

Generative AI as a Guided Learning Tool in Statics: Impacts on Student Performance and Problem-Solving Confidence

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AI-supported practice assignments **helped** students **identify mistakes** in their problem-solving process, leading to **improved performance** on targeted exam questions and **increased confidence** using AI as a learning tool.

Course Background

Statics is a foundational course in civil engineering that requires students to develop strong problem-solving and reasoning skills. Students often struggle with setting up problems correctly, even when they understand underlying concepts.

At the same time, generative AI tools are increasingly available to students but are often used to obtain answers rather than to support learning. This can limit opportunities for students to practice problem setup and solution strategies.

What We Changed

We introduced AI-supported pre-exam assignments aligned with selected exam problems. Students were required to:

- Use generative AI to **analyze problem setup and solution steps**
- Avoid using AI to generate final numerical answers
- Reflect on AI responses through structured reflection logs.

These assignments were designed to promote **metacognition and error identification** prior to exams.

Importantly, the following aspects of the course remained unchanged:

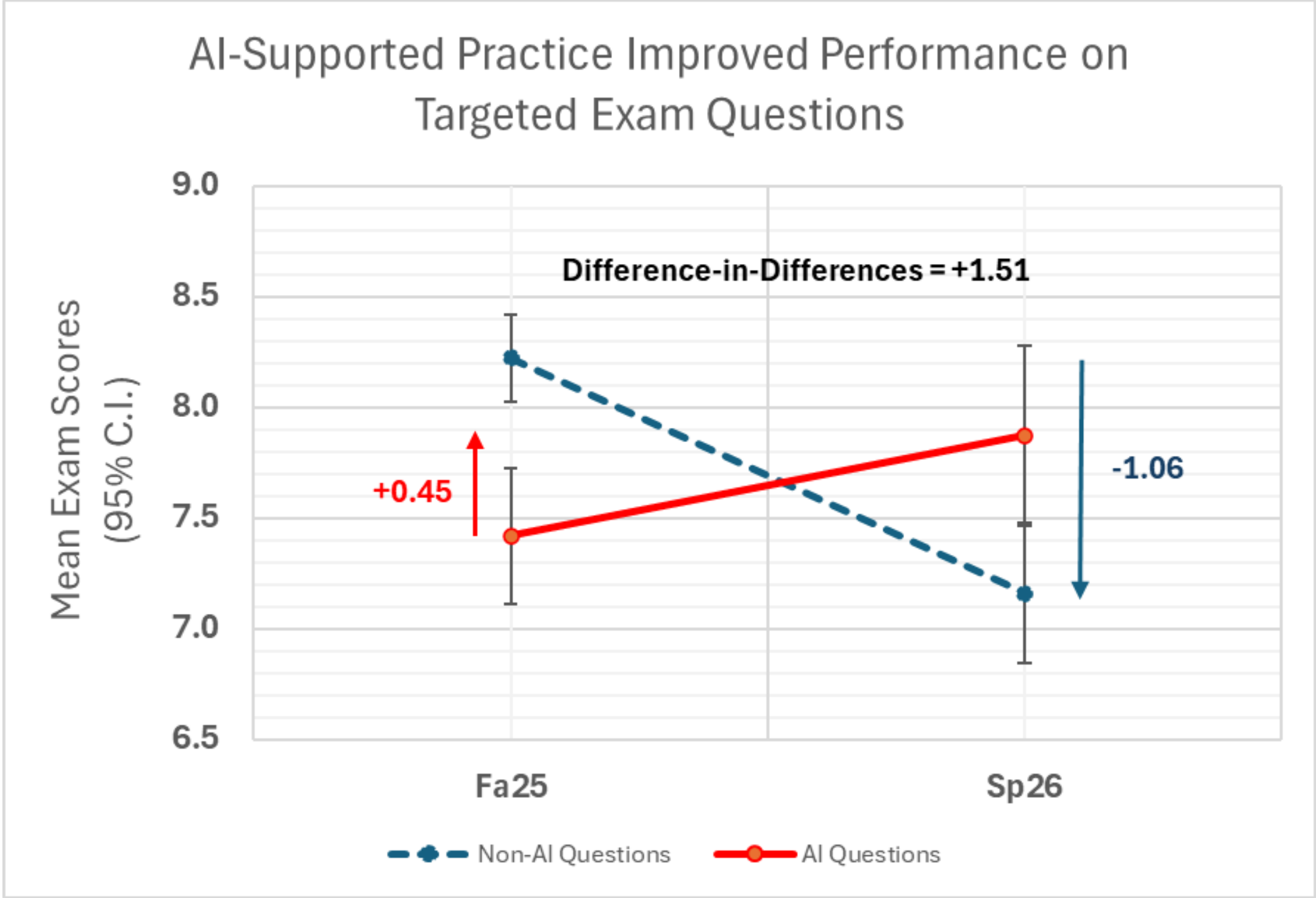
- Homework assignments
- Lecture content and delivery
- Course topics and sequence
- Overall structure and assessments

This allowed us to isolate the impact of AI-supported practice on student learning.

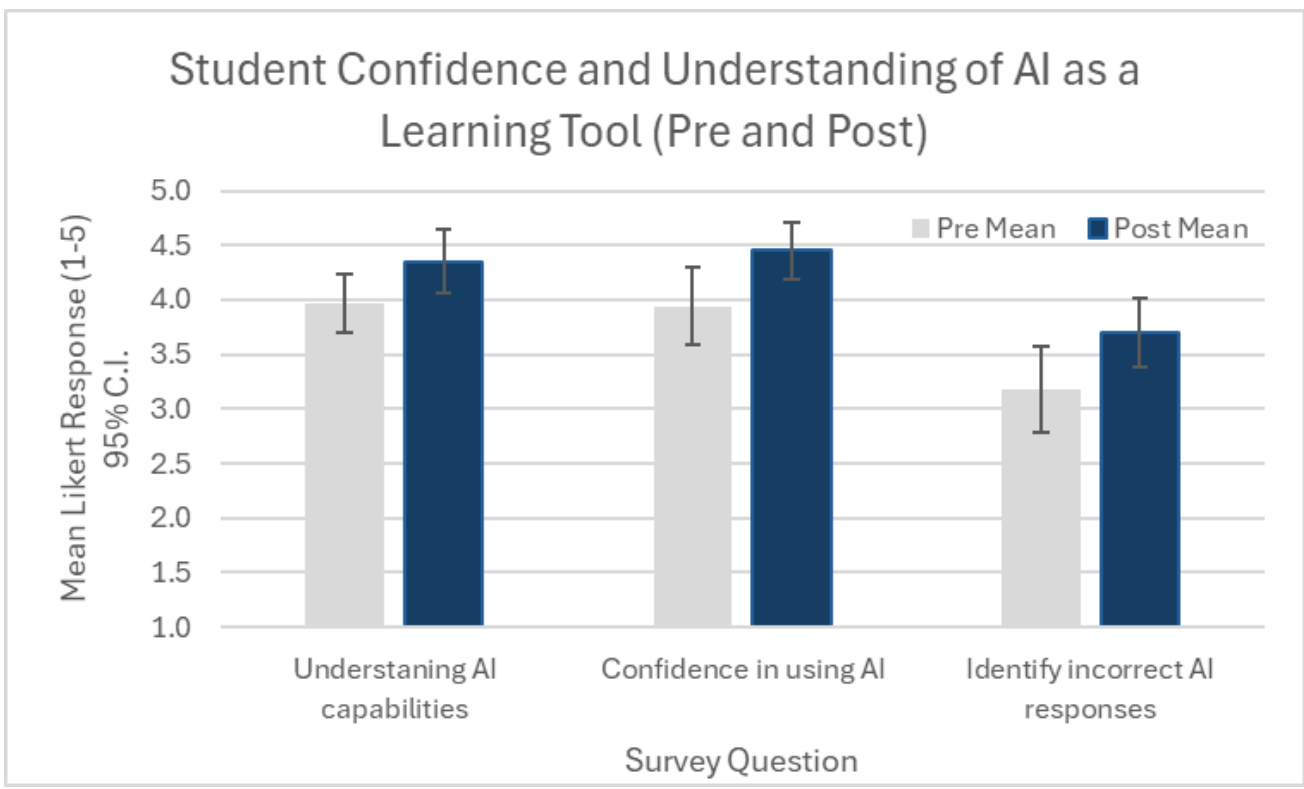
Results Summary

AI-supported assignments improved performance on targeted exam questions, with a difference-in-differences effect of +1.51 points. Students also reported increased confidence using AI and improved ability to evaluate AI responses, suggesting that AI functioned effectively as a guided learning tool.

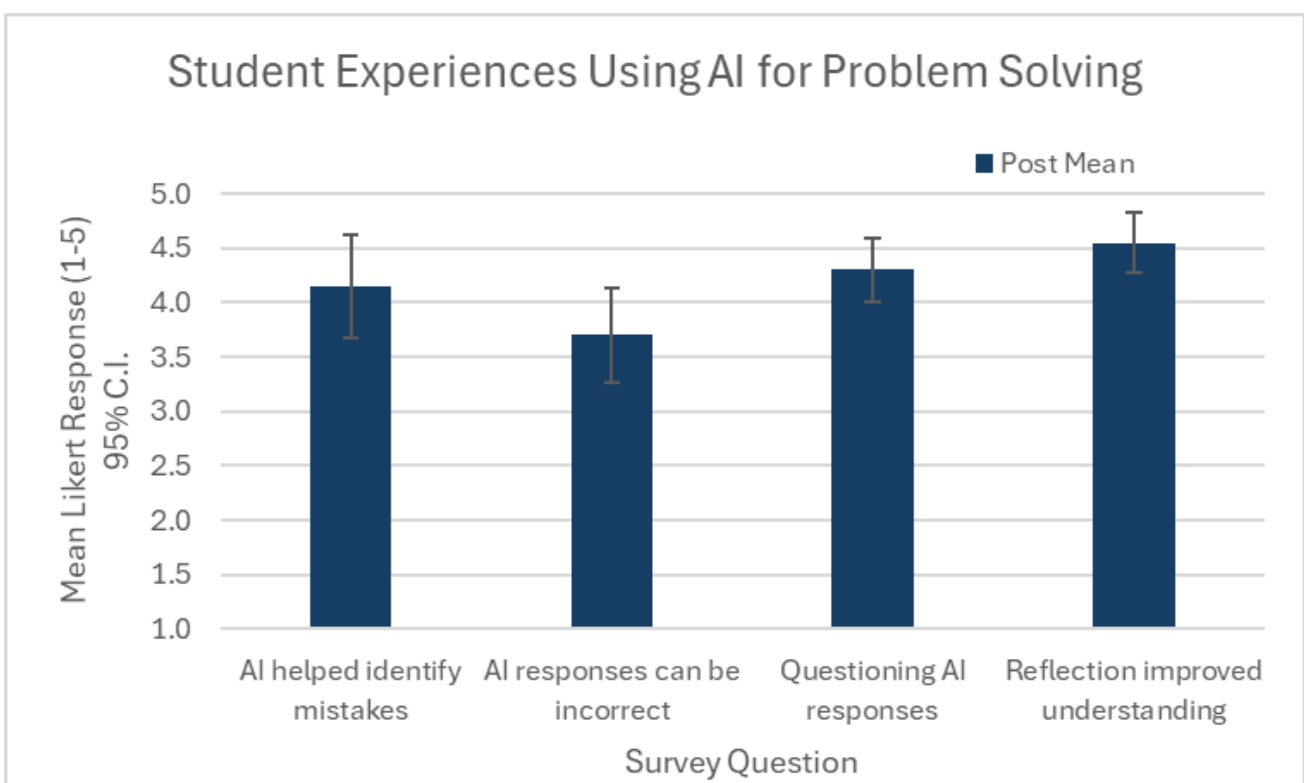
Student Performance



Performance on AI-aligned exam questions improved, while declining on other questions, resulting in a +1.51 point (out of 10) difference-in-differences effect.



Mean Likert responses before and after AI-supported assignments. Error bars represent 95% confidence intervals; all increases are significant (paired t-tests, $p < 0.01$).



Mean responses for post-survey items. Students reported using AI to identify errors, question responses, and reflect on problem setup, reinforcing its role as a learning and feedback tool.

“The most helpful part of using AI was learning how to make my FBDs and problem setup more clear... I can confidently say after doing these assignments, I know the importance of structuring my problems in a cohesive way.”