Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #46117

# ChatGPT in Engineering Education: Revolutionizing Writing, Navigating Ethics, and Promoting Responsible Use

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# ChatGPT in Engineering Education: Revolutionizing Writing, Navigating Ethics, and Promoting Responsible Use


## Abstract

Since its release in November 2022, ChatGPT has significantly influenced writing practices across educational disciplines, particularly in engineering writing courses. This study expands on a prior investigation that surveyed 110 undergraduate engineering students on their attitudes toward ChatGPT's role in writing tasks. To explore evolving perceptions, a follow-up survey with the same cohort was conducted after extended use of the tool. Additionally, 102 faculty members from the College of Engineering Technology were surveyed, focusing on their perspectives regarding students' effective use of ChatGPT, their ability to critically assess AI-generated content, and its implications for academic decision-making. Together, these datasets provide a comprehensive view of ChatGPT's impact on academic writing education from both student and faculty perspectives.

While students initially viewed ChatGPT with optimism, their growing awareness of its powerful capabilities led to heightened concerns about originality, plagiarism, and over-reliance. Faculty, by contrast, remained cautious from the outset, emphasizing the need to preserve critical thinking and foundational writing skills. Both groups called for clearer institutional policies and structured guidelines for the ethical use of AI tools in educational contexts.

The findings underscore the need for a balanced and proactive framework to leverage generative AI's benefits while safeguarding educational integrity. Key recommendations include: (1) establishing clear institutional policies on permissible AI use; (2) developing AI literacy modules to foster critical engagement; (3) implementing process-oriented assessment models, such as version history reviews and reflective writing logs, to emphasize students' intellectual contributions; (4) promoting active faculty involvement in guiding ethical AI use; and (5) adopting targeted detection and verification strategies to ensure accountability without discouraging legitimate tool use. This study offers a nuanced, evidence-based contribution to the discourse on responsible AI integration in engineering education, advocating for practices that balance technological innovation with core educational values.



**Keywords**: ChatGPT, AI Writing, Countermeasures, Engineering Education, Integrity Policies, Ethics


## Introduction

In recent years, the increasing sophistication of advanced Natural Language Processing (NLP) technologies has dramatically lowered the barrier to the use of information technology, thus igniting the development of conversationally ready robots. Among these transformative technologies, ChatGPT, developed by OpenAI, stands out for its ability to generate coherent and contextually relevant text. Simple commands can be used to customize the desired text, charts, and calculations. This straightforward and easy-to-use approach has led to ChatGPT's rapid entry into a wide range of disciplines in education. Since its release on November 30, 2022, ChatGPT has seen explosive growth and by November 2023 had amassed approximately 180.5 million users. Reports indicated that approximately one-third of college students are using this tool [1], and this number is still growing.

Engineering education is a specialized field that requires strong written communication skills. The American Council for Construction Education (ACCE) emphasizes the ability to "create written communications appropriate to the construction discipline" as a critical student learning outcome [2], because effective written communication is essential for conveying complex information to clients, contractors, and regulatory bodies. However, students often face challenges with writing assignments that require critical analysis and adherence to formal technical writing standards, while ChatGPT offers potential support by generating content, refining grammar and sentence structure, and improving their overall writing style.

**Benefits of using ChatGPT in classes**

ChatGPT demonstrates a wide range of applications, including drafting emails, providing interactive learning via chatbots, generating content for articles, assisting with coding and programming tasks, summarizing long-form essays, and providing creative writing prompts. Its utility extends to educational and academic contexts, where scholars widely recognize the content generation capabilities of AI tools like ChatGPT and their role in enhancing writing efficiency and quality. For instance, a study published in the International Journal of Educational Technology in Higher Education reported that ChatGPT significantly improved students' academic writing skills, leading to greater efficiency and improved quality in their writing processes [3].

Beyond content generation, AI tools like ChatGPT can assist in literature search, data management, reviewing and correcting grammatical errors, speeding up writing, developing outlines, adding details, and improving writing style [4], [5], [6], [7], [8]. It was noted that ChatGPT even demonstrated the capability to earn college degrees in controlled assessments, further highlighting its potential in academic achievement and complex cognitive tasks [9].

**Risks of using ChatGPT in classes**

However, ChatGPT’s powerful text-generation capabilities usually lead to the concern of plagiarism and loss of originality persist for many research scholars, especially instructors in writing-intensive classes. There is a risk that students may replicate AI-generated text without engaging in critical thinking or developing their own ideas [10], [11],[12]. Additionally, ChatGPT's knowledge has a degree of latency, being current only up to June 2024, which may result in outdated information regarding current events and recent developments [10].

To mitigate these risks, scholars propose strategies such as using plagiarism detection software to ensure originality [5], verifying information through multiple sources, and reshaping honor codes to standardize language model use [9],[13]. Providing appropriate training on AI tools and increasing manual review to prevent plagiarism are also recommended [12], [14], [15]. However, these tools currently appear to impose an additional burden on faculty and students [16], emphasizing the need for balanced implementation.

Concerns about the accuracy of ChatGPT's information additionally arise, as it can struggle to distinguish between factual and unreliable information, sometimes fabricating answers [8], [10], [12], [13], [16]. Moreover, incorrect or illogical responses can perpetuate privacy and security issues, as well as social biases, including racial, gender, and cultural biases [11].

**University policies**

Over the past years, many institutions have developed policies in response to the academic risks associated with ChatGPT. For example, Stanford University has quickly updated its academic integrity policies and processes to accommodate AI tools like ChatGPT in the

classroom. The University of Michigan, on the other hand, leaves the decision entirely in the hands of the instructor. Meanwhile, some universities, such as East Carolina University (ECU), where the authors are affiliated, are still discussing it before making any definitive policy changes. In general, however, colleges and universities have lifted their bans on ChatGPT's use on campus.

Some colleges limit student access to ChatGPT, while others encourage its use, providing technical support [17]. The University of Michigan, for example, developed an AI writing tutor, M-Write, to offer students with feedback on their writing. Policies are evolving, with many universities shifting from debating whether to ban ChatGPT to focusing on regulating its use. Training courses on ChatGPT have begun at several colleges, and the term "AI era" is becoming commonplace in academic discussions [18].

Overall, the integration of ChatGPT into construction management education presents both opportunities and challenges. While it has the potential to significantly enhance writing performance and educational experiences, concerns about plagiarism, originality, and accuracy must be addressed. Clear policy guidance and strategic measures are essential to harness the benefits of ChatGPT while mitigating its risks. However, there is a distinct lack of research on its impact in engineering and engineering education [19]. This study aims to provide insights into how ChatGPT impacts engineering education, reflecting the perspectives of both faculty and students. In short, this study aims to fill this gap by investigating the influence of ChatGPT on engineering education through the perspectives of instructors and students.

## Methodology

This study quantitatively explores the evolving perceptions of ChatGPT among engineering students and faculty. The findings were primarily from the second round of student surveys and the results of a faculty survey conducted in writing-intensive engineering courses. The second-round student survey, administered at the end of Fall 2023, was designed to compare and expand upon the first-round findings [20], capturing changes in attitudes following extended tool exposure. Meanwhile, the faculty survey was distributed to 102 faculty members in the College of Engineering Technology at East Carolina University, and it explored instructors' perspectives on students' effective use of ChatGPT, critical evaluation of AI-generated content, and institutional policy considerations.

Data was collected to measure perceived benefits, risks, and ethical implications of ChatGPT use. All data were anonymized. Quantitative analysis was conducted to identify shifts in perceptions and key trends. This dual-perspective approach provides a balanced examination of ChatGPT's role in engineering education, considering both student learning experiences and faculty oversight. This study was approved by the Institutional Review Board (IRB) of the authors' university.

### Student survey

The student surveys utilized a five-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree," with each option assigned a numerical value for statistical analysis (-2 for Strongly Disagree, -1 for Disagree, 0 for Neutral, 1 for Agree, and 2 for Strongly Agree). Higher scores indicated stronger agreement with the respective viewpoint.

The student surveys were conducted in two rounds: the pre- survey was administered at the

beginning of the Fall 2023 semester, and the post- survey was distributed at the semester's end. A total of 110 students from five intensive writing courses within the Engineering College were selected for participation. These students, in their second and third years of college, possessed a basic understanding of writing tasks in the construction field. The surveys were administered in class by the course instructors. The pre- survey, consisting of 19 multiple-choice questions, was conducted at the semester's commencement, with the post-survey tracking responses to 12 of those questions. Administered at the semester's end, the post- survey also included 7 new questions exploring students' perspectives on the ethical use of ChatGPT and faculty supervision. Each survey remained open for 10 days to ensure ample time for responses. By scheduling the surveys during these periods, the risks associated with AI tool usage in the class assignments were minimized, with negligible impact. The survey responses were anonymized.

The follow up survey covered five key aspects: (1) ChatGPT Usage, (2) ChatGPT's Benefits, (3) ChatGPT's Drawbacks, (4) Students' Attitudes, and (5) Integrity Policies. Of these questions, the first 12 multiple-choice questions were contrasted with the pre-survey to observe changes in students' views and attitudes as they gained some understanding of ChatGPT. The 19 questions are summarized as follows, the first 12 of which are a follow-up to the pre-survey:

1. After learning about ChatGPT, I believe that ChatGPT will be beneficial for my writing assignments.
2. I believe that ChatGPT can alleviate the stress that writing assignments bring me.
3. I believe that ChatGPT can be helpful in generating ideas for my writing assignments.
4. I believe that ChatGPT will be beneficial for learning writing concepts or techniques.
5. I believe that ChatGPT can save a lot of time on writing assignments.
6. I believe that ChatGPT will be helpful in proofreading and editing my written work.
7. I believe that ChatGPT will give me more confidence in my writing skills.
8. I am confident in distinguishing between ChatGPT-generated and human-generated content.
9. I think the use of ChatGPT may detract from the originality of the work.
10. I think additional guidance and policies are needed to clarify the boundaries of implementing AI tools in writing assignments.
11. I'm concerned about plagiarism-related issues when using ChatGPT.
12. I think AI tools should be limited in their use in writing assignments.
13. I am happy with the idea of collaborating with ChatGPT in real time while drafting assignments.
14. It is easier to cheat using AI tools than traditional cheating.
15. I think educators should be involved in monitoring and guiding students when using ChatGPT.
16. I think the risk of borderline cheating associated with using AI is more than worth it.
17. I think it is fair to require students to prove the authenticity of their research through revision ledgers and research browser history.
18. If I were allowed to use AI in my research, the methods required to prove authenticity of my work would discourage me from using AI.
19. I'm fine with allowing AI tools like ChatGPT while requiring detection software like Turnitin.

A total of 73 junior and senior students from ECU's Construction Management Department responded to the pre-survey (66.4% response rate), and 66 of them responded to the post-survey (60% response rate). The results of the pre-survey had been published at the 60$^{th}$

Annual ASC International Conference 2024 [20]. This paper focused on the outcomes of the post-survey, aiming to analyze any variations from the pre-survey in depth.

**Faculty survey**

The faculty survey utilized 16 multiple-choice and short answer questions to explore faculty members' perspectives about several aspects of using ChatGPT or comparable products as educational tools. It was distributed to 102 employees of the College of Engineering and Technology during the Spring 2024 semester. The survey was emailed to all college faculty listed in the university's online directory. It remained open for six weeks, from mid-February through the end of March, to accommodate responses. Participation in the survey was voluntary, and responses were anonymized.

The questionnaire covered four key aspects: (1) perceptions of student AI literacy skills, (2) current classroom usage, (3) collaboration with librarians to teach AI literacy and (4) demographic information. This article omits the third aspect as the author plans to address it in future publications within the library science discipline. The 16 questions are summarized as follows:

1. Do you agree or disagree with the assertion that students must acquire AI literacy skills to be successful in the future workforce?
2. How familiar do you think your students are with the methods generative AI tools use to create new information? (ChatGPT, Google Bard etc.)
3. How familiar do you think your students are regarding the strengths and limitations of generative AI tools?
4. How concerned are you about your students' ability to evaluate/verify the information created by generative AI tools?
5. How concerned are you about the ethical issues related to generative AI (bias, equity, privacy)?
6. Have you addressed issues related to generative AI tools with your classes?
7. If you have not addressed generative AI tools with your classes, why not?
8. Are you integrating generative AI tools into your teaching and/or assignments?
9. If yes, please specify how you are using the tools.
10. Have you ever collaborated with a librarian to teach library research skills to your students?
11. If yes, how have you collaborated with a librarian?
12. What ways would you prefer a librarian to teach AI literacy skills to students?
13. In which department do you primarily teach?
14. What is your position?
15. How many years have you taught at the college level?
16. Please provide any additional comments you would like to make about this topic.

Twenty-one faculty members responded to the survey (n=21) with a 20.5% response rate. The number of participants by department included: 8 from engineering (35%), 6 from construction management (30%), 5 from technology systems (25%), and 2 from computer science (10%). All participants held tenured, tenure-track, or full-time fixed term positions. Sixty percent of the respondents had 5-15 years of college-level teaching experience, while 20% had less than 5 years and another 20% had 16 or more years of experience.

While completing the survey, respondents could skip questions or select multiple answers for some questions, so the total number of responses could be more or less than 21. Given the small population size, results may not be generalizable, but information gleaned from the

results provide insight into faculty perceptions of student abilities, current classroom usage, benefits and risks, and future implications of using ChatGPT or other generative AI tools in engineering education.

## Results and discussion

### Student survey results

#### Pre-and post- shifts in student perceptions of ChatGPT

A paired samples t-test was conducted for the first 12 questions. Results revealed a statistically significant difference between the pre-test ($M = 0.35$, $SD = 0.77$) and post-test ($M = 0.85$, $SD = 0.44$) scores, $t = -2.39$, $p = 0.036$ ($p < 0.05$), indicating a significant increase in positive perceptions of ChatGPT's usefulness in writing tasks after its use, while concerns about its potential negative impacts, such as originality and plagiarism issues, also shifted. In short, the analysis of the pre- and post-survey data reveals a substantial transformation in students' perceptions of ChatGPT's role in academic writing tasks (see Figure 1). Several key indicators demonstrated striking shifts, indicating both increased perceived benefits and heightened awareness of ethical concerns associated with AI use in writing. The following provides a detailed discussion of the statistical analysis conducted after assigning scores ranging from -2 to +2 to the results of each question.

#### Significant positive changes in perceived benefits

Students' recognition of ChatGPT's direct benefits for writing assignments significantly increased over the semester. The belief that *"ChatGPT is beneficial for writing assignments"* surged from **0.6 to 0.92** (a 53% increase), while the perception that *"ChatGPT is helpful in completing writing assignments"* experienced a dramatic rise from **0.4 to 0.96**—a **140%** increase. Notably, the perception that *"ChatGPT is useful for proofreading and editing"* exhibited the most substantial positive shift, increasing from **0.1 to 0.8**, representing an **800%** growth. This surge suggests that students increasingly view ChatGPT not just as a drafting tool but as a valuable aid for refining and enhancing text quality.

#### Rising ethical concerns and academic integrity considerations

Alongside the growing acceptance of ChatGPT's practical benefits, students also expressed increased awareness of its potential risks and ethical implications. The perception that *"ChatGPT may detract from the originality of writing"* shifted dramatically from **-0.6 to 0.86** (a **243%** increase), indicating heightened concern about over-reliance on AI-generated content. Additionally, the statement *"Additional guidance and policies are needed to clarify AI boundaries in writing assignments"* saw a surge from **-0.1 to 1.32**—a staggering **1420%** increase—signifying a strong demand for clearer institutional policies and better-defined ethical frameworks regarding AI usage.

#### Growing concerns about plagiarism and misuse

Concerns about *"plagiarism-related issues when using ChatGPT"* also increased significantly from **0 to 1.22**, demonstrating a rising awareness of academic misconduct risks. Furthermore, the belief that *"AI tools should be limited in their use in writing assignments"* shifted from **-1.2 to 0.72**—a significant **160%** reversal toward a more cautious stance on unrestricted AI use in academic contexts.

#### Declining confidence in ChatGPT's learning potential

Interestingly, while perceived utility increased, certain expectations about ChatGPT's educational value declined. The belief that *"ChatGPT reduces stress associated with writing tasks"* slightly decreased from **0.91 to 0.78**, while the perception of its effectiveness in

*"learning writing concepts and techniques"* dropped more sharply from **0.7 to 0.45**. This suggests that while ChatGPT is increasingly seen as a task aid, its perceived role as a skill development tool has diminished.

Additionally, after undergoing a test comparing human-generated and AI-generated content [16], confidence in *"distinguishing between ChatGPT-generated and human-generated content"* dropped sharply from **0.9 to 0.16**. This substantial decline indicates growing difficulty in accurately identifying AI-generated text, suggesting that increased exposure through direct assessment revealed the sophistication of ChatGPT's outputs and the challenges it poses in differentiating between machine-generated writing and original work, with implications for authorship verification in academic settings.

**Stable indicators**

Some perceptions remained relatively stable, such as *"ChatGPT is helpful for idea generation"* (1.1 to 1.19, consistently positive) and *"ChatGPT increases writing confidence"* (0.4 to 0.5, positive but moderate growth). The minimal change in idea generation indicates this strength was evident from the start, while the modest growth in confidence suggests limited impact on deeper skill development, possibly due to reliance on external assistance.

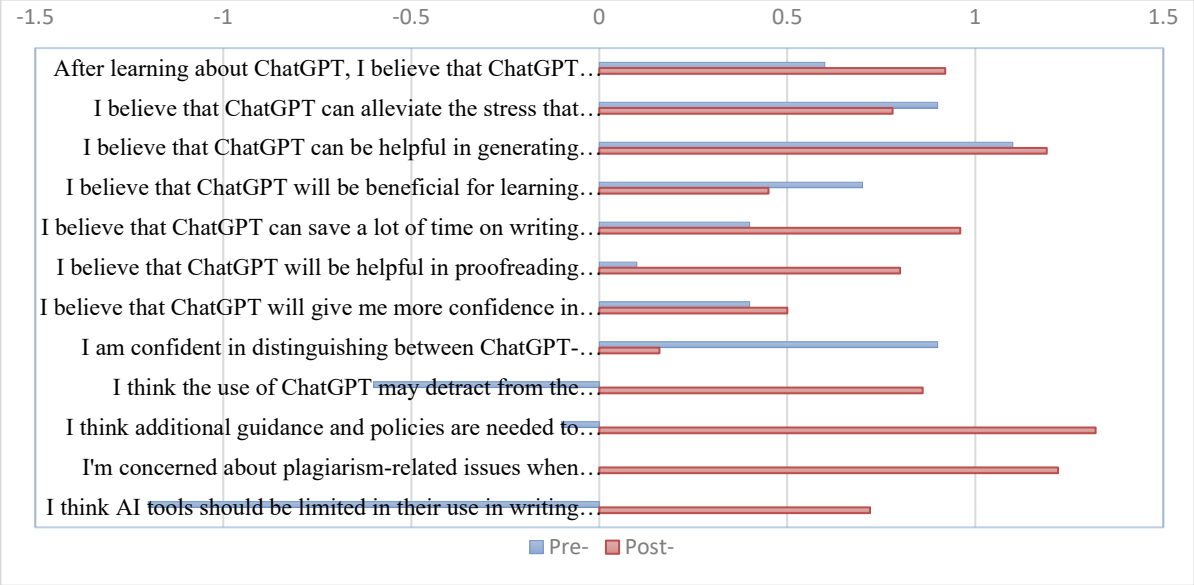


Figure 1. Pre-Post Shifts in Student Perceptions of ChatGPT (Results of the first 12 questions)

The following details the statistical analysis of the newly introduced 7 questions, with scores assigned from -2 to +2.

**Student attitudes on ethical use and faculty oversight of ChatGPT**

Seven new questions further explored students' ethical views, perceptions of academic integrity, and the conditions under which they are comfortable using AI tools like ChatGPT in their writing process (see Figure 2).

**Mixed views on real-time collaboration with ChatGPT**

When asked about working with ChatGPT in real-time during the drafting process, students expressed moderate approval, with a score of 0.53. This suggests openness to collaborative use but not an overwhelmingly positive stance, reflecting ongoing caution about over-reliance on the tool during initial composition stages.

**Heightened concern about cheating**
The perception that "*AI tools make it easier to cheat than traditional methods*" received a score of 0.74, indicating a notable concern that ChatGPT might lower academic integrity barriers compared to conventional forms of misconduct. This perception may correlate with the increasing awareness seen in the first 12 questions regarding plagiarism risks.

**Strong demand for instructor oversight**
A significant finding was the unanimous agreement that "*Educators should be involved in monitoring and guiding ChatGPT use in assignments*", with a perfect score of 1.0. This aligns with the previous demand for clearer policies and emphasizes students' preference for structured, supervised use of AI tools in the classroom.

**Skepticism toward justifying AI-related misconduct**
The statement "*The risk of borderline cheating associated with AI use is worth it*" received a negative score of -0.16, indicating that most students do not justify potential academic dishonesty facilitated by AI tools, even if they offer efficiency benefits.

**Mixed reactions to proving authenticity**
When asked if students should be required to prove the authenticity of their work through revision logs and browser histories, the response was moderately positive (0.29), suggesting a lukewarm acceptance of stricter accountability measures. However, when questioned whether such verification would discourage AI use if mandated, the score increased to 0.51, indicating that students may avoid AI tools if the documentation process becomes too burdensome.

**Support for detection tools and AI integration balance**
Finally, the statement "I'm fine with using AI tools like ChatGPT if detection tools like Turnitin are required" received a moderate score of 0.5, suggesting that while students generally support AI use, they also expect safeguards for academic integrity.

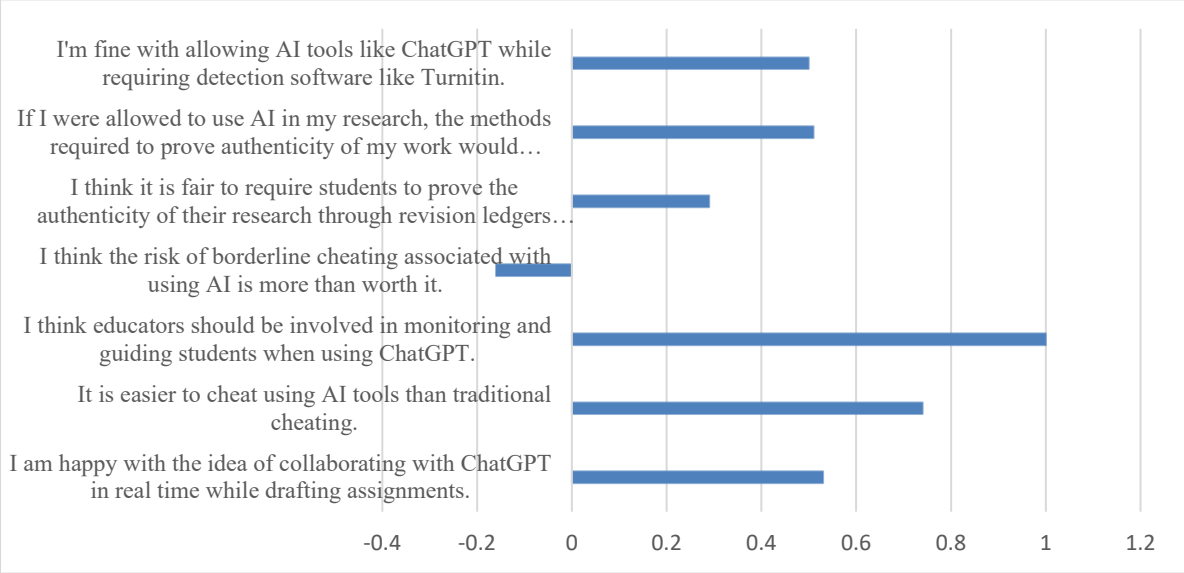


Figure 2. Student Perspectives on Ethical Use and Faculty Oversight of ChatGPT (Results of the 7 new questions)

**Faculty survey results**
**Need for AI literacy skills**

The faculty survey's initial question asked instructors if they agreed or disagreed with the assertion that students need AI literacy skills in the future workforce. This question aimed to gauge their perceptions of ChatGPT's future impact and the importance of AI literacy. Preparing students for the workforce is an important aspect of the university's mission and identifying in-demand skills is of utmost importance. Sixty-seven percent of the respondents agreed with the statement, 29% responded "neither agree nor disagree" and only 4% percent disagreed; two-thirds of the respondents deemed this skill set as being necessary for students' future success. The responses to this initial question laid the groundwork for determining the instructors' perceptions of their students' ability to effectively use ChatGPT or similar generative AI tools and to identify their concerns about using it as an educational tool.

According to the literature, a definition is beginning to develop for the concept of AI literacy. Based on themes emerging from this concept, an AI literate individual possesses the following four skills: (1) comprehends how generative AI tools create output, (2) recognizes the strengths and weaknesses of the tools, (3) evaluates the information created for credibility, and (4) is aware of ethical issues such as bias, equity, and privacy which often affect the output [21]. The second section of the questionnaire asked faculty members about specific perceptions and concerns related to these themes.

**Student understanding of output creation**

To address the students' level of understanding of ChatGPT's output creation, the questionnaire asked faculty members how familiar they thought their students were with the methods generative AI tools use to create new information. Nineteen percent responded, "very familiar," 67% responded "somewhat familiar" and 14% responded "not familiar." Two-thirds of the faculty members perceived their students to have some knowledge regarding the methods ChatGPT uses to create output. However, this general assumption needs further study to confirm the students' depth and breadth of knowledge as well as the impact their academic major may have on their understanding as some students in this college major in computer science and technology systems, instead of engineering.

**Credibility, evaluation, and ethical issues**

Participants were asked how familiar they thought their students were with the strengths and weaknesses of ChatGPT. None of the respondents perceived their students as being "very familiar" with the benefits and limitations of the tool. Twenty-nine percent answered, "somewhat familiar" and 71% answered, "not familiar." In this case, more than two-thirds of the faculty members perceive their students to be unfamiliar with the strengths and weaknesses of the tool even though they believe most are familiar with how the output is created. The findings suggest students may be using the information ChatGPT creates at face value with no further consideration about the quality or credibility of the output.

Two questions reflected the other themes associated with AI literacy: evaluating the credibility of information and ethical issues. The questionnaire asked faculty how concerned they were about their students' ability to evaluate or verify information created by ChatGPT. Most respondents answered, "very concerned" or "somewhat concerned" (see Figure 3).

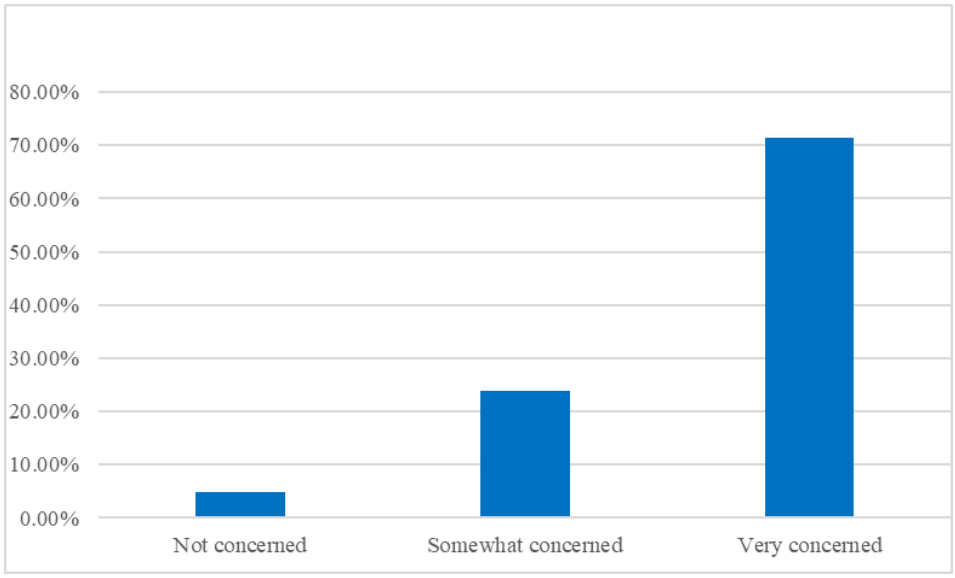

Figure 3: Faculty Concerns about Students' Ability to Evaluate ChatGPT-Generated Content

The final question of the section asked the faculty members how concerned they were about the ethical issues related to generative AI, specifically bias, equity, and privacy. Academic integrity matters were purposefully excluded from this question, so the respondents would solely focus on the aforementioned issues. Forty-eight percent answered, "very concerned," 38% answered "somewhat concerned" and 14% answered, "not concerned."

The findings related to these questions further illustrate the faculty members' concerns about their students' ability to evaluate information which corresponds to their perception that students do not understand the strengths and weaknesses of ChatGPT. Based on this information not only do students' foundational writing skills need improvement, but their critical thinking skills must be addressed as well. Furthermore, given the fact that fewer faculty members expressed concern about ChatGPT's ethical issues beyond those related to academic integrity raises questions about their own understanding of this aspect of AI literacy which may need further study as well.

**ChatGPT's flaws addressed by faculty**

The next section of the questionnaire focused on the current use of ChatGPT in the classroom. The survey asked if the instructors had addressed the problematic issues related to generative AI with their classes. The results showed almost an even split among the responses. Fifty-two percent of faculty answered "yes" they had addressed the issues in class, while 48% answered "no." For those who stated they had not addressed the use of ChatGPT, the questionnaire prompted them for an answer as to why not. Seven answer choices were provided including the category "Other" where they could further explain their answer (see figure 4).

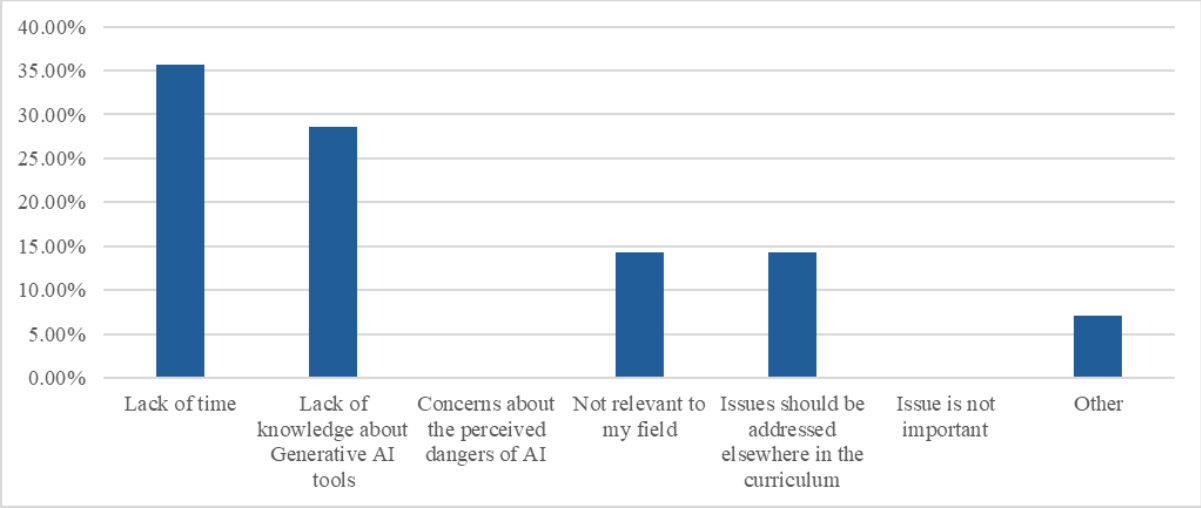

Figure 4: Reasons Faculty do not Address Problems with ChatGPT in their Classes

The respondents who elaborated on their choice of "Other" included remarks about the number of unknowns related to AI and the fact that the technology evolves so rapidly whatever they present in the classroom currently would be outdated in a few months. Faculty members cited lack of time and lack of knowledge as the primary reasons for not addressing ChatGPT in the classroom, which is unsurprising based on the amount of time and effort needed to stay abreast of this rapidly changing technology.

**Integration into coursework**

To further investigate the current use of ChatGPT, the faculty were asked if they were integrating the tool into their teaching or assignments; 25% answered "yes," and 75% answered "no." For those who stated they used generative AI tools in their teaching, the questionnaire prompted them with an open-ended question to explain their use further. Answers included: assistance with creating assignments, lab reports, outlines and prose as well as explaining technical topics in simpler terms. Also, several instructors mentioned using it for coding, analysing, and presenting data. While only a few faculty members have integrated ChatGPT into their teaching and assignments, they utilized it in a variety of ways.

**Takeaways from faculty survey**

Overall, the faculty of the College of Engineering and Technology perceive their students as having some familiarity with the methods ChatGPT uses to create information. Still, the majority believe their students are not familiar with the tool's benefits and limitations and they are concerned about the students' ability to apply critical thinking skills and evaluate outputs. To improve skills in both areas, faculty members may need to integrate more writing and critical thinking activities into their courses and seek the assistance of other campus personnel, including librarians, to collaborate in this endeavour if they want to use ChatGPT effectively.

While ChatGPT shows great promise for enhancing productivity, support and training are needed to implement and use it effectively. Collaboration between librarians and faculty members can facilitate the development of scalable training programs for students. Librarians can integrate AI literacy training into existing research skills instruction or offer standalone sessions. Additionally, they can expand access through asynchronous online tutorials or provide research consultations for individual students or small groups. Faculty members will need continuous training as well to enhance their proficiency with ChatGPT. Workshops for

faculty could be provided by librarians, centers for teaching and learning, or campus information technology units as generative AI tools continue to evolve. While education is important for all, university administrators must provide clear policies and procedures for its use and modify academic integrity policies accordingly to establish appropriate expectations for both faculty and students before generative AI tools can be integrated into the curriculum effectively.

## Discussions

The findings of this study provide critical insights into the evolving perceptions of ChatGPT's role in engineering writing courses, highlighting both its benefits and challenges. By examining the shift in student pre- and post-exposure attitudes, their views on ethical use, and faculty oversight, this study contributes to a deeper understanding of AI's place in higher education.

### Theoretical insights and practical implications

This research aligns with cognitive load theory [22], which emphasizes the importance of reducing extraneous cognitive load during complex tasks like academic writing. ChatGPT's effectiveness in simplifying drafting and editing processes, as evidenced by the dramatic improvements in perceived benefits (e.g., proofreading support rising from 0.1 to 0.8), suggests that it can serve as a valuable scaffolding tool for reducing cognitive barriers in early-stage writing tasks. However, the simultaneous decline in the perception that ChatGPT aids in learning writing concepts (from 0.7 to 0.45) raises important pedagogical considerations. This shift suggests that while ChatGPT may optimize task completion, it may not effectively contribute to long-term skill development—a pattern aligned with constructivist learning theories [23], which emphasize active engagement with material for deeper learning.

The rising concerns about originality and plagiarism risks (e.g., a shift from 0 to 1.22 on plagiarism-related concerns) further reflect engagement with ethical development frameworks such as Kohlberg's stages of moral development [24]. The increased demand for clearer policy guidance (from -0.1 to 1.32) reveals that students are actively reflecting on the ethical dimensions of AI use, indicating the importance of institutional support in guiding this process.

### AI in the engineering profession: broader ethical considerations

Beyond its applications in academic writing, the use of AI tools like ChatGPT in the engineering profession raises important ethical considerations, particularly regarding both potential benefits and misuses. While AI can enhance efficiency in technical communication, data analysis, and project management, over-reliance on these tools could compromise the development of critical problem-solving skills essential to the profession [25]. Additionally, the ethical implications extend to society sustainability concerns. The substantial energy consumption associated with large language models, driven by extensive computational resources, poses environmental challenges. For instance, data centers powering AI tools contribute significantly to carbon emissions, highlighting the need for responsible use within educational and professional contexts [26].

To address concerns about AI integration, institutions should focus not only on academic integrity but also on promoting AI literacy. This includes discussions on sustainability, long-term professional responsibilities, energy efficiency, ethical AI use in decision-making, and

balancing automation with human expertise. Such initiatives can better prepare engineering students for responsible AI adoption in their future careers. Establishing policies that encourage effective AI use while fostering awareness of its broader societal impact can help ensure a more ethically grounded engineering education. Meanwhile, to fully leverage the potential of tools like ChatGPT, university administrators must provide clear policies and procedures for its use, update academic integrity policies to set appropriate expectations for students, and offer continuous training and support for faculty. These measures will enhance faculty proficiency with ChatGPT and facilitate its effective application as an educational tool.

**Contributions to the field**

This study makes several significant contributions to the ongoing discourse on AI integration in engineering education:

1. As students' exposure to ChatGPT increased, their understanding of the tool deepened, with longitudinal data showing how extended use shifted initial optimism toward a more critical evaluation of both its potential and limitations.
2. The study explores both the efficiency gains facilitated by ChatGPT and rising concerns about originality and academic integrity, emphasizing its dual impact on academic writing.
3. Faculty concerns largely stem from perceived gaps in students' awareness of AI limitations and risks, underscoring the need for targeted AI literacy initiatives focused on responsible use.
4. The growing demand for clearer policy guidance and faculty involvement highlights the need for institutional reforms to promote both ethical standards and effective AI integration.
5. Finally, the study links cognitive load reduction with task optimization, showing how generative AI can support writing while raising ethical considerations around skill development and academic integrity.

**Practical recommendations for engineering writing education**

To balance the benefits of ChatGPT with the need for academic integrity, this study recommends a multifaceted approach to the responsible integration of AI tools.

Firstly, institutions should establish comprehensive policies that clarify acceptable AI use while addressing originality concerns. Explicit guidance can help students understand the boundaries of responsible AI usage in writing tasks, while also providing faculty and students with a structured framework and essential support resources for handling red-flag submissions effectively.

Second, writing courses should integrate AI literacy modules that focus on how generative tools work, their limitations, and how to critically assess AI-generated content. Emphasizing the distinction between constructive tool use and over-reliance can empower students to make informed decisions.

To balance the benefits of AI tools with academic integrity, educators could implement process-oriented assessment strategies, such as requiring version history logs, annotated drafts, and reflective reports that document the student's writing process. Moreover, ChatGPT can be highly effective for initial drafting, idea generation, and revision support. However, it should complement—not replace—direct instruction in foundational writing concepts and critical thinking skills. Educators should ensure that AI tools are positioned as supplementary

aids rather than skill substitutes.

Our data also reflects a strong student preference for faculty involvement in guiding ethical AI use. Proactive monitoring and open discussions about the ethical implications of AI tools can help students navigate responsible usage.

Lastly, to minimize red-flag misjudgements and reduce the burden of additional authenticity verification layers, institutions should develop and publicly share clear, step-by-step guidelines on responsible AI use in writing tasks. These guidelines should clarify acceptable practices, outline manageable verification strategies, and emphasize educational integrity without imposing excessive administrative burdens. Providing clarity can reduce hesitation among both students and educators who may otherwise avoid AI tools due to concerns about complexity and fairness. Writing centers and academic support units could play a critical role in this process by offering workshops, personalized consultations, and resources on ethical AI usage, helping to build confidence and promote responsible adoption across the campus.

## Conclusion

In conclusion, this study provides an overview of students' evolving perceptions of ChatGPT in engineering writing courses, revealing a dual narrative: while students increasingly recognize the practical benefits of AI tools, their awareness of originality risks and academic integrity concerns has also grown. These findings emphasize the need for a balanced approach to AI integration—one that harnesses the efficiency of tools like ChatGPT while ensuring ethical and pedagogically sound practices. The study also reveals that faculty generally support the development of AI literacy among students to better prepare them for future professional demands. However, their concerns about AI use in engineering writing education are largely driven by the perception that students may lack sufficient awareness of the limitations and potential risks associated with these tools, which underscores the critical need for AI literacy.

Furthermore, both students and faculty consistently emphasize the need for clear, actionable guidelines on acceptable AI use to maintain academic integrity. The study's contributions extend beyond immediate classroom practice, offering insights for both theoretical exploration and policy development in higher education. By advocating for policy refinement, AI literacy education, and transparent assessment models, this research provides a foundation for institutions seeking to responsibly integrate generative AI into writing-intensive courses. Future research could further explore faculty perspectives and long-term skill retention to create a holistic framework for AI adoption in education.

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