

Final Research Paper: How Artificial Intelligence Affects Student Cognition

Dat Tang

San Jose State University

CS 100W

Professor Deborah Choe

December 3, 2025

How Artificial Intelligence Affects Student Cognition

Nowadays, artificial intelligence, such as ChatGPT, Gemini, or Claude, is increasingly being used in schools for academic support. These tools offer students a better learning experience, such as quick feedback and personalized learning, but it raises a concern about how they might affect students' cognitive development. Chi and Wylie (2014) explained that when students rely heavily on automated systems, they may no longer engage in deep thinking and then may become less active thinkers (p. 243). This issue is extremely important in the educational field because cognition is important for developing students' reasoning skills, memory, and problem-solving abilities. If students become dependent on artificial intelligence to complete academic tasks, they may struggle to think independently and apply knowledge on their own. Therefore, the purpose of this paper is to examine how artificial intelligence affects student cognition and argue that AI should be used as a learning tool rather than a thinking replacement.

Review of the Literature

Artificial intelligence is important in education, offering both advantages and risks. One major benefit of AI is its ability to personalize learning. Luckin (2021) explained that AI can adjust content difficulty based on individual performance, allowing students to learn at their own pace. This use of AI helps struggling students reduce stress and also helps high-performing students by providing advanced challenges. Therefore, personalized learning increases students' learning experiences effectively.

In addition, AI also supports students through instant feedback. The University of Illinois College of Education (2024) stated, "AI offers students instantaneous feedback on their work" (para. 3). This means that students do not need to wait for their teacher to correct mistakes.

Instead, the quick response from AI helps students correct mistakes and improve understanding immediately after submitting a question. Compared to traditional classrooms, where providing instant feedback to every student at the same time can be difficult, AI tools ensure that students receive continuous and timely feedback.

However, relying heavily on AI will cause negative impacts. One major cognitive risk associated with AI use is overreliance. As shown in Figure 1, 82 percent of college students already rely on AI tools for academic work, which increases concern about long-term cognitive dependence. Moreover, Loga (2025) suggested that heavy dependence on digital tools can weaken cognitive depth (para. 6). As a result, students may struggle when solving problems or completing tasks if they just search for the answer from AI and then use it as their own work. Therefore, this dependence may lead to shallow learning and reduced memory construction.

Furthermore, Risko and Gilbert (2016) introduced the concept of “cognitive offloading”. This means that the mental effort of people is reduced when they rely on external tools, such as AI. This concept is significant because it shows that AI is not just a tool, but a cognitive substitute. Over time, this may reduce the critical thinking skills of some people who use it improperly. In the context of education, this illustrates that misusing AI in schools can reduce students’ ability to retain information independently.

Similarly, Sparrow et al. (2011) found that when people know information can be easily accessed online, they are less likely to remember it. With this information, AI may literally discourage students from remembering knowledge in long-term memory. Because students can easily get the answer from AI in just one click, they may assume that answer will always be available. As a result, they don’t try hard to deeply think anymore.

Despite these concerns, researchers demonstrate that AI can improve cognition if students use it strategically. For example, Fortino (2025) stated, “AI-driven educational platforms can tailor learning experiences to individual needs and preferences, catering to each student's pace and style of learning, and leading to more effective learning outcomes and a more inclusive education system” (para. 4). This means that AI can support learning by adjusting content and feedback to meet individual student needs. Moreover, Figure 2 illustrates that AI can have positive effects on students when it is used effectively. This information helps people understand that AI tools can enhance students' cognitive rather than cause harm when these tools encourage students to think independently.

Overall, the research suggests that AI itself is not the real problem. The only issue is how students actually use it in their daily schoolwork. When AI is used carefully as a learning tool, it can be helpful, but when it is used as a shortcut, it can interfere with real learning. This leads directly to the need for real-world investigation, which is addressed in the following methodology section.

Methodology

This research proposes a mixed-methods design to examine how AI affects student cognition. The first method would involve a student survey measuring how often AI tools are used and how students feel about their learning effectiveness. Approximately 50 high school and college students from different academic backgrounds would be invited to participate.

Secondly, qualitative interviews would further explore student experiences. These interviews would take place in a virtual format such as Zoom or Microsoft Teams to allow flexible participation. Interview questions could include:

- 1) How do you use AI in your daily academic work?

- 2) Do you believe AI helps or harms your ability to think independently?
- 3) In what ways has AI changed the way you study, complete assignments, or solve problems?

The third method would involve a document review of educational policies related to AI integration. This would help identify how schools regulate AI use and promote ethical learning practices.

The primary limitation of this study would be sample size and response bias, as students may provide socially desirable answers. Time constraints may also prevent long-term observations. Despite these challenges, this method would provide insight into real-world AI usage and its cognitive impact. Based on the findings expected from this research design, the following section introduces practical strategies for applying AI responsibly in education.

Implementation

As demonstrated in Figure 3, AI can either improve cognition or weaken critical thinking depending on how students use the technology. To ensure AI supports cognition rather than replacing it, schools should design structured AI usage policies. Firstly, educators must set guidelines encouraging AI to be used for learning support, not content generation. For example, students may use AI for brainstorming or feedback but not for completing assignments.

Secondly, implementation should focus on guided problem-solving. AI platforms could be programmed to offer hints instead of answers. This promotes independent reasoning and encourages students to think analytically.

Thirdly, teacher training is necessary. Teachers should learn how to integrate AI ethically and how to recognize misuse. After the training, teachers should implement AI strategies in their classroom to make sure that students consider AI as a learning support tool.

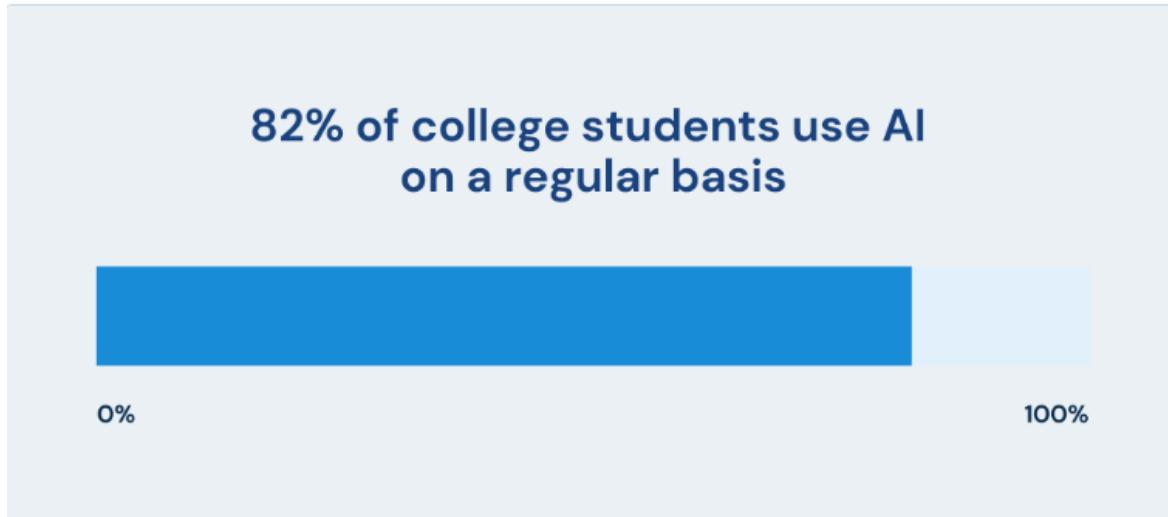
Examples of effective classroom implementation include:

- 1) Using AI to generate practice questions, while requiring students to solve them without AI assistance.
- 2) Allowing AI for idea generation, but requiring students to revise and evaluate the ideas.
- 3) Incorporating “explain your reasoning” assignments whenever AI is used.
- 4) Requiring students to correct AI mistakes as part of an accuracy-checking exercise.

Lastly, schools should promote digital literacy education. Students must understand AI’s limitations and risks, enabling smarter and more responsible use.

Illustration

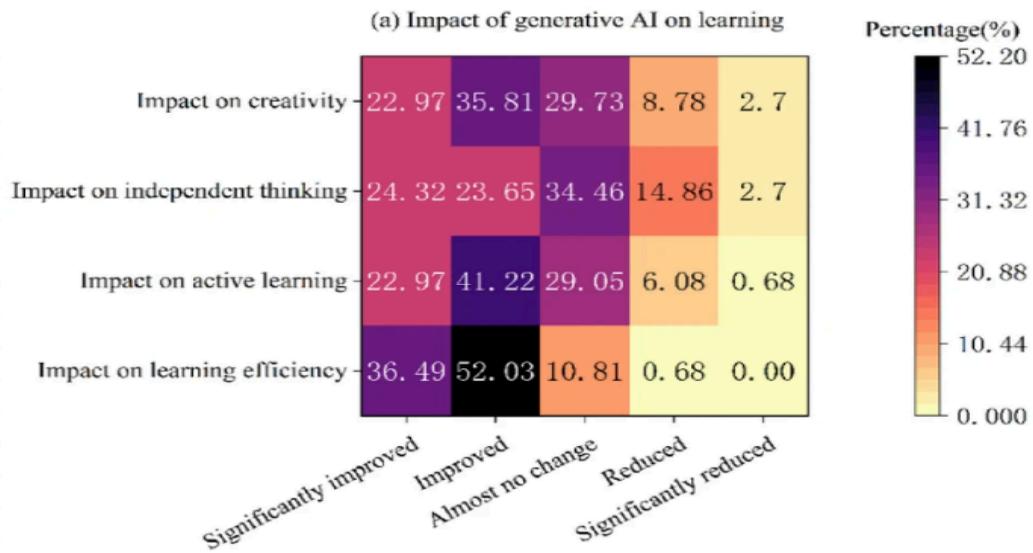
Figure 1. AI use among college students



Note. Adapted from “Quizlet’s State of AI in Education Survey,” by Quizlet, 2024.

Figure 1 shows that 82% of college students use artificial intelligence regularly. This demonstrates that AI is already deeply embedded in learning practices. While frequent use may increase efficiency, it may also reduce independent thinking and memory development.

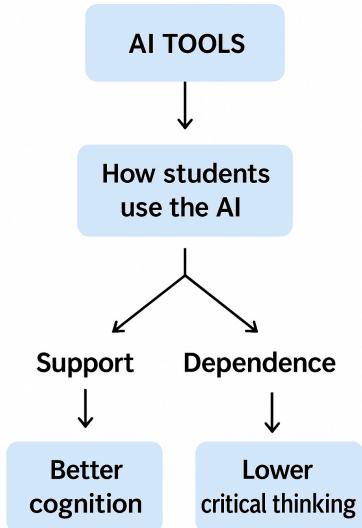
Figure 2. Impact of generative AI on independent thinking among engineering students in China



Note. Adapted from Fan, Deng, and Liu (2025).

Figure 2 shows that students have mixed experiences with AI's impact on independent thinking. Some students think better with AI, while others depend on it too much. This shows that AI should assist learning, not replace students' thinking.

Figure 3. Conceptual model of AI use and student cognition.



Note. Created by Dat Tang.

Figure 3 illustrates a conceptual model showing how artificial intelligence influences student cognition based on usage behavior. When students use AI as a support tool, it can improve their cognition. In contrast, when students heavily rely on AI, critical thinking may decline. This model emphasizes that AI is not harmful; instead, the way students interact with AI determines whether the learning outcomes are positive or negative.

Recommendation

AI should be used in schools as a support tool rather than as a replacement for students' own thinking. To do this, teachers should guide students on how to use AI by emphasizing critical thinking, asking students to explain AI answers in their own words, and designing assignments that require independent work. Moreover, educational institutions should create clear rules about when and how AI can be used. In addition, teachers should also have professional training from their school about how to create an effective learning environment

with AI, and how to recognize the misuse of AI in the classroom. In this way, they can help students learn how to use AI responsibly, and avoid becoming too dependent on it.

The scope of this proposal includes student learning strategies and it does not include creating new AI systems or running experiments. By using AI strategically, schools can protect students' cognitive skills while still gaining the benefits of this powerful technology.

Conclusion

In conclusion, artificial intelligence is important in education, offering tools that support learning in powerful ways. However, without careful control, AI can reduce cognitive skills and promote dependence among students if misused. By analyzing the literature, this research demonstrates that AI's impact depends on usage strategy. When AI promotes active engagement, cognition improves. When AI replaces thinking, it harms learning. Therefore, with strategic implementation, AI can enhance thinking rather than weaken it. Further research should explore long-term cognitive effects and classroom outcomes associated with AI integration.

References

Chi, M. T. H., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. *Educational Psychologist*, 49(4), 219–243.

<https://doi.org/10.1080/00461520.2014.965823>

Luckin, R. (2021). *AI's role in human learning*. UNESCO. <https://unesdoc.unesco.org>

Sparrow, B., Liu, J., & Wegner, D. M. (2011). Google effects on memory: Cognitive consequences of having information at our fingertips. *Science*, 333(6043), 776–778.

<https://doi.org/10.1126/science.1207745>

University of Illinois College of Education. (2024, October 24). *AI in schools: Pros and cons*.

<https://education.illinois.edu/about/news-events/news/article/2024/10/24/ai-in-schools--pros-and-cons>

Quizlet. (2024). *Quizlet's state of AI in education survey reveals higher education is leading AI adoption*. PR Newswire.

<https://www.prnewswire.com/news-releases/quizlets-state-of-ai-in-education-survey-reveals-higher-education-is-leading-ai-adoption-302195348.html>

Fortino, A. (2025). *Thinking with AI: Pros and cons, language, logic, and loops*. NYU SPS.

<https://www.sps.nyu.edu/homepage/metaverse/metaverse-blog/Thinking-with-AI-Pros-and-Cons-Language-Logic-and-Loops.html>

Loga, R. (2025). *AI's cognitive implications: The decline of our thinking skills*.

<https://www.ie.edu/center-for-health-and-well-being/blog/ais-cognitive-implications-the-decline-of-our-thinking-skills/>

Fan, L., Deng, K., & Liu, F. (2025). Educational impacts of generative artificial intelligence on learning and performance of engineering students in China. *Scientific Reports*, 15, 26521.

<https://doi.org/10.1038/s41598-025-06930-w>

Risko, E. F., & Gilbert, S. J. (2016). Cognitive offloading. *Trends in Cognitive Sciences*, 20(9), 676–688. <https://doi.org/10.1016/j.tics.2016.07.002>

