Learning Institute
PRACTICE BRIEFS
Translating Research into Practice

Human–Generative AI Interaction for Active Learning in STEM Education

1. WHY IT MATTERS

- STEM education has traditionally been characterized by content- and instructor-centered teaching, but it has increasingly shifted toward active learning approaches (problem-based, project-based, inquiry-based, and collaborative) that build higher-order thinking skills.
- Generative AI (GenAI) is becoming an integral part of STEM education because it offers new opportunities to enhance active learning rather than simply automate tasks.
- GenAI tools are now widely used by STEM students, but most applications remain individual rather than collaborative, even though active learning often emphasizes collaborative knowledge building.
- Understanding how GenAI is being used in active learning can help instructors integrate it more intentionally and effectively.

2. PURPOSE & CONTEXT

The study aimed to:

- Examine the distinct ways GenAI is used to support human interaction in active learning.
- Identify and map how these interactions support higher-order thinking skills.

This review synthesized current studies examining GenAI use in active learning across STEM education, from high school through graduate education.

3. KEY FINDINGS

- From the studies reviewed, five categories of human-GenAI interaction emerged: Tutoring, Co-creating, Processing, Coaching, and Simulating.
- GenAI was most frequently used to support problem-solving, critical thinking, computational thinking, creative thinking, and metacognition.

- Benefits of GenAI use included on-demand support, immediate and personalized feedback, and increased cognitive capacity for higher-order tasks when GenAI handled more routine work (e.g., writing code, retrieving information).
- Overreliance and the need for students to develop prompt and AI literacy skills were major concerns; students and researchers alike worried that relying on GenAI for answers could undermine critical thinking, creative thinking, and problem-solving skills.
- GenAI applications were predominantly individual in scope (N = 26 studies) rather than collaborative (N = 16), leaving the potential for GenAI-supported collaborative knowledge building largely underexplored.

4. RECOMMENDATION FOR PRACTICE

- Use GenAI to scaffold higher-order thinking by providing prompting guides, guiding questions, or structured rubrics, rather than assuming students will use GenAI productively on their own.
- Design learning activities that incorporate reflection, such as journals or peer critique of AI-generated content, to mitigate overreliance and keep students actively evaluating GenAI output rather than accepting it uncritically.
- Explore collaborative uses of GenAI, such as group problem-solving and peer review of AI output, since most current practice is individual and this area remains largely unexplored.
- Match task complexity to learning goals; use simple problems to build student confidence with GenAI before introducing complex, open-ended tasks that demand deeper higher-order thinking.
- Encourage productive struggle by adopting guidance-based tools (e.g., hints and prompts that help students formulate their own answers) rather than tools that simply generate answers.

5. REFERENCES

- Otto, S., Lavi, R., & Bertel, L.B. (2025). Human-GenAI interaction for active learning in STEM education: State-of-the-art and future directions. *Computers & Education, 239*:105444. https://doiorg.libproxy.library.unt.edu/10.1016/j.compedu.2025.105444