Proceedings of ICELIA 2027 Symposium: Modern Education Strategies: Innovative Pedagogies and Digital Learning
DOI: 10.54254/2753-7048/2027.NL38888

Exploring the Role of Generative Artificial Intelligence as a "Learning Scaffold" in Junior High School Students' Self-Regulated Learning

Zixian Yang

Graduate School, The Education University of Hong Kong, Hong Kong, China
yangzixian2025@163.com

Abstract. As digital technology becomes more deeply embedded in education, Generative Artificial Intelligence (GenAI) is increasingly present in junior high school students' daily learning. This paper explores the "scaffolding" role of GenAI in students' self-regulated learning (SRL) and its possible influence on enhancing academic self-efficacy. Based on Zimmerman's cyclical phase model of SRL and learning scaffolding theory, the study systematically deduces the human-AI interaction process. The analysis suggests that GenAI acts as planning, monitoring, and reflective feedback scaffolds across the forethought, performance, and self-reflection phases, effectively addressing the lack of personalized support in traditional autonomous learning. Furthermore, GenAI assistance contributes to the internalization of academic self-efficacy by accumulating direct mastery experiences and alleviating trial-and-error anxiety. Acknowledging the potential risks of cognitive offloading and academic misconduct associated with GenAI dependency, the paper proposes coping strategies such as cultivating students' critical GenAI literacy and implementing dynamic scaffold fading. This research provides theoretical support and practical guidance for educators to optimize GenAI-assisted self-regulated learning environments.

Keywords: Self-Regulated Learning, Generative AI, Scaffolding, Academic Self-Efficacy, Junior High School Students

1. Introduction

As digital technology and education become increasingly integrated, Generative Artificial Intelligence (GenAI), represented by Large Language Models (LLMs), is rapidly entering basic education and reshaping the daily learning ecology of junior high school students. Leveraging its powerful natural language processing capabilities and real-time feedback mechanisms, GenAI is gradually evolving from a simple "retrieval tool" into a "virtual learning partner" and intelligent tutor.

In educational psychology, Self-Regulated Learning (SRL) is regarded as a core driver of students' lifelong learning. In recent years, academic interest has increasingly focused on the intervention effects of GenAI on students' self-regulation and learning motivation. Existing studies demonstrate that GenAI can significantly promote learners' self-regulated learning abilities, and

© 2026 The Authors. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

DOI: 10.54254/2753-7048/2027.NL38888

longitudinal AI-based interventions tailored for adolescents can effectively satisfy their basic psychological needs, thereby enhancing their intrinsic learning motivation [1]. However, given the extreme convenience offered by GenAI, junior high school students—whose metacognitive and self-control capabilities are still developing—may be more susceptible to cognitive offloading during human-AI interactions. Scholars such as Gao et al. pointed out that excessive GenAI dependency significantly reduces learning engagement and exerts a negative inhibitory effect on individuals' academic self-efficacy [2]. Consequently, guiding students toward deep processing and transforming GenAI into a cognitive "learning scaffold" that fosters rather than replaces student thinking has become an urgent issue in contemporary educational psychology.

Currently, most empirical and theoretical studies on GenAI-assisted learning focus on higher education populations, leaving a relative scarcity of systematic theoretical deduction regarding how junior high school students can effectively utilize GenAI in specific stages of self-regulated learning.

Given this research gap, this study combines literature analysis with logical deduction and draws on self-regulated learning theory and scaffolding theory. It outlines GenAI's scaffolding functions in the three phases of junior high school students' self-regulated learning: forethought, performance, and self-reflection. It further analyzes how GenAI strengthens academic self-efficacy and identifies risks related to over-reliance, with the aim of guiding junior high school students in the appropriate use of GenAI tools for autonomous learning.

2. Theoretical foundations and conceptual definitions

2.1. Self-regulated learning

Self-Regulated Learning (SRL) refers to a dynamic process in which learners systematically and actively activate and maintain their cognitive, motivational, and behavioral aspects to achieve academic goals. American educational psychologist Barry J. Zimmerman proposed the classic three-phase cyclical model of SRL, dividing the process into three continuous phases: forethought, performance, and self-reflection [3]. The forethought phase involves task analysis and goal setting; the performance phase primarily encompasses self-control and self-observation, where learners execute learning strategies while continuously monitoring their learning process and performance. The self-reflection phase requires learners to evaluate and attribute outcomes, using these insights as input for the next learning cycle. The junior high school stage is a transition period in which students move away from external mandatory supervision toward autonomous learning; the multi-turn interaction and real-time feedback mechanisms of GenAI may support each phase of this cycle [4].

2.2. Scaffolding and characteristics of AI scaffolds

The concept of scaffolding originated from Vygotsky's theory of the Zone of Proximal Development (ZPD) and was further developed into educational scaffolding. Scaffolding is temporary support from teachers or experts that helps learners complete tasks beyond their current ability. Effective learning scaffolds reduce task difficulty or provide support tailored to the learner's current capability level. A key feature is fading: support is gradually removed as learners become more competent and can work independently [5]. In the context of GenAI applied to education, an AI scaffold means that GenAI provides cognitive or metacognitive support according to the task and the learner's responses, and this support decreases as the learner improves.

DOI: 10.54254/2753-7048/2027.NL38888

2.3. Academic self-efficacy

Self-efficacy, proposed by Albert Bandura, refers to an individual's subjective belief in their capability to organize and execute the actions required to attain specific goals [6]. Academic self-efficacy extends this theory to the educational domain, directly shaping students' task choices, effort, and perseverance when facing challenging academic demands. Bandura highlighted that an individual's direct "mastery experiences" serve as the most reliable source for building self-efficacy [6].

3. The "scaffolding" role of GenAI in self-regulated learning

Based on Zimmerman's cyclical phase model of self-regulated learning, this section analyzes the learning scaffolding roles that GenAI may play across the three phases: forethought, performance, and self-reflection.

3.1. Forethought phase: goal setting and planning scaffolds

In the forethought phase of self-regulation, the core tasks are task analysis and goal setting. When faced with complex academic tasks, junior high school students often feel intimidated because of limited cognitive capacity and difficulty in breaking tasks down effectively. Scholar Taber noted that effective learning scaffolds should provide a supportive outline that helps learners clarify logical structures amidst complex information [5].

In this phase, GenAI can act as a personalized planning scaffold, decomposing overarching learning goals into manageable, step-by-step subtasks. Chen et al. found that AI can help students create learning plans and time management strategies according to their stated goals [8]. Studies indicate that when AI dialogue breaks a task into smaller parts, students face lower initial cognitive load and are less likely to feel aimless at the beginning.

3.2. Performance phase: strategy execution and monitoring scaffolds

Moving into the performance phase, students need to execute learning strategies and maintain continuous self-observation. Pallant et al. note that in specific learning contexts, GenAI can serve as a "More Knowledgeable Other" (MKO), providing dynamic guidance within the student's Zone of Proximal Development (ZPD) to help them complete higher-order cognitive tasks they cannot achieve independently [9]. In this stage, GenAI not only facilitates knowledge retrieval but also scaffolds cognitive monitoring through ongoing diagnosis and adaptive feedback. By constructing a closed-loop cognitive system of "prompting-feedback-revision," GenAI can track the real-time development of learners' thinking [7]. When students hit an impasse during problem-solving, GenAI acts as a "virtual learning partner," providing step-by-step prompts that encourage iterative refinement.

3.3. Self-reflection phase: objective evaluation and metacognitive scaffolds

The core of the self-reflection phase is conducting self-evaluation and making reasonable attributions regarding learning outcomes. In this phase, AI feedback may reduce students' concern about being judged and help them analyze the causes of errors. When students submit learning outputs to GenAI, it not only rapidly identifies knowledge gaps but also guides students to critically verify the output [10]. Through detailed analysis of error causes, GenAI helps students attribute

DOI: 10.54254/2753-7048/2027.NL38888

failures reasonably to "inappropriate strategies" rather than "insufficient ability," thereby effectively refining the forethought goals for the next learning cycle.

4. Enhancement of academic self-efficacy through GenAI assistance

Academic self-efficacy refers to a student's subjective judgment of their ability to complete academic tasks successfully and achieve academic goals. According to Bandura's social cognitive theory, efficacy beliefs primarily stem from direct mastery experiences, vicarious experiences, verbal persuasion, and physiological and emotional states [11]. In digital learning environments, Generative AI, acting as a learning scaffold, enhances junior high school students' academic self-efficacy through two main routes: accumulating direct mastery experiences and optimizing emotional arousal.

4.1. Mastery experiences and the reinforcement of academic self-efficacy

Bandura emphasized that direct success experiences individuals personally undergo are the most powerful and reliable source for building self-efficacy [6]. In traditional autonomous learning, junior high school students facing complex tasks beyond their current cognitive level often lose confidence due to frequent setbacks. Whether students gain authentic task-completion experiences during learning is a crucial factor influencing their academic self-efficacy. GenAI can provide learning scaffolds through task decomposition, personalized guidance, and immediate feedback. Rather than directly replacing students in completing tasks, these supports transform high-difficulty tasks into stepped subtasks within students' "Zone of Proximal Development."

Several studies support this view. A longitudinal intervention study by Galindo-Domínguez et al. demonstrated that AI-based instructional interventions significantly satisfy and improve students' psychological need for "competence," and thus increase their intrinsic learning motivation [11]. With GenAI support, students solve problems step by step and gain repeated experience of success. Zhang et al. found that structured guidance and immediate feedback from GenAI increase students' sense of control, which strengthens their self-efficacy in complex tasks [12].

4.2. Emotional states and judgments of academic self-efficacy

Physiological and emotional states are another vital source of information that influence academic self-efficacy. Junior high school students are in a developmental stage characterized by high self-consciousness; in traditional teacher-student or peer interactions, they often hesitate to ask basic questions for fear of being evaluated or criticized, experiencing high levels of "social evaluation anxiety." Compared with human mentors, GenAI provides immediate, repeatable interactive feedback, allowing students to receive explanations, prompts, and suggestions through multi-turn questioning. To a certain extent, this interaction mode reduces psychological stress caused by fears of exposing knowledge gaps or receiving negative evaluations. Studies indicate that the experiences and emotional states accumulated during learning are directly related to the formation of efficacy beliefs [2]. The pressure-free interaction environment provided by GenAI significantly reduces negative emotional arousal caused by fear of difficulty, allowing students to engage in cognitive processing in a positive, stable psychological state. Research also suggests that immersion in GenAI-assisted learning reduces negative emotional interference and supports academic buoyancy and self-efficacy.

DOI: 10.54254/2753-7048/2027.NL38888

5. Potential risks and coping strategies of GenAI scaffolds

When external support exceeds the reasonable threshold for students' autonomous cognitive activities, GenAI may shift from a scaffold that promotes learning to a tool that replaces learning activities, creating new learning risks. Therefore, this paper further analyzes the potential risks of GenAI-assisted learning at both the cognitive and academic behavior levels and proposes corresponding normative and intervention strategies.

5.1. Cognitive offloading and academic misconduct

First, over-reliance on GenAI can easily induce cognitive offloading. Studies indicate that when learners systematically transfer core cognitive tasks such as problem-solving to external GenAI tools, their depth of active processing decreases, leading not only to metacognitive laziness but also to weakened critical thinking and academic self-efficacy [2]. Because of their relatively weaker self-control, junior high school students, without appropriate guidance, are highly susceptible to shifting GenAI from a "cognitive support" scaffold into a "thinking substitute" tool.

Second, students risk becoming trapped in "information cocoons" and violating academic integrity. Zhou et al. point out that GenAI's algorithmic recommendations and anthropomorphic interactions may trap students in homogenized information, reducing tolerance for diverse perspectives and independent judgment [13]. In generative academic help-seeking, students may ask GenAI to generate assignment answers, essays, or complete solutions to problems and then use the output without comprehension or verification. This practice can foster instrumental help-seeking aimed only at obtaining task results. If students also lack verification awareness, they may treat GenAI outputs as correct answers. This can undermine their ability to discriminate information and exercise critical judgment.

5.2. Cultivation of critical literacy and dynamic scaffold fading

To mitigate these risks, educational practice urgently requires systematic prevention and guidance mechanisms. On the one hand, educators must emphasize cultivating students' critical GenAI literacy (GenAI literacy). Instructional design should incorporate procedures for multi-channel source tracing, cross-verification, and critical reflection on GenAI-generated content. On the other hand, educators must implement normative guidance and "scaffold fading" in human-GenAI collaboration. As Taber's scaffolding theory emphasizes, a key characteristic of learning scaffolds is their "fading" nature [5]. Educators should establish clear ethical boundaries and process evaluation standards for Generative AI usage, gradually reducing the proportion of direct GenAI intervention as students' autonomous learning capabilities improve. By progressively tapering external support, students are encouraged to maintain independent thinking and cognitive engagement, ensuring that GenAI truly fulfills its empowering and efficiency-enhancing function as a "scaffold."

6. Conclusion

Based on self-regulated learning and scaffolding theories, this study systematically demonstrates GenAI's cognitive "scaffold" functions across the three phases of forethought, performance, and self-reflection, showing its capacity to bridge the gap left by insufficient personalized support in traditional autonomous learning. Meanwhile, GenAI significantly enhances junior high school students' academic self-efficacy and intrinsic learning motivation by helping them accumulate direct

DOI: 10.54254/2753-7048/2027.NL38888

mastery experiences and creating a low-anxiety trial-and-error environment. However, technological empowerment and alienation risks inherently coexist. Faced with the potential hazards of "cognitive offloading" and academic misconduct, the effectiveness of GenAI scaffolds must be grounded in "fading" and "critical usage." Future educational practice should not evade technological intervention, but rather actively guide students away from the trap of technology dependency by deepening human-GenAI collaborative teaching models and cultivating students' digital literacy.

This paper's conclusions are mainly based on existing theories and related literature and lack direct empirical testing tailored to junior high school students. Therefore, whether GenAI scaffolds can actually influence junior high school students' academic self-efficacy through pathways such as mastery experiences and learning emotions, as well as the specific intervention effects of different types of GenAI support, still requires further verification through experimental or longitudinal studies.

References

[1] Shen, Q., Chen, X., Huang, Y., & Zhang, L. (2026). A study on the effectiveness of generative artificial intelligence in promoting foreign language learners' self-regulated learning ability. *Digital Education*, (2), 73–81.

[2] Gao, M., Zhao, C., Yu, M., et al. (2026). AI dependency and learning engagement among college students: The chain mediating role of academic self-efficacy and growth mindset. *Chinese Journal of Clinical Psychology, 34*(3), 686–690.

[3] Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory Into Practice, 41*(2), 64–70.

[4] Liu, J., & Qi, Y. (2026). A meta-analysis of the impact of generative artificial intelligence on students' self-regulated learning ability. *Education Prospects*, (2), 115–125.

[5] Taber, K. S. (2018). Scaffolding learning: Principles for effective teaching and the design of classroom resources. In M. Abend (Ed.), *Effective teaching and learning* (pp. 1–43). Nova Science Publishers.

[6] Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191–215.

[7] Tang, Y., & Deng, Y. (2026). The mechanism, technical risks, and practical directions of generative AI in empowering autonomous learning of vocational students: From the perspective of learning sciences theory. *Chinese Vocational and Technical Education*, (7), 35–42.

[8] Chen, S., Zhao, H., & Zhao, J. (2025). Primary school students' self-regulated learning supported by generative artificial intelligence: Core essence, risks, and practical recommendations. *Education and Teaching Research*, (23), 149–151, 164.

[9] Pallant, J. L., Blijlevens, J., Campbell, A., & Jopp, R. (2026). Mastering knowledge: The impact of generative AI on student learning outcomes. *Studies in Higher Education, 51*(4), 714–735.

[10] Bai, S., Yeung, S. S., & Lo, C. K. (2026). Enhancing the effect of AI-assisted learning: The use of scaffolding strategies to develop students' prompt engineering skills. *Interactive Learning Environments*, 1–20.

[11] Galindo-Domínguez, H., Delgado, N., Urruzola, M.-V., Etxabe, J.-M., & Campo, L. (2025). Using artificial intelligence to promote adolescents' learning motivation: A longitudinal intervention from the self-determination theory. *Journal of Computer Assisted Learning, 41*, e70020.

[12] Zhang, R., & Liu, Y. (2025). Research on the mechanism of flow experience, self-efficacy, and academic buoyancy in college English writing assisted by ChatGPT. *Journal of Xi'an International Studies University, 33*(3), 61–67.

[13] Zhou, Q., Cheng, Z., & Fan, Y. (2026). Opportunities, risks, and resolutions of generative artificial intelligence empowering autonomous learning. *Journal of Zhengzhou University (Philosophy and Social Sciences Edition), 59*(2), 172–176.