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# Case Study: Using a Generative AI Assignment to Promote Verification and Conceptual Understanding in a Statics Course

**Dr. Alyssa DeSimone, George Washington University**

Alyssa DeSimone currently serves as an Assistant Professor of Civil Engineering at George Washington University. She received her Ph.D. in Structural Engineering from the University of Michigan in 2021.

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## Introduction

Generative artificial intelligence (AI), particularly large language models (LLMs) capable of producing fluent text, code, and explanations, has rapidly become embedded in students' academic work. Recent large-scale surveys indicate widespread adoption, with 92% of UK undergraduates reporting AI use and 88% using generative AI for assessments [1], alongside similarly high usage reported internationally [2]. These data underscore that generative AI use cannot be addressed solely through academic integrity policies, as students will bring these tools into engineering learning environments, often without clear guidance on appropriate use. This shift is consequential in engineering, where conceptual understanding and professional judgment are important. Unlike traditional computational tools (e.g., finite element software) whose limitations and failure modes are more apparent, LLMs can produce solutions that appear reasonable while being incorrect. OpenAI's own technical discussion of hallucinations emphasizes that models can produce "plausible but false" outputs even when they sound confident [3]. These limitations are especially concerning when students rely on LLMs to reason through engineering problems in the early stages of learning a new topic without understanding its limitations.

A growing body of scholarship argues that higher education must pivot from banning AI use toward AI literacy, which teaches students how to evaluate AI tools, recognize limitations, and apply them responsibly. A recent study suggests that effective interventions tend to be those that connect ethical reasoning directly to practice and assessment [4]. Within engineering education research, early work on generative AI integration has explored student perceptions, learning experiences, and course-level implementations. A recent study in a mechanics course reports that students often perceive ChatGPT-enabled support as helpful for learning, but outcomes and experiences depend strongly on how the tool is scaffolded and what expectations are set [5]. Another recent contribution in a mechanics context explored learning activities where students engage with ChatGPT to improve their understanding of engineering concepts, suggesting that learning benefits are more likely when students are required to evaluate and correct AI-generated work rather than accept it [6].

Building on this literature, the present work examines a structured mechanics assignment designed to cultivate AI literacy through verification-centered practice. The assignment intentionally exposes AI limitations by requiring students to evaluate and correct AI-generated shear and moment diagrams using fundamental equilibrium reasoning. By positioning students as evaluators rather than consumers of AI output, the study analyzes pre- and post-survey measures and reflective writing to examine how failure-driven, scaffolded AI use can support conceptual understanding and ethical practice in engineering education.

## Institutional Context

The assignment was implemented in a Statics course, a foundational engineering class that introduces force and moment equilibrium, simple structures, and internal forces, including shear and moment diagrams for statically determinate structures. Students are typically in the first

semester of their sophomore year and are pursuing majors such as civil, mechanical, aerospace, or biomedical engineering, and may have limited prior experience with computational modeling and result verification. Notably, most of the mechanical engineering students enrolled in this course (approximately 50% of the class) were concurrently enrolled in an engineering computations course that integrates generative AI for code development. The study was conducted at George Washington University, a mid-sized private research institution in Washington, DC, which has prioritized responsible AI integration through its Trustworthy AI initiative. Trustworthy AI is an initiative focused on ethical, reliable, and socially beneficial AI development.

**Assignment Description**

The instructional intervention examined in this study was an assignment implemented in a statics course that required students to use ChatGPT to generate shear force and bending moment diagrams for four statically determinate beams. Rather than treating AI as an answer-generation tool, the assignment was designed to expose the limitations of generative AI and position students as critical evaluators of its output. Students were instructed to continuously evaluate and verify the AI's reasoning against fundamental principles of equilibrium and internal forces, with the expectation that the model would produce incorrect or incomplete solutions. Students were required to iteratively refine their prompts and explanations to guide the AI toward correct results and to use ChatGPT-generated code to produce the diagrams in Matlab or Python. Final submissions included AI interaction logs, professionally formatted plots, and a reflective essay analyzing the strengths, limitations, and ethical implications of AI use in engineering practice.

ChatGPT was selected for this assignment due to its ability to share complete conversation histories with the instructor, which was a required component for verifying that students engaged with the model as intended. Students were expected to identify and correct errors in the model's reasoning and guide it toward correct solutions, rather than simply providing the correct answers. ChatGPT (v5.1), the most current model available at the time, was used by most students. Most model errors observed during the assignment were related to sign convention mistakes in support reaction calculations or moment diagram construction, as well as issues with image interpretation. When errors were identified, students reviewed the model's reasoning and corrected the underlying analytical steps to arrive at valid solutions. This exercise was implemented once lectures on shear and moment diagrams had concluded and students had completed a homework assignment on internal forces in beams and a homework assignment on shear and moment diagrams, to ensure that they attained the necessary skills to verify and correct the output generated by AI.

The goal of the assignment was to (1) help students recognize the limitations of AI in solving complex engineering problems, (2) reinforce the importance of human expertise and conceptual understanding, (3) promote reflection on the ethical and responsible use of AI in engineering, and (4) reinforce students' conceptual understanding of shear and moment diagrams by engaging with the material in a different way.

**Results and Discussion**

Students were given class time to complete an online survey before and after completing the assignment. The first survey was administered once the assignment was introduced, and the post-activity survey was administered on the due date. Both surveys asked similar questions to compare how students' attitudes toward artificial intelligence and their confidence in their ability to perform steps related to the construction of shear and moment diagrams changed over the course of the assignment. The questions used in the survey are listed in Table 1. Students rated their responses using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The course

had 68 students enrolled. 72 students completed the pre-activity survey (some students must have mistakenly filled out the survey twice), and 60 students completed the post-activity survey. All surveys were completed anonymously to ensure that students could report their perspectives candidly, without concern for instructor expectations. It should be noted that the responses to the first three survey questions are most susceptible to bias and may be impacted by experiences outside the course intervention being studied [7].

The pre-activity survey asked students to report how often they use generative AI tools to support their coursework. 35% of respondents (25 students) reported that they use AI frequently to support their coursework, 47% of respondents (34 students) reported using AI occasionally, 17% (12 students) reported they rarely use AI, and 1.4% (1 respondent) reported never using AI before this assignment.

Survey results related to AI literacy and mechanics confidence are summarized in Table 1. Students' agreement that AI tools can accurately perform technical engineering analyses increased slightly from 2.8/5 to 3.0/5 after completing the assignment, while agreement that AI can replace human reasoning remained low and unchanged (1.8/5). Students completing the assignment may have found that ChatGPT performed somewhat better at drawing shear and moment diagrams than initially expected; however, they still did not rate its overall ability highly. This suggests that the activity confirmed their skepticism while also leading them to recognize that AI may be useful for certain limited tasks. Importantly, the assignment did not lead students to overtrust AI. Agreement that responsible AI use is an important professional skill increased modestly from 4.5/5 to 4.7/5.

Larger gains were observed in student confidence related to shear and moment diagram skills. Confidence in identifying support reactions increased modestly (4.4/5 to 4.7/5), reflecting a high baseline, while confidence in identifying and communicating errors increased substantially (3.6/5 to 4.6/5), as did confidence in explaining reasoning behind diagram construction (3.7/5 to 4.6/5). Although these gains cannot be fully isolated from concurrent instruction and exam preparation, the comparatively larger increases in error identification and explanation align with the assignment's emphasis on critiquing and correcting AI-generated solutions.

In Table 2, pre-activity responses to the AI literacy survey were disaggregated by students' self-reported frequency of AI use in coursework. Generally, students who reported more frequent AI use expressed higher agreement with the statements "AI tools can accurately perform technical analyses in engineering" (3.1/5) and "AI can be used as a replacement for human reasoning in engineering contexts" (2/5) compared to students who reported occasional or rare AI use. In addition, students who frequently used AI demonstrated the highest agreement with the statement "Responsible use of AI is an important professional skill for engineers" (4.8/5). Notably, this suggests that increased exposure to AI does not correspond to diminished ethical awareness; rather, students who engage most frequently with AI tools appear simultaneously more confident in their capabilities and more aware of the need for responsible use. Taken together, these results indicate that students who already rely on AI in their coursework may be particularly receptive to structured instruction that emphasizes verification, professional judgment, and ethical responsibility, reinforcing the value of integrating guided AI literacy experiences within engineering curricula.

**Table 1. Impact of a structured AI assignment on AI literacy and student confidence in engineering analysis**

| Learning Objective | Pre-Activity Average (out of 5) | Pre-Activity Standard Deviation | Post-Activity Average (out of 5) | Post-Activity Standard Deviation | Percent Increase (%) |
|---|---|---|---|---|---|
| (1) AI tools can accurately perform technical analyses in engineering. | 2.8 | 0.82 | 3.0 | 1.00 | 5.7 |
| (2) AI can be used as a replacement for human reasoning in engineering contexts. | 1.8 | 0.86 | 1.8 | 0.85 | - |
| (3) Responsible use of AI is an important professional skill for engineers. | 4.5 | 0.77 | 4.7 | 0.63 | 3.0 |
| (4) I can identify and determine support reactions for beams. | 4.4 | 0.78 | 4.7 | 0.59 | 6.8 |
| (5) I can identify and communicate errors in a shear or moment diagram. | 3.6 | 0.93 | 4.6 | 0.61 | 29.3 |
| (6) I can explain the reasoning behind each step of constructing a shear or moment diagram. | 3.7 | 0.96 | 4.6 | 0.59 | 23.3 |

**Table 2. Pre-activity student responses to AI literacy questions sorted by prior use of AI for coursework**

| | Pre-Activity Responses (out of 5) | | | | | |
|---|---|---|---|---|---|---|
| Use of AI | AI tools can accurately perform technical analyses in engineering. | | AI can be used as a replacement for human reasoning in engineering contexts. | | Responsible use of AI is an important professional skill for engineers. | |
| | Average | Standard Dev. | Average | Standard Dev. | Average | Standard Dev. |
| Frequently (25 respondents) | 3.0 | 0.80 | 2.0 | 0.94 | 4.8 | 0.40 |
| Occasionally (34 respondents) | 2.8 | 0.80 | 1.9 | 0.82 | 4.4 | 0.86 |
| Rarely (12 respondents) | 2.3 | 0.62 | 1.4 | 0.67 | 4.3 | 0.97 |
| Never (1 respondent) | 2 | - | 2 | - | 4 | - |

Finally, students were asked to complete a reflective essay after completing the assignment, where they responded to two questions (1) what do you see as the strengths and weaknesses of AI use in engineering? and (2) how do you define ethical and responsible use of AI in engineering practice? Students completed this part of the assignment outside of class time and were given a one-page limit (average word count of the essays was 354). The essays were not anonymous. Across the responses, students consistently described generative AI as a useful but unreliable tool for mechanics problem solving. Most reported that the tool frequently produced confidently presented but incorrect outputs (especially when interpreting support conditions or sign conventions), which forced them to rely on their own conceptual understanding to diagnose mistakes rather than accept outputs at face value. Many students emphasized that AI is more valuable when redirected into structured workflows, particularly by having it generate or modify code for shear/moment diagrams. In response to the second prompt, students framed "responsible use" as treating AI as a tool requiring human verification, transparency about use, and domain expertise to catch errors, especially given the potential for high-consequence failures in real engineering contexts. Quantitatively, these themes appeared broadly across the essays: limitations/inaccuracy (63/64), ethics/responsibility framing (61/64), verification/oversight (51/64), usefulness for code/tedious work (50/64), and the need for iterative prompting/"teaching" (42/64); AI should not replace human judgment (20/64).

## Summary and Conclusions

This study examined the impact of a structured, verification-centered generative AI assignment implemented in a Statics course, with the goal of supporting students' AI literacy, reinforcing conceptual understanding of shear and moment diagrams, and promoting responsible AI use in engineering contexts. Through pre- and post-surveys and reflective writing, this work provides insight into students' opinions and experiences of AI use in engineering.

The survey results indicate that students entered the assignment with skepticism regarding AI's ability to perform technical engineering analyses and low agreement that AI could replace human reasoning, and these perceptions remained largely unchanged following the activity. Students demonstrated very modest increases in their belief that responsible AI use is an important professional skill, suggesting that the assignment reinforced, rather than radically altered, students' ethical framing of AI use. Notably, students reported substantial gains in confidence related to identifying and communicating errors in shear and moment diagrams and explaining the reasoning behind each step of their construction. These findings suggest that the assignment was effective at strengthening evaluative and diagnostic skills.

Qualitative analysis of student reflective essays reinforced the quantitative findings. Students consistently described generative AI as a useful but unreliable tool for engineering problem solving that requires substantial human oversight and verification. Many students acknowledged AI's efficiency for routine calculations and code generation. Ethical and responsible use was framed not as avoiding AI altogether, but as maintaining accountability, transparency, and professional judgment, especially in contexts where errors could have serious safety consequences.

These results suggest that structured AI assignments that focus on error detection, verification, and reflection may be well-suited for foundational engineering courses. The assignment supported students in developing evaluative judgment and a more nuanced understanding of AI's appropriate role in engineering practice.

This study has several limitations that should be acknowledged. The intervention was implemented within a single Statics course at one institution, which may limit the generalizability of the findings to other courses, disciplines, or institutional contexts. In addition, the data sources were self-reported surveys and reflective essays, which capture student perceptions and confidence rather than direct measures of learning and may be subject to response bias. Also, gains in conceptual understanding of shear and moment diagrams reflected in the results cannot be fully isolated from concurrent instruction and exam preparation.

While this assignment supported students' ability to critically evaluate AI outputs and recognize ethical responsibilities, future iterations could further emphasize strengthening students' AI literacy. This could be done by focusing on a structured comparison of AI outputs and deliberate evaluation of AI reliability. In addition, clarifying appropriate roles for AI within engineering workflows and connecting AI errors to real-world consequences may deepen students' professional judgment. These refinements would help students develop transferable AI literacy skills aligned with engineering practice.

**References**

[1] Higher Education Policy Institute (HEPI) and Kortext, *Student Generative AI Survey 2025*, United Kingdom, 2025.

[2] Digital Education Council, *Global AI Student Survey 2024*, 2024.

[3] A. T. Kalai, O. Nachum, S. S. Vempala, and E. Zhang, "Why language models hallucinate," *OpenAI*, Sept. 2025.

[4] L. J. Wiese, I. Patil, D. S. Schiff, and A. J. Magana, "AI ethics education: A systematic literature review," *Computers and Education: Artificial Intelligence*, vol. 8, Art. no. 100405, 2025, doi: 10.1016/j.caeai.2025.100405

[5] M. Rezvani Rad and J. L. Davis, "Exploring student perceptions of learning experience in fundamental mechanics courses enhanced by ChatGPT," in *Proceedings of the American Society for Engineering Education (ASEE) Annual Conference*, 2024.

[6] H. Buyones-Gonzalez and M. Quezada-Espinoza, "Using ChatGPT to improve learning in applied statics for construction engineering students," in *Proceedings of the American Society for Engineering Education (ASEE) Annual Conference & Exposition*, 2025.

[7] H. Schuman and S. Presser, *Questions and Answers in Attitude Surveys: Experiments on Question Form, Wording, and Context*. Thousand Oaks, CA, USA: Sage Publications, 1996.