

WIP: Innovative Practice: Incorporating ChatGPT into Technical Writing Assignments in Chemical Engineering Education

Eleanor F. Woolever
Dept. of Chemical and Biological Engineering
Montana State University
Bozeman, MT, USA
elliewoolever@gmail.com

Stephanie G. Wettstein
Dept. of Chemical and Biological Engineering
Montana State University
Bozeman, MT, USA
stephanie.wettstein@montana.edu

Abstract—This work in progress (WIP) innovative practice paper describes the incorporation of ChatGPT into technical writing at the undergraduate and graduate level of an engineering program. Since professional skills play a critical role in the success of an engineer, specifically communication through writing, it is critical to incorporate writing into the curriculum; however, large class sizes, overloaded faculty, and the qualitative aspect of writing, can make it difficult to convince faculty to do so. The rise of Artificial Intelligence-Driven Conversational Agents (AI-DCA) that can understand and respond to human language and give immediate feedback could aid in resolving this challenge. To understand the students' perceptions of using AI platforms for revisions, a homework assignment in both a graduate and undergraduate course incorporated the use of ChatGPT for editing and creation. Then, a survey that included their likes and concerns about using AI for educational purposes was given. The preliminary results found that many students had never used ChatGPT, and that they were impressed with its ability to correct grammar mistakes and assist in making sentences more concise. While the majority of both graduate and undergraduate students found value in the changes that ChatGPT suggested, concerns regarding ethics, accuracy, and the use of AI in general were mentioned. Although the setting for this innovative practice was within the context of chemical engineering education, the principles can be applied to other disciplines as well. Motivations for adopting this practice include the desire to improve student writing skills, increase engagement and accessibility, and better prepare students for future careers in industry.

Keywords—*Technical Writing, ChatGPT, AI Technology, Laboratory, Chemical Engineering*

I. INTRODUCTION

Surveys indicate that practicing engineers spend a large portion of their work time writing; however, feedback from industry indicates a lack of communication skills in many engineering graduates [1]. These so-called “soft” skills [2], recently redefined as “professional” skills, need to be learned

within the engineering curricula and be transferable to the engineering workforce, which is reflected in current ABET criteria [3] and publications such as *The Engineer of 2020* [4]. Not only will improving technical communication skills [5-8] benefit all students [9, 10], but becoming familiar with Artificial Intelligence (AI) tools will be critical for students' future careers [11]; particularly for students with lower than average English skills, which may include first-generation students [12], rural students [13], and English as a second language students [12, 14]. These students are posed to gain even more than other students in using AI to improve their writing skills [15, 16].

Recent trends in communication instruction within engineering curriculums have arisen from studies using sociocultural theoretical frameworks [17, 18] and social theories of learning such as situated learning [19, 20], amongst others [21]. Through the research using these frameworks, two key points shaping engineering communication practices have emerged: 1) engineering communication is situated and rhetorical and 2) engineers' perspectives on communication vary along a rhetorical continuum [19]. Research has found that iterative writing, where one writes, receives feedback, and incorporates the feedback into the writing, has significant benefits to students becoming masters of their own learning experience [22]; however, large class sizes make iterative writing difficult due to the increased workload it entails. Additionally, considering that instructors may provide incorrect feedback and different graders emphasize various aspects of writing, it becomes desirable to find other ways to deliver more consistent feedback for student writing. This is where the recent influx of AI that can understand and respond to human language known as AI-Driven Conversational Agents (AI-DCA), such as ChatGPT, Elicit, Generate LLM, Wordtune, and others could be used. These tools are available on demand, wherever the student is working, and would allow students to become more familiar with the capabilities of AI; however, many questions remain on students' beliefs and intentions of using AI-DCAs.

The goal of this study was to develop methods to incorporate advances in emerging technologies, like ChatGPT, into engineering education while taking into consideration

students' experiences with them. Engineering writing takes many rounds of revision and with each new set of feedback, a more cohesive product arises. Emerging AI technologies introduce a new form of feedback and change how things are written, so having students be aware of the strengths and weaknesses of AI is key to responsible and effective use. The findings of this research will provide insights into the potential benefits of AI-DCA in education and help improve the effectiveness of technical communication training for students.

II. METHODOLOGY

A. Participants and Materials

1) Graduate Students

Graduate students ($N = 26$) enrolled in the course ENGR 650: Scientific Communication and Proposal Development at Montana State University in the Spring of 2023 were given an assignment with the goal of assessing the effectiveness of using ChatGPT for editing and generating writing. The students were instructed to input abstracts they had written into ChatGPT with different editing prompts. A few of these prompts included "edit for clarity," "edit for length," and "edit in the style of Edgar Allan Poe." Additionally, they were instructed to generate an abstract using only a few keywords, testing ChatGPT's generative capability. Following the completion of the assignment, they were asked to reflect on their experiences using ChatGPT, highlighting the positives and negatives associated with using the technology.

2) Undergraduate Students

Undergraduate students ($N = 57$) enrolled in the course ECHM442: Unit Operations Senior Laboratory I at Montana State University in the Fall of 2023 responded to an optional survey after the completion of a homework assignment. For the homework assignment, the students had to write a paragraph describing the safety considerations of their experiment. They were then instructed to use ChatGPT to make edits to the paragraph using the following prompts: "find grammatical errors," "improve this text for a particular audience," "make this more concise," and "provide a one-sentence summary of the paragraph." They reflected on using ChatGPT. Following this, an optional survey was distributed asking the students about their perceptions and experiences using ChatGPT. The reflections, from both the homework and survey, were coded similarly to the graduate student feedback.

B. Procedures

For the graduate student assignment, the responses were analyzed using NVivo for thematic coding. Two cycles of coding were performed, with the first cycle identifying two main themes, positive and negative, with 3-4 subthemes each. The second cycle developed several more subthemes which were clarity, coding (as in MatLab, Python, etc.), cohesive, concision, editing and grammar, elaborates, fast, flow, free, generates output, starting point, and summarizes for positive and concerns about creative reduction and ethics, incoherence, incorrectness, irrelevance, limitations, worsened writing quality, repetition, overreliance on ChatGPT, brevity, wrong

focus, and the effort required to use ChatGPT for negative. For the undergraduate assignment in which the survey was given through Qualtrics, the paragraph that the students submitted was coded based on the subthemes identified in the graduate assignment above.

III. PRELIMINARY FINDINGS AND DISCUSSION

Graduate students highlighted the usefulness of ChatGPT in generating initial drafts, editing for clarity and conciseness, and identifying grammatical errors (Figure 1; blue bars). However, they also noted limitations, such as the need for human oversight to ensure relevance in the final output, especially when the AI failed at advanced scientific concepts by providing incorrect and irrelevant information (Figure 1; red bars). Ethical considerations about the use of AI-generated content in academic submissions were also discussed, emphasizing the need for transparency and integrity in using such tools. Some students expressed concerns about becoming overly dependent on AI for academic writing, fearing it might undermine their own creative and analytical skills, which underscores the importance of critical engagement with the tool rather than passive acceptance of its output. Students noted that ChatGPT cannot replace the creative and critical input required for high-level academic writing and that ChatGPT's role was primarily seen as supplementary, particularly useful in overcoming writer's block and refining drafts.

From the undergraduate survey responses, it was found that many students (64%) had never used ChatGPT and that they were impressed with its ability to correct grammar mistakes and assist in making sentences more concise (Figure 2; blue bars). The undergraduate students were also impressed with the utility of ChatGPT, particularly for grammar assistance and enhancing

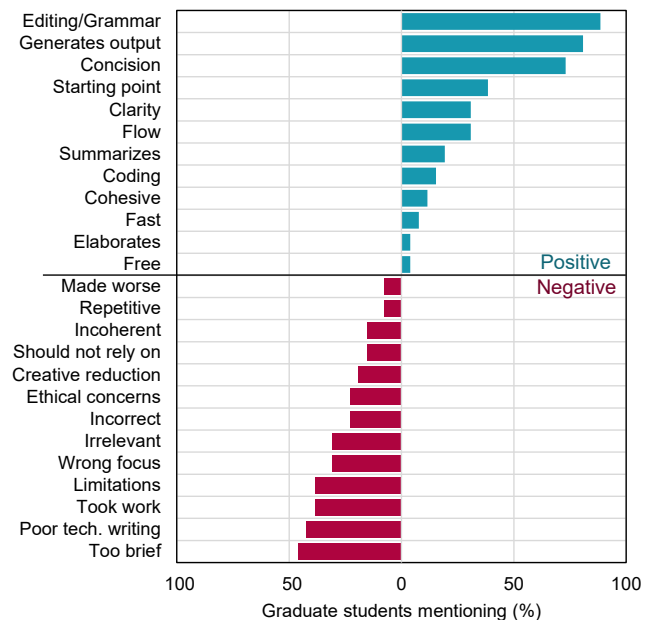


Figure 1: Percent of graduate students (26 total) that mentioned the identified subthemes in reflections on using ChatGPT for scientific writing in a graduate writing course.

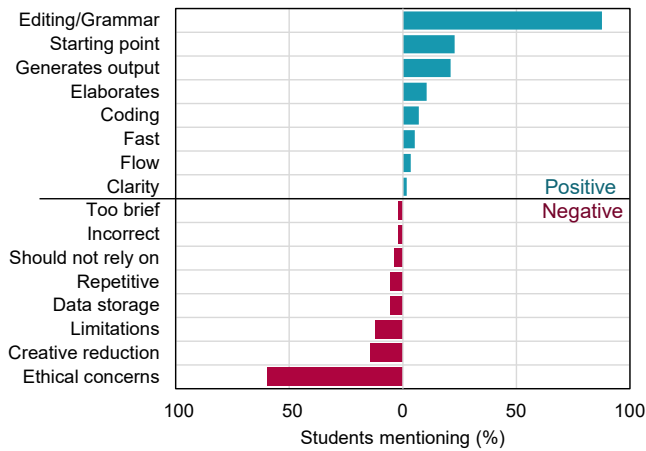


Figure 2: Percent of undergraduate students (57 total) that mentioned the identified subthemes in reflections on using ChatGPT for scientific writing in a senior engineering lab course.

clarity in writing. ChatGPT served as a learning mechanism for students by providing instant feedback on grammatical errors and sentence structure that they cannot get from instructors in a timely fashion. Also, the undergraduates felt that ChatGPT was a supportive tool for conducting preliminary research, drafting, and revising documents. However, almost 60% of students had ethical concerns about how to use AI-DCA appropriately and the fear of being accused of using ChatGPT when they had not (Figure 2; red bars). Although students are typically held to the Code of Conduct at their institution, many institutions have not amended their codes to include wording around the use of AI and in some cases, flat out banning its use, leaving students wondering if they are allowed to use AI. Additionally, undergraduates were concerned about the overall creativity reduction from using AI as well as the limitations it has, which was seen in the graduate student reflections as well.

When comparing the themes from both the graduate and undergraduate reflections (Figure 3), similar trends were observed for the positive aspects of using AI in technical writing. For both groups, almost 90% of students felt that ChatGPT improved the editing and the grammar of their technical writing. Additionally, both groups felt that ChatGPT could generate output and gave them a starting point for their writing. The negative themes differed slightly, which was likely due to the differences in the assignments. For the graduate students, they had ChatGPT generate writing on a topic using a few keywords, which likely led to the negatives of too brief, poor technical writing, took work, and wrong focus, which were mentioned much less in the undergraduate reflections. This could be due to the more extensive technical writing experience that graduate students have; that is, undergraduates are still not sure what constitutes good technical writing. However, 60% of undergraduates versus just over 20% of graduate students mentioned ethical concerns. This may be due to undergraduate students depending on a grade for their technical writing versus graduate students typically are writing to present their original research, but further research would be necessary to determine why there was such a large discrepancy.

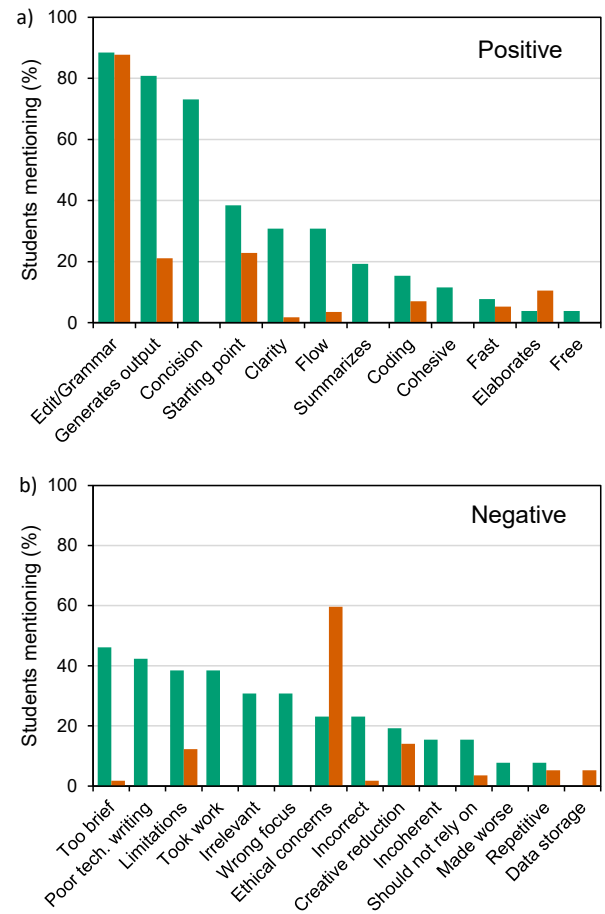


Figure 3: Percent of students that mentioned the identified subthemes in reflections on using ChatGPT for scientific writing categorized by a) positive and b) negative responses for graduate students (26 total; green bars) and undergraduate students (57 total; orange bars).

IV. CONCLUSION

Graduate and undergraduate students were given a writing assignment where ChatGPT was used to explore what benefits and negatives AI can have on writing and asked to provide their thoughts on ChatGPT. The preliminary findings showed that the majority of both graduate and undergraduate students in these classes found value in the changes that ChatGPT suggested, and the majority agreed that ChatGPT made good grammar and editing suggestions. However, several negatives arose as well including concerns regarding ethics, accuracy of information, and the use of AI in general. There were several key differences in the themes of the undergraduates and graduate students: undergraduates appeared to embrace AI tools for practical utility but remained cautious of potential ethical pitfalls. In contrast, graduate students' concerns reflected the increased importance in producing original research and focused on the limitations and accuracy of AI tools, but that could be due to the nature of the homework assignment. Both groups recognize the utility of AI-DCAs like ChatGPT but emphasize the need for careful, ethical usage to complement their learning and research efforts. Future research

should explore the ethical concerns students may have as well as the limitations and biases of AI-DCAs.

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