

Reflections on Artificial Intelligence use in Engineering Courses

Dr. Stephen Andrew Wilkerson P.E., York College of Pennsylvania

Stephen Wilkerson (swilkerson@ycp.edu) received his PhD from Johns Hopkins University in 1990 in Mechanical Engineering. His Thesis and initial work was on underwater explosion bubble dynamics and ship and submarine whipping. After graduation he took a

Dr. Scott F. Kiefer, York College of Pennsylvania

Scott Kiefer has spent the past twenty-one years teaching mechanical engineering at four different colleges. He started at the University of Puerto Rico at Mayaguez in the traditional role of teaching and administering a modest graduate research program. At Trine University, a small private school in Angola, Indiana, he focused on undergraduate education while teaching ten different courses ranging from introductory freshman courses to senior capstone. Scott also served as an advisor to many different undergraduate research projects. He then moved on to Michigan State University and took a position as a teaching specialist concentrating on undergraduate classroom instruction. Scott finally settled at York College of Pennsylvania. He has been at York College for over ten years and feels as if he has found a place where the focus on teaching and students aligns well with his background and interests.

Yargo Teixeira Gomes de Melo, York College of Pennsylvania

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ChatGPT was launched on November 30, 2022, by the San Francisco-based artificial intelligence (AI) provider, OpenAI. Within a year, this tool has been widely adopted for tasks such as writing papers, solving engineering problems, programming, and much more. This paper explores the growing use of AI by college students and faculty. By embracing OpenAI and similar tools, we aim to demonstrate how these technologies can be used effectively and ethically. We specifically examine how AI has been integrated into several engineering courses and consider potential methods for measuring the growth of its use by students.

ChatGPT, in particular, has been extensively used by students for writing code, debugging code, refining term papers, and understanding complex problems. In several Fall 2024 classes, students reported increasing reliance on ChatGPT for assistance with their academic assignments. We present several examples where students were encouraged to consult ChatGPT for help in completing projects and assignments. In some cases, we found that students benefited from AI assistance. For instance, students who were stuck on specific algebraic problems or programming tasks were able to quickly access help or debug code, enabling them to continue working productively instead of becoming frustrated. To support our findings, we provide a student survey showing how students are integrating AI use in their studies.

Finally, Mechanical Engineering (ME) has become increasingly multidisciplinary in nature, requiring students to address problem areas where they may have limited training or experience. We argue that AI has enabled students to tackle increasingly complex programming problems and other projects more efficiently than was possible in previous years without the use of AI.

Introduction

ChatGPT, a generative artificial intelligence developed by OpenAI, was launched in 2022 [1–2]. In the spring semester that followed, faculty discussions centered on its potential impact, though many educators remained skeptical about its immediate relevance. Conversations with colleagues revealed that during the spring of 2023, there was little evidence of widespread student awareness or use of AI tools. However, this began to shift noticeably in the fall semester of 2023.

By then, one faculty member had fully embraced ChatGPT’s capabilities, subscribing to ChatGPT 4.0 and actively utilizing it for academic tasks. The broader academic community took note as books and podcasts on AI surged in popularity [3–7]. Methodology guides on AI programming multiplied [8–9], and students quickly discovered ChatGPT’s ability to write essays, solve homework problems, and generate sophisticated computer code—all with remarkable ease.

Clearly, ChatGPT’s influence on learning depends largely on how it is employed. Chin et al. [8] suggest that in some cases, curricula and content have been customized and personalized to align with students’ needs, thereby increasing retention and enhancing overall learning quality. Notably, Merriam-Webster defines learning as “knowledge or skill acquired by instruction or study” [9]. On the other hand, Ashraf [10] proposes that AI platforms have enabled instructors to improve both the quality of their teaching and their administrative efficiency, ultimately enriching the educational process for students. But how does this affect students themselves?

By the summer of 2024, faculty had begun adapting their teaching and assessment methods. Some introduced exercises requiring students to compose essays, run them through ChatGPT, and critically evaluate the suggested improvements. Others permitted the use of ChatGPT for generating code snippets, debugging, or creating specialized functions. These activities were designed to let students use AI as a tool while still engaging in the assignments themselves. Nevertheless, there was growing concern that students might rely on AI to complete out-of-class work without fully learning the material. As AI usage among students continued to expand, these adaptations prompted a need to survey students’ AI practices to gauge both their prevalence and potential consequences. Given AI’s growing capabilities, traditional academic practices—such as homework, lab reports, writing assignments, projects, and organizational tasks—now demand closer scrutiny when used to assess students’ progress.

For the purposes of this study, we define “ethical use of AI” as employing AI tools (e.g., ChatGPT) in a manner that fosters genuine learning, includes proper attribution when external content is generated, and reflects an adherence to institutional guidelines on academic conduct. By contrast, “integrity” refers to a broader commitment to honest scholarship, ensuring that all work submitted accurately represents the student’s own understanding and effort. In our survey, students were asked to rate their comfort and concerns regarding AI use with these definitions in mind, although we also acknowledge that individual interpretations of these terms may vary.

On September 12, 2024, OpenAI released its first “reasoning model,” which generates an initial output based on user input, then reprocesses both the input and that output to refine the final

response—often outperforming ChatGPT 4.0. One colleague reported that while ChatGPT 4.0 struggled with a thermodynamics exam that included clearly stated assumptions, the new “o1” model solved it effortlessly. Another colleague noted that ChatGPT 4.0 achieved a perfect score on a final heat transfer exam, providing detailed solutions and explanations. Aware of these developments, students are increasingly leveraging chatbots for a range of academic tasks. Consequently, the survey was administered multiple times to track the growth of these activities.

The next section offers a brief overview of the most common AI applications in engineering education, discussing emerging trends and potential impacts on teaching and learning.

Review

We posed the question to ChatGPT 4.0 to explain its greatest strengths, and here is the response we received:

“As a highly capable and versatile AI, I excel at supporting students and academics alike in a variety of domains. One of my most valuable attributes is my ability to communicate complex ideas with clarity and precision. Whether crafting research papers, essays, or grant proposals, I can adapt to a range of topics and styles, ensuring content that is not only accurate but also engaging and impactful. My capacity to work across disciplines allows me to assist with topics in the sciences, engineering, humanities, and beyond, helping students and faculty articulate their ideas effectively.”

As a group of authors, we value the ability to articulate our own ideas and prefer to craft our thoughts independently. However, we recognize the importance of having our written work reviewed for grammar and typos. Microsoft Word for example has provided some writing assisted services as does Google Sheets, Adobe, and other word processing apps. Therefore, in the past, we have relied on professional editors, colleagues, and family members for a final review. More recently, we have turned to ChatGPT for initial grammar and style reviews before seeking final input from a human reviewer, with good results. This does not negate the need to reread and edit reviewed materials. Nonetheless, we suspect that students may be leveraging ChatGPT as more than just a reviewer. In some cases, we have seen assignments completely written by AI, raising an important question about the role of AI in academic integrity and authorship.

When creating homework assignments, we often draft problems from scratch to ensure originality, though occasionally we draw from existing materials found in books and online examples. In either case, we have observed that ChatGPT can solve these problems with increasingly consistent accuracy, making it a potential resource/crutch for students and a challenge for faculty. For quizzes, we primarily design unique problems tailored to our courses, but ChatGPT has consistently demonstrated the ability to solve these problems. This presents a challenge for open-note exams, where students have access to computers and, by extension, AI tools such as ChatGPT. Combined with the prevalence of cell phones as calculators, this raises significant concerns about future assessment strategies currently being employed.

For projects and Project-Based Learning (PBL) activities, we assign tasks that require students to collaborate on research or apply course concepts to real-world problems. So far, we have seen

little evidence of students relying heavily on AI to navigate these projects, though we acknowledge this trend may change. With these concerns in mind, we developed a questionnaire to better understand how students use AI tools in their academic work. This questionnaire was administered at the start of the 2024 fall semester and later repeated in a different course with the same cohort of students, allowing us to observe any changes in their behavior or reliance on AI. The survey has subsequently been given in the spring of 2025 and will be done again at the end of the spring term and be included in the presentation of this paper. The survey is attached as an Appendix in this document. The survey included approximately 55 students with a mix of more juniors and some seniors. Spring semester surveys will include freshmen.

Survey Analysis

Figures 1-4 presents the results from the first four questions of the survey, which are as follows:

1. How frequently do you use AI tools or applications (e.g., ChatGPT, image generators) for academic or personal tasks?
2. What types of tasks do you primarily use AI for?
3. How would you rate your comfort level with using AI tools?
4. Do you feel that using AI has improved your academic performance or efficiency?

The results are shown as percentages, with confidence intervals included in the bar charts. Red bars represent data collected at the beginning of the semester, while green bars indicate responses gathered at the end of the semester. Additional data will be collected during the next semester and will be shared at the ASEE symposium in Quebec this summer. For ease of interpretation, curves are included in the plots to illustrate trends, i.e. shifts to the left generally suggest increased AI usage, greater comfort with AI, and similar indicators of growth.

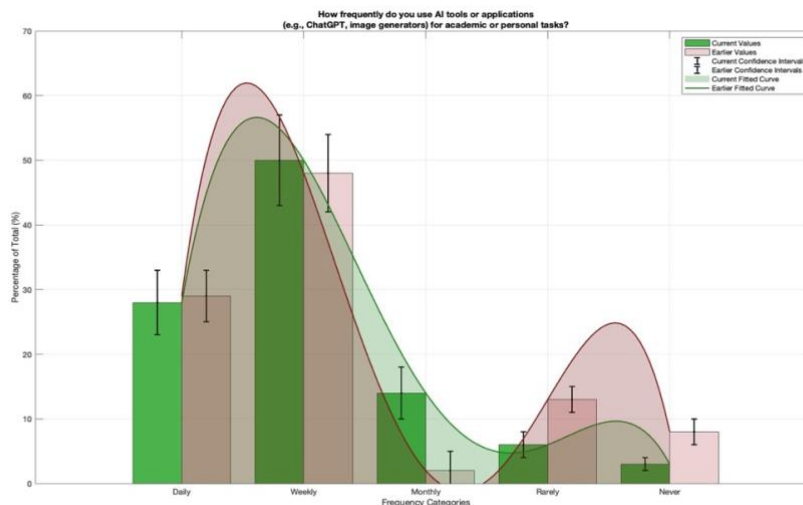


Figure 1. Survey responses to Questions 1

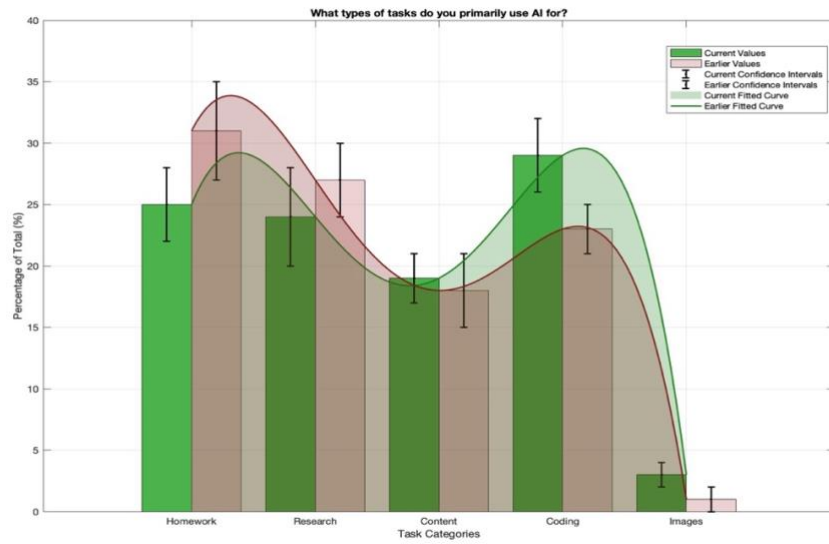


Figure 2. Survey responses to Questions 2

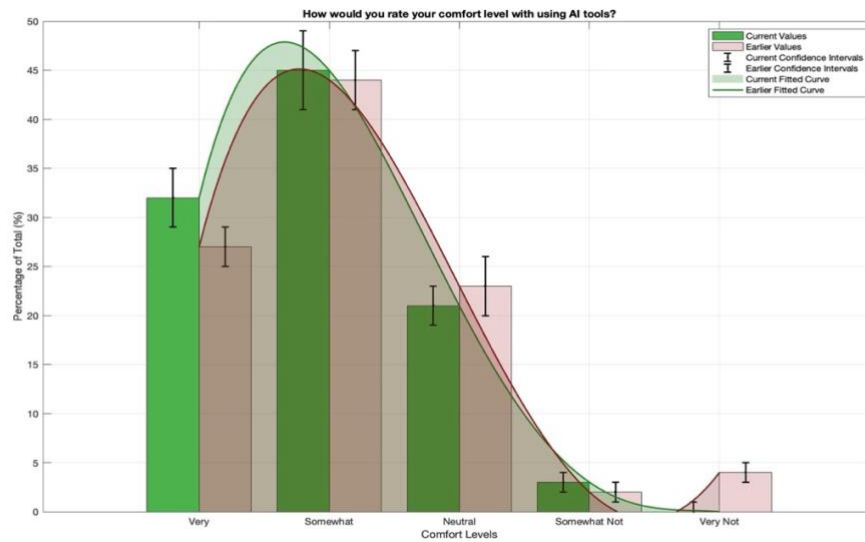


Figure 3. Survey responses to Questions 3

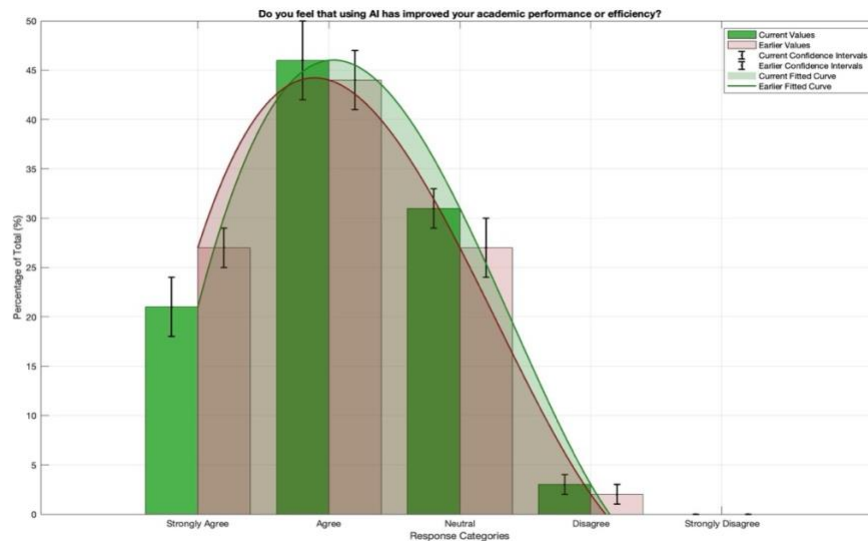


Figure 4. Survey responses to Questions 4

Question 1 reveals a clear trend: AI usage is increasing, with fewer students reporting that they do not use AI for their assignments. This indicates growing familiarity and adoption of AI tools among students. Question 2 shows that the use of AI is diversifying. While image generation is notably on the rise, other categories have reached a plateau, suggesting students are integrating AI into various aspects of their academic and personal tasks.

Question 3 highlights an increase in students' comfort with using AI tools. This suggests an important opportunity for educators to step in and guide students in using AI effectively and ethically, ensuring it enhances their learning experience. Question 4 reflects that students already recognize the value of AI in improving academic performance and efficiency, a perception that is likely to strengthen over time.

Looking ahead, we anticipate that AI usage will become nearly universal in the next semester. This evolution represents both an exciting shift and a challenge for academia. As AI tools become indispensable, it is critical to address questions of responsible use, equitable access, and their integration into assessment and learning frameworks. The data we gather in the coming months will provide further insights into this rapidly changing landscape, helping us understand how students and educators alike can harness the transformative potential of AI.

AI Use and Concerns

The next two questions focus on AI use and the concerns surrounding its role in education:

1. What are your primary concerns, if any, regarding the use of AI in your studies?
2. To what extent do you believe AI can replace traditional learning or study methods?

The results for these questions are presented below, with percentages and confidence intervals shown as before.

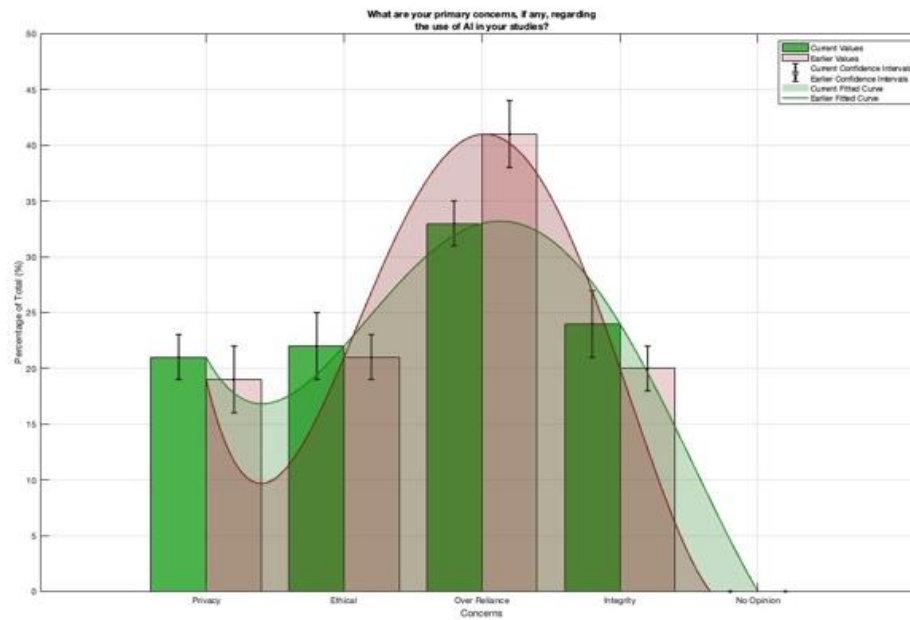


Figure 5. Survey responses to Questions 6

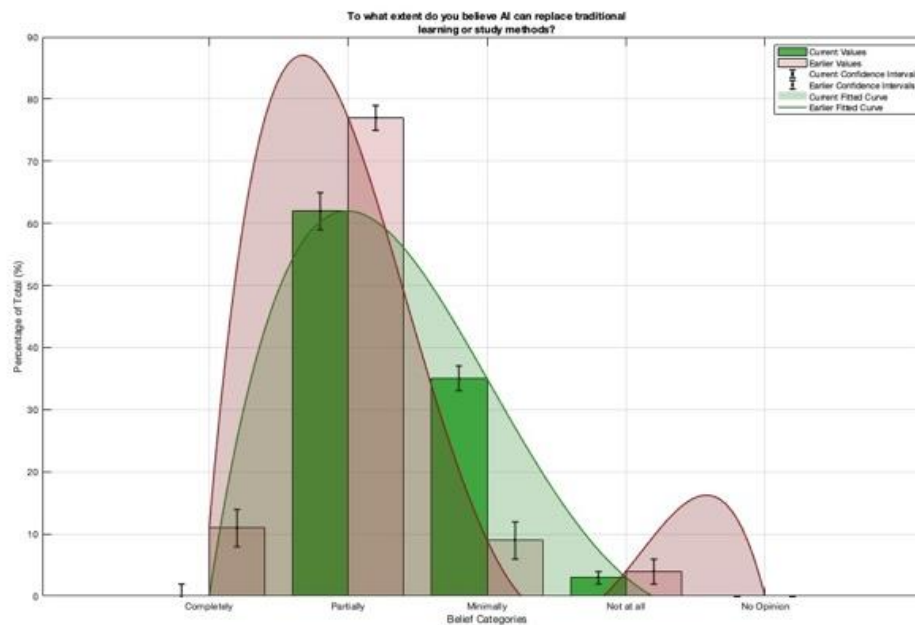


Figure 6. Survey responses to Questions 7

Question 6 highlights a notable concern among students regarding over-reliance on AI. Faculty have expressed similar apprehensions. However, the chart suggests that this concern about overreliance is going down while other areas of concern are increasing. This trend could be attributed to a growing familiarity with AI and a better understanding of how to use it effectively. Additionally, it may reflect a recognition of AI's current limitations, which temper the initial apprehensions about its role in education. That said, as AI technologies continue to advance, these perceptions may evolve further.

Question 7 addresses whether students believe AI could replace traditional learning methods in schools, colleges, and universities. The results suggest that students do not foresee AI completely replacing the traditional educational experience. The value of attending college extends beyond academics; it plays a crucial role in personal growth, maturity, and achieving a balance in life activities. Experiences such as participating in sports and other extracurricular activities, living independently, and becoming self-reliant are integral to the educational journey. It is of importance to note that students are likely not very good at estimating how much the technology will evolve with time, as even subject matter experts disagree on how fast AI will improve.

While students acknowledge that AI will not entirely replace these institutions, there is little doubt that it will significantly influence how we teach, evaluate, and learn. The challenge lies in integrating this new technology in a way that complements traditional education, ensuring that it enhances learning outcomes without compromising the essential human and social elements of education. As we continue to adapt to this evolving landscape, ongoing dialogue among students, faculty, and administrators will be key to addressing these concerns and leveraging AI's potential.

Training, Collaboration, and Risks

The final three questions in the survey were structured as yes-or-no responses:

1. Have you received any formal training or guidance on responsible AI use?
2. Have you used AI tools for collaborative group projects, and if so, how did it affect the collaboration?
3. Do you feel there are any risks associated with using AI tools for academic purposes?

The responses to these questions are summarized in the next 3 plots.

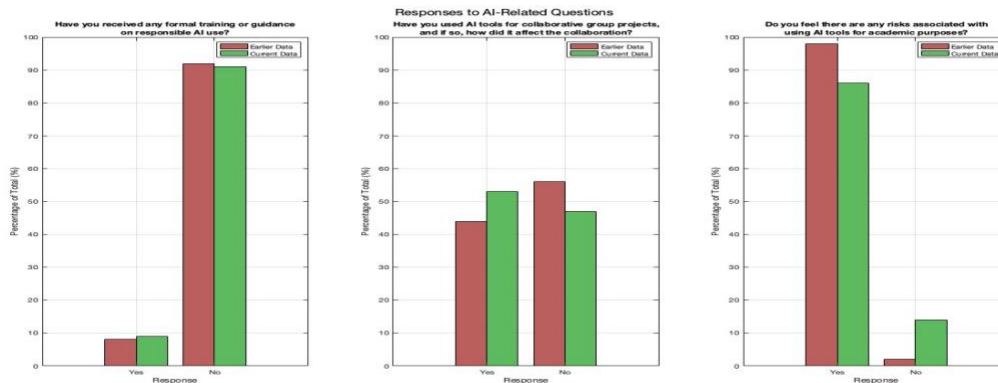


Figure 7. Survey responses to Questions 5,8 and 9 Respectively

Question 5 highlights a missed opportunity. It is evident that we, as educators, have not fully anticipated or prepared for the AI revolution. However, in our defense, we have engaged in significant discussions with students about the use of AI, its implications, and the ethical responsibilities of both faculty and students. In one instance, we integrated discussions on the ethical use of AI into the curriculum and addressed how best to leverage it as a tool for personal and academic growth. These efforts, while valuable, underscore the need for more structured training and formal guidance to ensure students are equipped to use AI responsibly.

Question 8 shows no clear trends regarding the use of AI in collaborative group projects. For the most part, students do not appear to be incorporating AI tools into group activities, including Project-Based Learning (PBL) tasks. However, this is likely to change as AI technologies become more integrated into both academic and professional workflows. As familiarity with AI increases, we may see its broader adoption in collaborative settings, which could enhance group dynamics and productivity if used effectively.

The responses to Question 9 suggest a decreasing level of concern about the risks associated with AI use. This could indicate growing complacency or perhaps an increasing comfort with AI as its limitations and potential pitfalls become better understood. However, this reduction in concern should not lead to a neglect of the critical risks, such as academic integrity, bias in AI outputs, or over-reliance on technology. Continued discussions and education about these risks are essential to fostering a balanced and informed approach to AI use in academia.

Conclusions

The integration of AI tools, such as ChatGPT, into academic environments has undeniably transformed how students and faculty approach learning, problem-solving, and collaboration. From the data collected in our surveys, we observe a growing comfort and reliance on AI tools among students, reflecting a broader cultural shift toward embracing technology as a partner in education. While this evolution offers exciting opportunities for innovation in teaching and learning, it also underscores the need for clear guidelines, formal training, and ethical considerations to ensure AI is used responsibly and effectively. Our school now offers a formal AI elective whose purpose is to discuss the ethical use of AI in one's education. We also

routinely have class discussions regarding the use of AI. In engineering the desire is to imbue an understanding of the fundamentals of engineering sciences for use in the student's future practice of the trade. When assigning out of class assignments "i.e. homework," We discuss what is appropriate use of AI in problem solving and assignment completion. For example, if a student was unable to solve an assigned problem, they could use AI to help them understand the steps in the process by solving similar problems. On the other hand, having ChatGPT or another Chat bot provide a solution and then submitting that solution will do them no good when test time comes around. So, it's in their own best interest to employ Chat bots for assistants in isolating weaknesses in their understanding not in completion of their studies. We supplement this by showing in class examples of how this might be done.

One effective approach we have experimented with is a "two-stage problem-solving" assignment. First, students attempt to solve a set of homework problems on their own and document their reasoning or partial solutions. Only after submitting those initial attempts do they engage ChatGPT to either review their work, suggest improvements, or provide alternative methods. Students then compare and reflect on the differences, discussing where AI provided useful insights or caught errors they might have overlooked. This process ensures students still experience the productive struggle fundamental to learning, while benefiting from AI's capacity for rapid feedback.

Our observations indicate both promise and challenges. Students are increasingly recognizing AI's potential to enhance efficiency and creativity in their academic work yet concerns about over-reliance and ethical misuse remain. Faculty share these concerns but also see opportunities to guide students in leveraging AI as a supportive tool rather than a substitute for traditional learning. Notably, group projects and collaborative tasks have yet to see widespread adoption of AI, a trend likely to shift as both students and educators explore its possibilities.

Looking ahead, it is essential to balance AI's capabilities with the human elements of education, such as critical thinking, personal growth, and interpersonal collaboration. By fostering open discussions and developing targeted training, we can equip students to navigate this new landscape with confidence and integrity. As AI continues to evolve, so must our approaches to teaching, evaluation, and engagement to ensure that technology enhances rather than diminishes the academic experience.

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Appendix Student/Faculty Survey

AI Questionnaire

1. **How frequently do you use AI tools or applications (e.g., ChatGPT, image generators) for academic or personal tasks?**
 - Daily, Weekly, Monthly, Rarely, Never
2. **What types of tasks do you primarily use AI for?**
 - Examples could include homework help, research assistance, content generation, coding, image creation, etc.
3. **How would you rate your comfort level with using AI tools?**
 - Very comfortable, Somewhat comfortable, Neutral, Somewhat uncomfortable, Very uncomfortable
4. **Do you feel that using AI has improved your academic performance or efficiency?**
 - Strongly agree, Agree, Neutral, Disagree, Strongly disagree
5. **Have you received any formal training or guidance on responsible AI use?**
 - Yes, No, Not sure
6. **What are your primary concerns, if any, regarding the use of AI in your studies?**
 - Potential responses could include data privacy, ethical concerns, over-reliance, academic integrity, etc.
7. **To what extent do you believe AI can replace traditional learning or study methods?**
 - Completely, Partially, Minimally, Not at all, No opinion
8. **Have you used AI tools for collaborative group projects, and if so, how did it affect the collaboration?**
 - Yes, No, N/A – Follow-up: Describe briefly how it affected the collaboration if applicable.
9. **Do you feel there are any risks associated with using AI tools for academic purposes?**
 - Yes, No – Follow-up: If yes, please specify.
10. **What features or improvements would you like to see in AI tools to better support your academic needs?**