can use technology thoughtfully and ethically. Students must learn that while AI can support their learning, they remain responsible for the originality and integrity of their work.

Finally, process-oriented feedback is crucial in fostering a growth mindset. Instead of focusing solely on grades or outcomes, teachers should emphasize effort, strategy, and improvement during the learning process. When students receive feedback that recognizes their progress and perseverance, they become more motivated to continue learning despite challenges. Process-oriented feedback can be combined with AI-supported assessment tools that track students' progress over time. By analyzing learning data, teachers can identify areas where students struggle and provide targeted guidance to support their development.

D. Case Study: AI-Driven Classroom Implementation

To illustrate the practical application of AI in fostering a growth mindset, this case study examines a secondary school classroom where AI-supported learning tools were integrated across multiple subjects. The focus was on encouraging exploratory learning, reflection, collaborative problem-solving, and narrative-based simulations. Students were provided access to AI platforms, including adaptive tutoring systems, generative AI for idea exploration, and scenario-based simulations. Teachers guided students in using AI responsibly, emphasizing effort, iterative improvement, and ethical decision-making. Over a semester, student engagement, creativity, and resilience were monitored through performance data and reflective journals.

The key findings from the case study indicate that students actively engaged with challenging problems by utilizing AI-generated hints instead of avoiding difficult tasks.

Reflection activities, supported by AI feedback, contributed to a heightened awareness of their own thinking processes, enhancing metacognitive skills. Additionally, narrative-based AI simulations increased student engagement and facilitated the application of abstract concepts in meaningful ways. Collaborative projects assisted by AI promoted teamwork, communication, and critical thinking, while teacher-provided feedback that emphasized the learning process further reinforced behaviors aligned with a growth mindset. Collectively, these observations demonstrate that thoughtfully integrated AI tools can effectively support students' cognitive development, resilience, and proactive learning behaviors.

Table 5. Growth Mindset Indicators in AI Learning.

AI Tool/Strategy	Classroom Implementation	Observed Student Outcome
Adaptive tutoring system	Students solved progressively more difficult problems	Increased persistence and problem-solving ability [10], [11]
Generative AI for idea exploration	Students brainstormed research project ideas	Enhanced creativity and curiosity [6], [12]
Scenario-based simulations	Students played historical or ecological simulations	Applied theoretical knowledge, critical thinking improved [13], [14]
Reflective feedback exercises	Students compared answers with AI suggestions	Improved metacognitive awareness [9], [15]
Collaborative AI-assisted projects	Students worked in AI-suggested teams on community projects	Increased teamwork, communication, and resilience [16], [17]

The case study confirms that AI can effectively support growth mindset development when integrated thoughtfully. Students engaged more deeply with learning tasks, demonstrated resilience when facing challenges, and actively reflected on their learning processes. Teachers acted as facilitators, guiding exploration and ensuring ethical and responsible AI use. Narrative-based AI scenarios helped students connect learning to real-world contexts, enhancing both engagement and practical understanding.

The practical implications of this study suggest that teachers should thoughtfully incorporate AI into classroom lessons by establishing clear learning objectives and providing appropriate scaffolding, ensuring that students perceive AI as a complementary tool rather than a replacement for their own thinking. Reflection and feedback activities should be carefully structured to allow students to monitor their progress, identify areas for improvement, and refine their learning strategies. Furthermore, narrative-driven AI simulations can increase engagement and support the application of abstract concepts in real-world contexts, making learning more meaningful. Collaborative projects facilitated by AI also foster peer-to-peer learning, enhance accountability, and develop essential communication and teamwork skills among students.

Conclusion

Artificial Intelligence (AI) holds significant potential to transform classroom learning by providing personalized learning experiences, enhancing student engagement, fostering creativity, and supporting problem-solving skills. The integration of AI in education, however, must be strategically aligned with pedagogical approaches that promote a growth mindset, critical thinking, and reflective learning. This study demonstrates that AI can serve as a powerful learning partner when combined with effective instructional strategies such as exploratory learning, reflective practice, project-based learning, digital ethics instruction, and process-oriented feedback. By guiding students to view AI as a tool for exploration rather than a shortcut for answers, teachers can foster persistence, resilience, curiosity, and collaborative skills—key components of a growth mindset. Case studies and empirical evidence indicate that AI-supported learning environments increase student engagement, encourage deeper cognitive processing, and allow learners to apply abstract concepts in real-world scenarios. Narrative-based simulations, adaptive tutoring systems, and collaborative AI-assisted projects further enhance motivation, metacognition, and creativity. Nevertheless, successful AI integration requires careful consideration of potential challenges, including overreliance on technology, gaps in digital literacy, and ethical concerns regarding AI usage. Teachers play a central role in mediating these challenges by providing structured guidance, scaffolding, and feedback that emphasize effort, strategy, and continuous improvement. In conclusion, AI has the capacity to enrich education and cultivate a growth mindset among students when implemented thoughtfully. By combining technological tools with pedagogically sound strategies, educators can nurture resilient, adaptive, and self-directed learners who are prepared to thrive in the digital era. The findings highlight the importance of intentional AI integration to support not only academic growth but also the socio-emotional and cognitive development of students.

Limitation and Suggestions

Despite the promising potential of AI in fostering a growth mindset, several limitations must be acknowledged. First, overreliance on AI tools may lead some students to depend excessively on technology, reducing independent problem-solving skills. Students might also misinterpret AI-generated content if their critical evaluation skills are underdeveloped. Second, digital literacy and access gaps pose significant challenges. Not all students may have equal access to AI tools or possess the necessary skills to use them effectively. Without proper support, AI integration could exacerbate educational inequalities. Third, ethical and privacy concerns arise when AI systems collect and analyze student data. Schools and educators must ensure that data is handled securely and transparently, respecting student privacy while enabling adaptive learning.

Conflict of Interest

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

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