# BOARD # 47: A Case Study: Students' Perception of the Use of Generative AI in Learning and the Civil Engineering Profession.

**Dr. Priyantha Wijesinghe, University of Vermont**

Priyantha Wijesinghe is the Director of Curricular Enrichment at the College of Engineering and Mathematical Sciences (CEMS) and a Senior Lecturer in Civil and Environmental Engineering at the University of Vermont (UVM). A structural engineer and architect by education, she is also an expert in engineering education and assessment. As the assessment coordinator for CEMS, she oversees the evaluation of five ABET-accredited engineering programs along with mathematics, statistics, computer science, and physics. Priyantha teaches engineering mechanics and civil and structural engineering courses at UVM, spanning sophomore to graduate levels. She also co-leads the Generative AI Learning Community and spearheads various Generative AI initiatives for CEMS faculty.

**Holly Ann Buckland Parker, University of Vermont**

Holly Buckland Parker is an educational developer at the Center for Teaching and Learning at the University of Vermont (UVM). Holly coordinates the Graduate Teaching Program and conducts workshops on pedagogy and educational technologies. Dr. Buckland Parker continues to work on her research interests regarding the implementation of Universal Design for Learning (UDL) and inclusive teaching practices in Higher Education. Holly is also a part-time faculty member in the Higher Education and Student Affairs Program in the College of Education and Social Services at the University of Vermont. She teaches graduate courses on the implementation of anti-racist teaching practices, inclusive teaching pedagogy, and UDL in the higher education context. Holly is an active member of the Contemplative Practices Learning Community at the UVM Center for Teaching and Learning. She has her own mindfulness practice and strives to incorporate mindfulness practices into classrooms and meetings on the UVM campus.

**Ethan Zachary Stein, University of Vermont**

Ethan is a graduate student at the University of Vermont (UVM) with the department of social work. Originally hired as a work-study student at UVM's Center for Teaching and Learning (CTL) to support faculty engaged in Scholarship for Teaching and Learning (SoTL) research, Ethan is enjoying the many opportunities to facilitate data collection and carry out qualitative and quantitative data analysis. In collaboration with the other authors, Ethan is also analyzing data from a SoTL study looking at the impact of introducing mindfulness practices into undergraduate STEM classes. As a graduate student at UVM, Ethan has worked with faculty across a variety of disciplines to understand how use quantitative and qualitative approaches to tell a story about the data and make explicit commonly held assumptions. In addition to his work with SoTL faculty, Ethan is a research assistant with the College of Education and Social Services (CESS) and currently supporting data collection of cancer experiences within Vermont's LGBTQ community. Expected to graduate from UVM in May 2025, Ethan is planning to apply for a summer fellowship so he can analyze the CESS data. Post-graduation, Ethan hopes to continue to be involved in research that drives social change.

# A Case Study: Students' Perception of the Use of GenAI in Learning and the Civil Engineering Profession.

## I. Introduction

Generative AI (GenAI) is reshaping education, challenging educators to reconsider what they teach, how they teach, and how they engage and assess student learning in the classroom. As students are already using these tools in their academic work at a higher rate than we expect [1], taking a proactive and forward-thinking approach to integrating GenAI into engineering education is becoming increasingly important. Such an approach will not only equip students with the ability to critically evaluate AI-generated outputs but also encourage them to explore its limitations and ethical and professional implications.

In this case study, the authors explore the integration of two GenAI-based writing assignments into a senior-level design course. The goals of this case study are to (i) cultivate a culture of understanding the use and implications of AI among students, (ii) enable them to critically evaluate the GenAI outputs and their limitations, and (iii) assess and discuss the ethical use of GenAI within the civil engineering profession. Twenty-seven students participated in the two writing assignments: one requiring the use of GenAI and the other permitting its optional use. The first assignment (homework) encouraged students to explore the design of steel structures by selecting a structure of their choice and generating a one-page write-up using GenAI. In the second assignment, a take-home quiz, students were asked to read and analyze two articles. The first article discusses the implications of GenAI in civil engineering and architecture professions [2], while the second article explores the integration of human and artificial intelligence in civil engineering [3]. In their analysis, the instructor asked the students to discuss how GenAI could enhance efficiency and safety in the field and the ethical challenges associated with GenAI use. Students were asked to critically assess the AI-generated output, verify facts, and document their interactions with the GenAI tool by providing all prompts. Additionally, students were asked to provide a brief reflective analysis of the AI tools they used, such as ChatGPT, and how these influenced their learning.

## II. The Course and the Assignments

Structural Steel Design is a senior-level elective and one of five design courses that civil engineering students must complete to satisfy their fourth-year degree requirements in the author's institute. This is a project-based course that emphasizes active learning and integrates real-world examples and case studies throughout. The course includes a group design project, six homework assignments, four reading quizzes, three exams, and weekly discussions. In Fall 2024, twenty-seven students enrolled and successfully completed the course. A syllabus statement adhering to the university's recommended language was included to address the use of GenAI tools in the course (refer to Appendix A). This ensured that students were clearly informed of the expectations and guidelines for using GenAI within the course.

**Assignment 1 – Homework:** In this first homework assignment of the course (2.5% towards the final grade), the instructor aimed for students to explore creative design and construction solutions using structural steel. The key objectives were to enable students to analyze a real-

world structure built primarily with structural steel, identify various steel components and sections, and evaluate challenges associated with design and construction. Students were tasked with analyzing and assessing the use of GenAI in their exploration and writing process. Students were required to select a real-world steel structure, such as an industrial, residential, recreational, or infrastructure project, and write a one-page analysis addressing specific topics. These included an introduction to the structure (e.g., location, function, year built, cost, architect, and engineer), its significance (e.g., design features, structural form, and material choices), and an evaluation of why structural steel was used to address specific issues. They were also asked to identify different types of steel sections used in the structure and provide their own critiques of the design. Students were instructed to engage critically with GenAI by reviewing and verifying the AI-generated content against credible sources, identifying inaccuracies, and making necessary corrections or additions. This part of the assignment was a chance for students to fact-check what the GenAI tools used for references against what students knew to be credible sources. Students were asked to highlight their edits in a different color to distinguish their improvements, document all prompts, and compile references used for fact-checking. Additionally, students wrote a half-page reflection on their experience using GenAI, discussing its utility, challenges encountered, and reliability. This reflection was completed without the assistance of GenAI to provide an authentic analysis of their learning process. See Appendix B for the instructions provided to the students.

**Assignment 2 - Take-Home Quiz:** For the second assignment (2.5% towards the final grade), the instructor asked the students to read and analyze two articles: *How Generative AI Will Change the Jobs of Architects and Civil Engineers* [2] and *What Does Human-Machine Intelligence Mean for Civil Engineers?* [3]. Students were asked to discuss how AI can improve efficiency and safety in civil engineering, transform the roles of civil engineers and architects, address challenges and opportunities of AI integration, and explore ethical considerations. They were also asked to identify future research directions and suggest how the industry can prepare for the integration of GenAI. The length of the assignment was limited to 300–500 words. Unlike in the first assignment, students had the option to use ChatGPT or another GenAI tool for this assignment. If they decided to do so, they were required to record their interaction with the tool, following the same instructions provided in the first assignment.

## III. Process

The study received expedited approval from the university's Institutional Review Board (IRB) for human subjects research. The instructor introduced the assignments to the students as part of the required component of the course and shared information about the study and consent forms through the university's learning management system. After final grades were submitted, the second author, a staff member from the university's Center for Teaching and Learning, redacted identifying information from the consented forms and assigned unique identifiers to maintain confidentiality. Qualitative data analysis was performed by manual coding by the third author.

## IV. Results and Discussion

Thirteen out of twenty-seven students submitted their consent forms, allowing the authors to include their work in the qualitative analysis. While the authors reviewed all submissions for a broader context, quotes and excerpts were taken only from students who provided consent. Twenty-six students submitted Assignment 1. Of these, 65% had a steel structure in mind and used GenAI for the write-up, while the remaining students relied on GenAI to select a structure for them. As a result, 19% of the submissions focused on the Sydney Harbor Bridge, which may reflect a bias in the AI's suggestions. Authors also noticed that 42% of students engineered their prompts while the rest copied the assignment to a single prompt. Additionally, 73% of students rewrote and edited the AI output, while the rest did not correct any information.

**Assignment 1- Homework:** Authors identified three key themes under two categories: (i) the tendencies of GenAI in the context of Assignment 1 (as identified by the students) and (ii) students' perspectives of GenAI. The GenAI tendencies included a pro-development and pro-steel industry bias and the presentation of opinions as facts.

### (i) The tendencies of AI in the context of Assignment 1

**Pro-development and pro-steel bias:** Student reflections highlighted a pro-development bias in AI-generated content. Though not part of the assignment, students expressed concern about environmental and labor impacts. In the Burj Khalifa summary, AI described it as a "testament to contemporary engineering prowess" and an "iconic symbol of Dubai's rapid development and ambition," omitting mentions of environmental consequences. The Firth of Forth summary ignored harm to estuaries despite their ecological significance. Similarly, the Golden Gate Bridge summary referred to the structure as a "testament to ingenuity" and an "example of excellence" while failing to address worker conditions or fatalities. Students also noted that AI often relied on sources from steel companies when compiling summaries.

**Present opinion as facts:** Student reflections revealed that AI often presented opinions as facts. For example, AI referred to the Brooklyn Bridge as an "enduring symbol of architectural prowess," which is an opinion rather than a historical fact. In another summary about the Brooklyn Bridge, AI briefly mentioned the "difficult working conditions and health issues" but still described the bridge as a "celebrated landmark" without addressing the social and environmental impacts of its construction. A student added details about the health impacts on workers, explaining that they consulted outside sources to provide information not included in the AI-generated summary. Students also noted that AI's descriptions of projects as "remarkable," "examples of excellence," or "continuing to inspire" reflect biases in the data used by large language models like ChatGPT and are not grounded in historical fact.

### (ii) Students' Perspectives of AI

Students expressed mixed perspectives on the usefulness of AI, both in the context of the assignment and in general. Their viewpoints included that AI is helpful, but its output is often repetitive; fact-checking is essential; AI reinforces public sentiment; AI strips users of individual expression; AI is efficient but lacks precision; and AI is ubiquitous and "not going anywhere."

These perspectives were grouped into three categories: Qualities of GenAI, Potential Uses of GenAI, and Responses to GenAI.

**Qualities of GenAI:** Students identified several qualities of AI based on their reflections. One student noted that AI "lacks emotions" and is "incapable of analytical thinking," while another observed that it reinforces, rather than critiques, "expected public sentiment." Many students reflected that AI-generated summaries are repetitive, often saying the same thing in different words. They also noted that AI defaults to passive voice unless prompted to write actively. One student remarked that AI relies on "unreliable sources" that are often commercial rather than scientific. While students found that AI does not produce "technical writing" or offer a "critical lens," they acknowledged that its summaries are "easy to read." Some noted additional issues, such as filler sentences and unnecessary words.

**Potential uses of GenAI:** Many noted the need to fact-check AI-generated information, even when it was used to gather information. Several students appreciated AI's ability to generate information rapidly and found this feature helpful. Students found AI to be grammatically correct, even when the content was inaccurate. AI was identified as useful for brainstorming, with one student reflecting on whether AI could replace civil engineers. Another student found it helpful for providing and formatting sources. One student described AI summaries as easy to read but noted that they offered only surface-level information. Another reflected that AI left "little room for individualized expression of creativity" and "strips me of the opportunity to do more comprehensive research to cultivate something that is more unique to me." Students also found AI useful for learning about new topics with ease, considering it a "great substitute for Google searches," and reflected that it "can be efficient when helping to research topics."

**Responses to GenAI:** Students expressed conflicting opinions on how they and society should respond to AI in their lives. One student reflected that people "need to accept AI" as it is "not going anywhere" and described it as "the future." Another student suggested a need to "resist AI" due to its lack of emotions, inability to think analytically, and because it is replacing human jobs. One student found "high value in using Generative AI" because it can produce "generally very accurate" information quickly when compared to "reliable references." However, this student also expressed concern about "just blindly trusting AI," particularly with "complex engineering problems," but did not propose ways to address this issue.

**Assignment 2 - Take-Home Quiz:** For the second assignment (Take-Home Quiz), the instructor observed that the majority of students (82%) chose not to use GenAI. This decision may have been influenced by their experience in the first assignment, where they were required to fact-check AI-generated output. Many students found this aspect of the assignment to be burdensome and extra work, which likely discouraged them from opting for GenAI use. When asked in class, students expressed the same concerns about extra work for validation and fact-checking. Students reflected on AI's benefits and limitations, revealing common themes related to efficiency and workplace applications, innovation and sustainability, ethical concerns and job displacement, and critiques of AI.

**Efficiency and workplace applications:** Students highlighted AI's ability to "improve efficiency by offloading mundane tasks," allowing them to focus on "management, personal

relationships, and creative work." Many reflected on how AI could improve workplace safety by "monitoring real-time working conditions" through "real-time data from wearable and vision sensors." These ideas were frequently repeated from the assigned articles, but students did not provide critical analysis of what implementing such systems would entail.

**Innovation and sustainability:** Students reflected on AI's potential to support environmental sustainability goals in civil engineering. However, their responses often repeated points from the articles without deeper engagement or analysis. Many students expressed pro-AI sentiments, describing AI as having "substantial opportunities for innovation" and the ability to "expand the thinking of the engineer." Other reflections included statements such as "AI provides a great deal of promise" and "we need to take advantage of this technology." Students also noted that "AI will just continue to grow" and is "something being implemented in our daily lives and is something that we will not get rid of."

**Ethical concerns and job displacement:** Ethical concerns were a common theme among students. One student noted the "high cost of AI technology" and its "potential for job displacement." Another argued in favor of AI replacing human jobs, stating, "those in charge of businesses will always choose the cheapest and most efficient option" and questioning, "why have a human in a job that a robot can do for free?" Some students used circular reasoning to defend AI, arguing that since AI exists, it should be used. Others raised questions about the ethics of allowing AI to make decisions regarding human safety and emphasized the importance of supervision to ensure accountability for AI's outputs.

**Student critiques of AI:** One student reflected that AI takes designs from architects and offers them to others, potentially replacing the job of the architect. Another wrote that AI does not understand the complexity of problems like transportation and warned that over-relying on AI "could contribute to crashes." A student noted that it is difficult for AI to learn from its mistakes and "could replace human engineers [who] possess critical problem-solving skills and creativity that AI cannot." Other critiques included concerns about AI's "accuracy and level of safety when designing structures" and the "potential bias in AI algorithms," though students did not elaborate on who might benefit or be negatively impacted by such biases. Several students raised questions about who should be credited for AI-generated outputs and who should be held responsible for its mistakes, emphasizing that only humans, not software, can be held accountable for errors.

**Instructor reflections - creativity and individuality in student responses:** The instructor (first author) observed a lack of creativity in students' responses to Assignment 1. Many students relied heavily on GenAI to select the structure for them, resulting in the selection of many famous structures like the Sydney Harbor Bridge, Brooklyn Bridge, and the Eiffel Tower. This repetition made the instructor's reading and grading less engaging than in previous years when students chose their structure of interest without GenAI. Additionally, the instructor found that students' responses lacked the expression of their personalities, voices, diversity of thought, and genuine critical thinking, which concerned the instructor as an engineering educator.

## V. Conclusions

The findings of the study highlight both the opportunities and challenges of incorporating GenAI into the engineering curriculum. Students identified several benefits of GenAI, such as improved efficiency, potential workplace safety enhancements, and support for sustainability goals, while expressing optimism about its growing role in engineering. However, they also raised concerns about ethical implications, including job displacement, biases in GenAI algorithms, and accountability for AI-generated outputs. The reliance on GenAI in assignments revealed a tendency for students to prioritize convenience over creativity and critical engagement, as seen in their repetitive selection of well-known structures and lack of personalized responses. These insights underscore the importance of fostering a balanced approach to GenAI integration in engineering curriculum, ensuring students develop both technical proficiency with AI tools and the critical thinking necessary for addressing real-world challenges. Authors believe giving such an opportunity in the engineering classroom [4] with low-stake assignments will help prepare students to use GenAI responsibly and effectively in their profession upon graduation. As GenAI becomes more prevalent, educators must develop AI literacy to guide students using these tools effectively and responsibly. Integrating AI into courses will require revisiting and revising course learning outcomes [5] while aligning with the "why," "what," and "how" of learning [6].

## References


[1] O. K. Terry. "I'm a Student. You Have No Idea How Much We're Using ChatGPT [The Review op-ed]." The Chronicle of Higher Education. Accessed: Dec. 28, 2024. [Online.] Available: https://www.chronicle.com/article/im-a-student-you-have-no-idea-how-much-were-using-chatgpt

[2] B. Marr. "How Generative AI Will Change The Jobs Of Architects And Civil Engineers." FORBES. Accessed: Oct. 1, 2024. [Online.] Available: https://www.forbes.com/sites/bernardmarr/2024/03/15/how-generative-ai-will-change-the-jobs-of-architects-and-civil-engineers/

[3] C. Zhang, et al., "What does human-machine intelligence mean for civil engineers?," *ASCE Civil Engineering Magazine,* pp. 1 - 17, 1 Sept. 2023. [Online]. Available: https://www.asce.org/publications-and-news/civil-engineering-source/civil-engineering-magazine/issues/magazine-issue/article/2023/09/what-does-human-machine-intelligence-mean-for-civil-engineers.

[4] Y. Walter, "Embracing the future of Artificial Intelligence in the classroom: the relevance of AI literacy, prompt engineering, and critical thinking in modern education," *International Journal of Educational Technology in Higher Education,* vol. 21, no. 1, 2024, doi: 10.1186/s41239-024-00448-3.

[5] "Artificial Intelligence Tools: Advancing meaningful learning in the age of AI." Oregon State University. Accessed" Dec. 28, 2024. [Online.] Available: https://ecampus.oregonstate.edu/faculty/artificial-intelligence-tools/blooms-taxonomy-revisited/

[6] Y. Song, et al., "A framework for inclusive AI learning design for diverse learners," *Computers and Education: Artificial Intelligence,* vol. 6, 2024, doi: 10.1016/j.caeai.2024.100212.

## Appendix A

**Course Syllabi Language on GenAI Use:**

*Use of ChatGPT (or other similar tools that generate text) is allowed in this class for specific assignments only. When use of the tool is allowed, it will be explicitly noted in the assignment directions. If you utilize ChatGPT for any part of the assignment (from idea generation to text creation to text editing), you must properly cite ChatGPT. Failure to cite ChatGPT is considered a violation of the plagiarism standard of the UVM Code of Academic Integrity. Violations could result in failure of the assignment or failure of the course and a notation on your transcript.*

## Appendix B

**Assignment 1: GenAI Instructions:**

*ChatGPT Use:*

*You can use ChatGPT or any other Generative AI tool for this assignment. Use the following guidelines:*

1. *Begin by choosing a structure that interests you. You may brainstorm ideas or explore options using the Generative AI tool of your choice (e.g., ChatGPT).*
2. *Use the Generative AI tool to generate the one-page write-up about the selected structure. Ensure the output aligns with the assignment's requirements.*
3. *Carefully review the information provided by the AI tool. Use credible sources to verify facts and identify any inaccuracies or fabricated details that cannot be substantiated.*
4. *Make necessary additions and edits to the AI-generated content.* ***Use a different color to highlight your changes, showing the areas where you made improvements or corrections.***
5. ***Document all the prompts you used*** *during your interaction with the Generative AI tool. Include these in your final submission to demonstrate your process.*
6. *Compile all the references you used for fact-checking and verifying the AI output. Ensure that these sources are credible and relevant to the structure you've chosen.*
7. *Write a half-page reflection on your experience using Generative AI for this assignment. Discuss how the tool-assisted you, any challenges you encountered, and your thoughts on the reliability of AI-generated content. Do not use Generative AI to write this reflection—****this part should be your own authentic analysis.***

**Assignment 2: Instructions**

*ChatGPT Use:*

*You are free to utilize ChatGPT or any other Generative AI tool for this task.* ***If you opt for GenAI, you must adhere to the following guidelines:***

8. *Carefully assess the AI-generated output.* ***Highlight and explain any content you disagree with.***
9. *Make necessary modifications to the AI-generated content,* ***using a different color to indicate the changes.***
10. *Document all prompts used with the GenAI tool and include them in your final submission.*
11. *Additionally, write a 2-3 sentence reflection on your experience with GenAI for this assignment. This reflection should be your own authentic analysis.*

***Reading Assignment:***

***Article 1: How generative AI will change the jobs of architects and civil engineers (Source: Forbes.com)***

***Article 2: What does human-machine intelligence mean for civil engineers? (Source: ASCE Source)***

*Read the two articles linked above, discuss, and answer the following questions.*

- *How can AI improve efficiency and safety in civil engineering, and how will it transform the roles of civil engineers and architects?*
- *What are the challenges of integrating AI, and what are the opportunities?*
- *Discuss the ethical considerations of AI in civil engineering.*
- *Identify future research directions for AI in civil engineering. How can the industry prepare for the future integration of GenAI?*

*Limit your discussion to a minimum of 300 words and a maximum of 500 words. The text should be typed using size 12 font and 1.5 spacing.*