Characterizing student adoption of generative AI in technical communication courses

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Abstract

The inevitable diffusion of generative artificial intelligence (genAI) into the academic sphere has rapidly progressed in the past two years. Courses that prioritize critical thinking and technical writing have seen students relying on genAI to brainstorm, clarify questions, and improve their report writing. Of particular interest are engineering students utilizing genAI to potentially support their avoidance of writing. Engineering students tend to have more reluctant attitudes toward writing-based assessments compared to problem-solving-based assessments and hands-on project work. These attitudes may be related to student perceived barriers to writing, which can transpire for a multitude of reasons, least of which being the potential lack of emphasis on writing in engineering curricula. Irrespective of the reasons for the perceived barriers, students are turning to genAI to support their technical writing. This study, which originated as a work in progress, aimed to investigate the following research question: How and why are students adopting genAI tools to surmount perceived barriers to technical writing? To investigate this question and the ways students use genAI for technical communication, we introduced structured usage of genAI in one lecture and provided forms to track genAI usage by type and the exchange in biomedical engineering courses that emphasize technical communication skills. Specifically, data was collected in three ways: (i) a pre-course survey on technical communication and genAI use; (ii) responses to a Generative Artificial Intelligence Assistance (GAIA) disclosure form submitted with assignments; (iii) a post-course survey mirroring the pre-course survey to see how student responses evolve. We aim to characterize biomedical engineering students' adoption of the new technology and what student-identified barriers exist to potentially motivate student adoption of genAI for technical writing. Our study results showed that BME students adjusted their usage of GAI for technical writing after receiving a lecture on genAI prompting techniques for writing, editing, and assessing its efficacy. The students changed their usage of genAI in different ways and fell into two categories: 1) those who adopted it willingly and used it more frequently, and 2) those who decided to abstain from using it at all. The latter group of students reported strong feelings for self-efficacy and to be independently proficient at technical writing. By examining the ways in which students adopt genAI for technical writing and the underlying intentions, we hope to identify areas in curricula that may require greater emphasis. This insight could enable us to better support our students' development of their technical writing skills.

1. Introduction

Engineering undergraduates often prioritize their technical and hands-on skills through their academic journey, sometimes at the expense of other crucial competencies. One area that frequently receives less attention is technical writing. Studies have shown that engineering students believe that their technical knowledge is adequate when job seeking, and tend to neglect their academic writing skills [1, 2]. To address this perceived difficult task of writing, many students have begun to use shortcuts and tools to overcome this, such as paying for ghost writers, installing software like Grammarly, and now with generative artificial intelligence (genAI) emerging as a popular tool students turn to circumvent heavy writing[3, 4]. In particular, educators have seen students relying on genAI in courses that prioritize critical thinking and problem solving to brainstorm, clarify questions, and improve their report writing[5-7].

As genAI tools become commonly used by students, educators are also adapting genAI to use in the classroom in parallel[8]. The implications of this are deep, as reports show students and instructors have relied on AI to varying degrees, from a learning aid to a full replacement of traditional classroom teaching[9-12]. Ely et al. adopted best practices to integrate AI into a writing-focused course where a module was used to establish boundaries for students using ChatGPT to aid their writing in sustained or long-term writing projects[13, 14]. Due to this module, the majority of students were optimistic towards using AI in future assignments for writing. However, students who use ChatGPT to write tend to run into common pitfalls such as ambiguous writing, bias reinforcement, and “hallucinations”[15]. This shift reflects the need to provide clear guidance on appropriate AI usage in educational settings. This work highlights the growing recognition that fostering AI literacy is a crucial educational practice in modern classrooms.

To investigate the ways students respond to AI literacy efforts and how they may change their use of genAI in these situations, we introduce structured usage of AI in one lecture to increase AI literacy for writing focused tasks, and provide forms to track AI usage by type and the exchange in BME courses that emphasize technical communication skills. Such instances are qualitatively analyzed to identify themes and understand two areas of interest: (1) the efficacy of AI in helping students become better technical writers, and (2) if the type of AI usage by students can be used to inform instructors of areas to improve and clarify in their curriculum[16-18]. This work expands upon a previous Work in Progress paper which analyzed the preliminary data from self-reported student responses that captured intention and purpose behind using AI for writing assignments[19]. This approach examines students’ intentions to use AI for writing, their impressions of AI literacy in the classroom, and the changes thereafter. This may offer valuable insights for educators and policymakers seeking to develop effective strategies for AI integration in engineering curriculum.

2. Methods

Data was collected in a lab-based BME course at Boston University, BE493 Biomedical Measurements & Analysis, that includes an emphasis on developing technical communication skills. Eighty-eight students were in the class, of which 88% of the students were of junior year

standing, 2% were sophomore standing, and the remaining 10% were students from an accelerated graduate engineering program whose undergraduate degrees were not in engineering. The students did not have a required technical writing class prior to this course. Data was collected in three ways: (i) a pre-course survey on technical reading/writing/presenting and AI use; (ii) responses to the Generative Artificial Intelligence Assistance (GAIA) disclosure form submitted with assignments; (iii) a post-course survey mirroring the pre-course survey to see how student responses evolve. This was an observational study, and all data was analyzed in a de-identified manner. The Boston University IRB determined that the study does not meet the definition of 'research' under 45 CFR 46.102(l), nor the definition of 'human subjects' under 45 CFR 46.102(e), thus this work was exempt from further IRB review.

2.1 Pre-course Survey to Gauge Baseline Reliance on AI in Areas of Technical Reading, Writing, and Presenting

The pre-course survey questions are listed in Appendix 7.1. Students were asked to complete the survey after the first lecture was given and before students worked on and submitted their first written assignment. Majority of the questions focused on gauging what kind of background and understanding students had with respect to technical reading, writing, and presenting. It was also interesting to see what career paths the students were interested in at the time they completed the survey and how important they thought communication skills would be in their future careers. Finally, there were two questions related to student use of generative AI tools prior to the course: first about how *often* students used generative AI tools for technical communication, and second about *what* they used such tools for if they used them. Likert scale, while others are multiple choice or open responses. For any questions that allowed for open responses, responses were analyzed taking inspiration from grounded theory[16-18]. Most questions were given on a 1 to 5 Students had to answer all questions to submit the survey.

2.2 Generative Artificial Intelligence Assistance (GAIA) Disclosure Form

The GAIA disclosure form is provided in Appendix 7.3. On every assignment, students were required to provide a statement regarding GAIA use, stating whether they did or did not use generative AI while completing an assignment. If AI was used, students were expected to submit the GAIA disclosure form with their assignment. To dispel any student perceived threat, guilt, or negative consequences for using generative AI tools, the following statement was included on the GAIA form: "*There is no academic consequence for using GAIA, however, please include this with your submitted assignments if you do. We're hoping to use this information to help you and future students be more successful.*" This was also emphasized in subsequent lectures, scheduled course times (e.g., lab sessions, office hours, etc.), and through interactions with students. The instructors strived to create a culture that not only allowed for unrestricted use of generative AI tools, but one that also embraced and encouraged students to use such tools without penalty and with accountability in hopes of receiving honest and accurate feedback on their usage.

2.3 Analysis of Disclosure Form Responses to Discern Curricula that Students Perceive as Confusing or Difficult

The percentage of students using AI for each assignment was tabulated, along with their reasons for choosing to use AI (see Appendix 7.4 for an example analysis of one assignment). Any short answers were coded into qualitative categories for further analysis based on grounded theory[16-18]. Additionally, the intentions behind student written prompts were also indicated in the

disclosure form, potentially providing insights to the instructors as to why students decided to use and/or rely on AI rather than other resources.

2.4 Structured Lecture on AI Use and Approach

To improve AI literacy focused on technical writing, one class module was conducted to demonstrate multiple methods of how to use genAI to improve writing and editing. This lecture also covered how AI was being adopted across various engineering disciplines and industries to expose students to broader trends in AI usage. This exposure allowed students to understand how their peers and future employers are integrating AI, potentially influencing their own decisions to adopt or reject AI in future tasks. This module relied on students having independently completed written assignments prior to the start of the lecture. During the lecture, the instructors showed how to access the genAI tool Microsoft Copilot through an institutionally supported website. The lecture included demonstrations of how differently composed prompts changed the AI output and how prompts can be intentionally composed to improve technical writing in a pattern-based approach, such as word choice, word location, sentence structure, and grammar. Techniques such as prompt chaining, negative prompting, and few-shot learning were shown[20-22]. The lecture also demonstrated how AI may lack in editing for sentence location, paragraph structure, and paragraph location, as well as biases that exist between various large language models (LLMs) such as Claude, ChatGPT 4, ChatGPT 3.5, and Copilot. The instructor then graded a passage of text generated by AI to illustrate areas with weak writing and how students could identify areas to be improved. Students then participated in the workshop and were encouraged to put in one paragraph of their own writing from a completed assignment into an AI tool to see how various suggested prompts changed the AI output. They were then asked to grade the output and discuss strengths and weaknesses through a reflection assignment where their perceptions of genAI were also recorded.

2.5 Comparison of AI Reliance from Start to End of the Course

Students were asked to complete a post-course survey after the penultimate lecture was given and before the students submitted their last assignment. The post-course survey questions are listed in Appendix 7.2. Like the pre-course survey, open responses were analyzed by coding with the most common themes[16-18]. Students had to answer all questions to submit the survey.

3. Results

88 students were asked to fill out the pre- and post-course surveys, and the instructors received greater than 80% response rates for both surveys. In the pre-course survey, 21.4% responded that they never tried using generative AI for writing, meaning the remaining 78.6% have tried using AI for writing before the course with varying frequency (**Figure 1**). By the end of the course, nearly 40% of students said they did not use AI for writing during the course, while about 60% said they did with varying frequency. Interestingly, the number of students using AI often for writing (4 or 5 on the Likert scale) increased post-course relative to pre-course. In the post-

course survey, students self-reported how often they used AI for writing during the course (**Figure 2**).

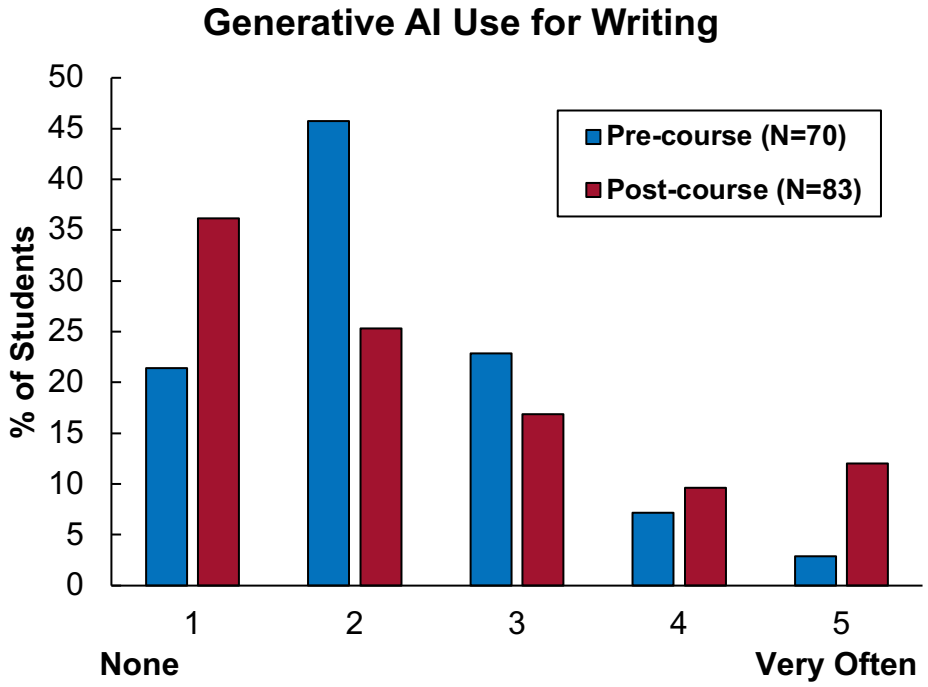

Figure 1. Pre- vs post-course survey results of how often students use GenAI for technical writing. Post-course survey used language asking for usage since the start of the semester.

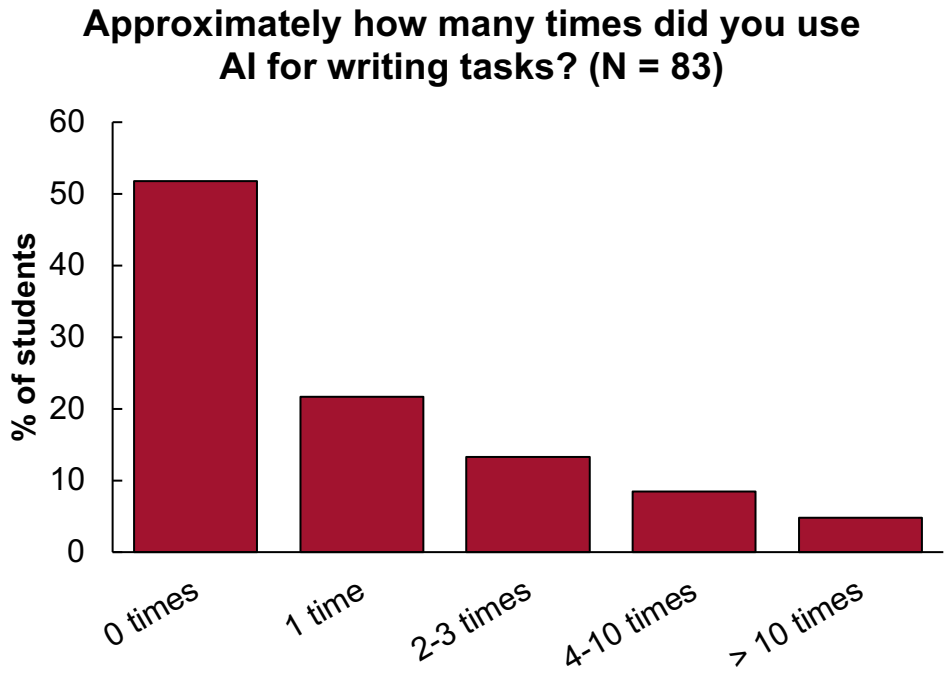

Figure 2. Self-reported number of times students used GenAI for writing during the course.

Tables 1 and 2 summarize the results from the pre- and post-course survey question about how students have used AI before the class to serve as a baseline measure and during the class, respectively. The responses were coded by one author, which were then reviewed by both authors to come to a consensus. It should be noted that a response could be counted toward multiple categories depending on the content of the response. For example, one student in the pre-course survey responded: "I use AI tools to enhance my vocabulary and present my ideas in a way that flows better than if I did not use them." Accordingly, their response counted towards the categories of both "Clarity/Brevity/Grammar/Editing" and "Organize Writing/Outlining." Interestingly, "No AI Usage" rose to the top three use categories post-course relative to pre-course.

Table 1. Pre-course Generative AI Use Categories (N=70)

Reported Use	**Count**
Clarity / Brevity / Grammar / Editing	26
Search Engine / General Knowledge	15
Idea Generation / Brainstorming	14
No AI Usage	12
Coding / Programming	11
Organize Writing / Outlining	8
Generate Emails / Cover Letters	5
Creative Non-Academic Pursuits	4
Problem Solving (math/science Qs)	3
Summarize Text	3

Table 2. Post-course Generative AI Use Categories (N=83).

Reported Use	Count
No AI Usage	33
Clarity / Brevity / Grammar / Editing	28
Idea Generation / Brainstorming	27
Coding / Programming	19
Answering Lab Worksheet Qs	10
Writing Lab Reports	9
Writing Group Project Report	8
Search Engine / General Knowledge	3
Problem Solving (math/science Qs)	4
Summarize Text	1

Table 3 summarizes the feelings of students towards using genAI for writing post course into the three categories of positive, mixed, and negative with counts and an example quote from student responses for each category. **Table 4** provides a breakdown of those feelings, and the top three feelings of students towards AI for writing post course were skepticism, helpful, and interest, with negative feelings denoted in red text. Similar to **Tables 1 and 2**, it should be noted that a response could be counted toward multiple categories depending on the content of the response. **Tables 3 and 4** were coded together by both authors.

Table 3. Post-course Generative AI Writing Feelings Summary (N=83)

FEELING	Positive	Mixed	Negative
COUNT	20	28	35
EXAMPLE	"I didn't know that AI could be used to correct for writing/grammar until we had that lecture which was really interesting, and I think using AI to help perhaps edit my own writing for clarity could be a helpful use of it."	"It can really help with writing for finding synonyms and better phrasing especially when stuck, but I try not to use it out of principle. I don't want to lose my creativity and critical thinking skills."	"I don't like it. Using it for editing writing wasn't useful for me during the workshop, and I have serious moral concerns about using it to fully generate writing. It's scraping someone else's words and work. I'd rather develop my own writing skills."

Table 4. Post-course Generative AI Writing Feelings Breakdown (N = 83).

Feeling (negative, positive)	Count
Skepticism	37
Helpful	22
Interest	17
Alienation	11
Apathetic	7
Frustrating	7
Other Uses	5
Grateful	4
Guilt	4
Conflicted	3
Dislike	3
Absolved	2
OK	2
Supportive	2
Empowered	1

Finally, just over 75% of reporting students expressed that they found the dedicated lecture and workshop on using LLMs for writing and editing to be helpful or very helpful (**Figure 3**).

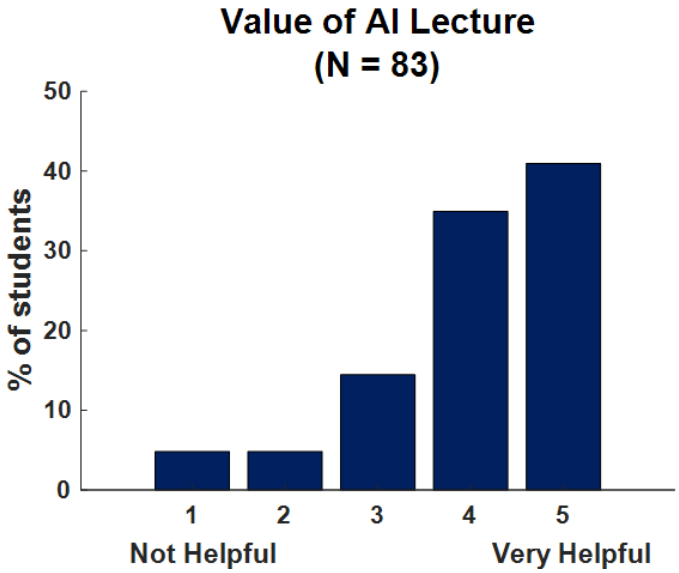

Figure 3. Student rating of the structured lecture on AI use and approach.

4. Discussion

Collected responses showed that more than 50% of students use AI, and they freely disclose use if the instructors are clear that there is no penalty. The goal of this self-reported use was to ensure that we observed the undiluted intentions behind students who decided to adopt AI for writing and those who did not. While our study may have incurred the Hawthorne effect and artificially increased the use of AI due to AI exposure in the course, this before and after change is indirectly addressed with the pre- and post-course survey data[23].

Students found the structured module was very useful (Figure 3) and students referenced prompt engineering techniques introduced in the lecture as useful tools since they were specifically for technical writing. One student stated, "*I didn't know that AI could be used to correct for writing/grammar until we had that lecture which was really interesting, and I think using AI to help perhaps edit my own writing for clarity could be a helpful use of it.*" The pre- and post-course answers showed that students were more deliberate in their AI usage after the module, choosing to follow the guidance given directly during the lecture and workshop. We saw an increase in students using genAI for editing and students tended to use genAI for simpler one-off tasks, such as for correcting grammar and brainstorming (Table 1 and 2). This was acknowledged by some students in their reflections, with examples of how genAI editing was better than TA feedback for grammar, clarity, and concision at times. However, students also noted that they felt genAI lacked the ability to maintain technical and scientific accuracy and content. We also saw reduced use of AI as a search engine and for answering questions about knowledge gaps. This corresponded with an increase in students who had negative views and increased skepticism in the technology (Table 3).

4.1 An Emerging Split in Adoption of AI and Rejection of AI

At the end of the course, we see a polarization in the frequency of genAI use by students, with a discernible shift towards both ends of the usage spectrum (Figure 1). More than one third of students decided to not utilize genAI as a tool for their writing assignments (Table 2) and had negative feelings towards it (Table 3). This points to a group of students gaining AI literacy through the class and then deciding to no longer use it. An example of a student who was part of this group and reflected this sentiment: "*I don't like it in general. It may have its uses, but overall I don't like the growing trend of relying on AI for skills that we should be developing ourselves during college. I also have my doubts about any ethically sound way to use it.*"

Our survey answers reflect a high degree of skepticism and belief that the generated text is not reliable in contextual and scientific content. Students in this group rejected the use of AI due to the low quality and accuracy of the generated text, as seen in this student's response: "*I don't like directly copying the AI's text, because it can often make mistakes in things and sometimes it has very repetitive and non-concise reasoning.*"

There was also a smaller shift of students who increased their use of genAI after the AI literacy lecture as compared to the beginning of the semester, as seen in Figure 1. A representative quote from a student from this group stated: "*I became very interested right before the guest lecture and became even more interested afterwards. I learned how AI skills are similar to research skills in a way; developing them is worth investing time into.*"

4.2 Limitations

The pre-course survey questions solicited students for how they used AI before coming into the course, while the post-course survey questions asked students how they used AI during the course. This potentially led to some differences in the pre and post codes related to AI usage in Tables 1 and 2, respectively. For example, the pre-course survey asked the open response question 'If you use these AI tools, what specifically have you used them for?' (section 7.1, question 11), which followed the question 'How often do you use ChatGPT, BingChat or other AI Large Language Model (LLM) tools for writing tasks? On an integer scale of 1 to 5, where 1 is "Never Tried" and 5 is "Very Often".' On the other hand, the post-course survey asked the question 'What did you use generative AI for? Select all that apply and add anything in the Other field you used genAI for that's not already listed below.' listing several codes for students to choose from, including assignment types, as well as a write-in option (section 7.2, question 8).

Another limitation was that students had to answer all questions to submit the pre- and post-course surveys, which could have elicited non-meaningful responses. However, if there were non-meaningful responses, the number of them did not rise to a noticeable level or were exceedingly few.

5. Future Work Incorporating genAI into Curriculum and Increasing AI Literacy and Conclusion

Additional research must be conducted to identify the nuanced themes from these student perceptions of AI as it is increasingly integrated into the workflow of the average engineering student. From our study, students appear to have low expectations regarding genAI's ability to improve their academic performance in writing assignments. However, as the capabilities of AI tools become more reliable, we expect to see an accelerated adoption of genAI for not just writing, but also other engineering tasks. Additionally, the polarization of students choosing to increase the frequency of use of genAI and those who reject it could additionally be studied using mixed-model approaches in the future.

Further research will study paired data of student responses to comfort levels for technical communication in writing, reading, and presentations, and their reliance on genAI to write and edit. Additionally, a multi-institutional study will compare usage of genAI for technical writing in a lab course to usage in a scientific writing course where written formats are review papers, grants, and academic journal papers.

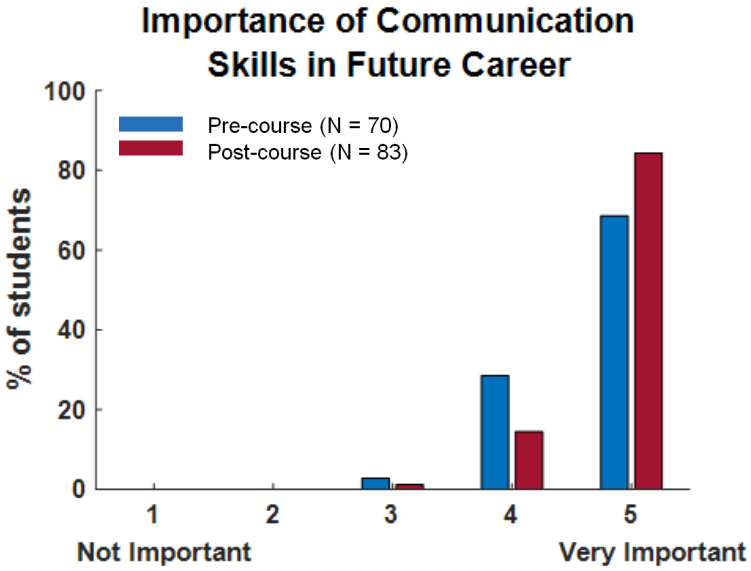

Figure 4. Student-reported importance of communication skills in their future careers, on pre- and post-course surveys.

Regardless of AI usage, students placed more value on communication and writing skills for their future careers (**Figure 4**). With the value placed on communication skills by both students and employers, there is a persistent drive to improve those skills through coursework[24, 25]. In this context, genAI is likely to emerge as a tool that students will increasingly leverage to augment their written communication. As instructors, we must ensure that we can properly assess student learning and competence in technical writing. Through this study, we found that students sought feedback and editing help through ChatGPT and are optimistic in continuing to do so after the class. We also learned that the module was well received due to it providing a scaffold for many students that were novices in using genAI to try out in a low-risk space with

boundaries. Based on these student reflections, instructors can improve courses with high technical writing components in two key ways. Firstly, develop targeted modules on specific genAI applications. These focused lessons could help students to more strategically and critically evaluate genAI generated text. Secondly, find ways to implement personalized feedback as students value the tailored guidance that the genAI tool was able to return. By incorporating these elements, instructors can better prepare students to use genAI tools effectively while still developing their own critical thinking and writing skills.

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7. Appendix

7.1 Pre-course survey questions

1. What career path are you most interested in pursuing right now? Select all that apply.
    a. Graduate school
    b. Medical school
    c. Biotechnology sector (R&D)
    d. Lab manager/technician (Academic R&D)
    e. Consulting
    f. Other professional school
    g. Sales/Marketing
    h. Data analytics
    i. Software/Hardware engineering
    j. Other: [open response]

2. How important do you believe communication skills will be in your future occupation? On an integer scale of 1 to 5, where 1 is “Not Important” and 5 is “Very Important”.

3. How comfortable are you with finding and accessing primary technical articles using scholarly databases (e.g., Pubmed, Web of Science, Engineering Village)? On an integer scale of 1 to 5, where 1 is “Never Tried” and 5 is “Very Comfortable”.

4. Have you used Google Scholar or the National Center for Biotechnology Information (NCBI) to stay updated on technical knowledge?
    a. Yes
    b. No
    c. What?

5. How comfortable are you with using citation managers (Zotero, Endnote, Papers, Mendeley, etc.)? On an integer scale of 1 to 5, where 1 is “Never Tried” and 5 is “Very Comfortable”.

6. How comfortable are you with reading technical papers from scientific/engineering journals? On an integer scale of 1 to 5, where 1 is “Never Tried” and 5 is “Very Comfortable”.

7. Rate your understanding of the scientific writing process. On an integer scale of 1 to 5, where 1 is “Weak” and 5 is “Strong”.

8. Rate your understanding of ethics in scientific publication. On an integer scale of 1 to 5, where 1 is “Weak” and 5 is “Strong”.

9. How comfortable are you with preparing and presenting technical presentations? On an integer scale of 1 to 5, where 1 is “Never Tried” and 5 is “Very Comfortable”.

10. How often do you use ChatGPT, BingChat or other AI Large Language Model (LLM) tools for writing tasks? On an integer scale of 1 to 5, where 1 is “Never Tried” and 5 is “Very Often”.

11. If you use these AI tools, what specifically have you used them for? [open response]

12. What is one area of technical communication that you would like to learn about or improve on by the end of this course? [open response]

7.2 Post-course survey questions

1. How important do you believe communication skills will be in your future occupation? On an integer scale of 1 to 5, where 1 is “Not Important” and 5 is “Very Important”.

2. Compared to the start of the semester, how comfortable are you with reading technical/scientific papers? On an integer scale of 1 to 5, where 1 is “Never Tried” and 5 is “Very Comfortable”.

3. Compared to the start of the semester, how comfortable are you with technical/scientific writing? On an integer scale of 1 to 5, where 1 is “Never Tried” and 5 is “Very Comfortable”.

4. Compared to the start of the semester, how often did you use ChatGPT, BingChat or other generative AI Large Language Model (LLM) tools for writing tasks? On an integer scale of 1 to 5, where 1 is “Never Tried” and 5 is “Very Often”.

5. Approximately how many times did you use generative AI for writing tasks? (enter a number, or 0 for never).

6. Compared to the start of the semester, how often did you use ChatGPT, BingChat or other generative AI Large Language Model (LLM) tools in general? On an integer scale of 1 to 5, where 1 is “Never Tried” and 5 is “Very Often”.

7. Approximately how many times did you use generative AI in general? (enter a number, or 0 for never).

8. What did you use generative AI for? Select all that apply and add anything in the Other field you used genAI for that's not already listed below.
    a. I did NOT use genAI
    b. For brainstorming
    c. For coding
    d. For editing grammar, clarity, etc.
    e. For writing responses to lab worksheet questions
    f. For writing lab reports
    g. For writing the final project report
    h. Other: [open response]

9. What kind of feelings do you have towards you using AI for writing? (Interest, skepticism, secrecy, guilt, apathy, or other feelings?) [open response]

10. What kind of feelings do you have towards you using AI in general? (Interest, skepticism, secrecy, guilt, apathy, or other feelings?) [open response]

11. Compared to the start of the semester, how comfortable are you with giving technical presentations? On an integer scale of 1 to 5, where 1 is “Never Tried” and 5 is “Very Comfortable”.

12. Rate the value of the "AI Tools for Technical Communication" lecture/workshop we had in helping you develop different technical reading or writing skills. On an integer scale of 1 to 5, where 1 is “Not Very Helpful” and 5 is “Really Helpful”.

7.3 Generative Artificial Intelligence Assistance (GAIA) disclosure form

Generative Artificial Intelligence Assistance (GAIA) Disclosure

There is no academic consequence for using GAIA, however, please include this with your submitted assignments if you do. We're hoping to use this information to help you and future students be more successful.

Name:
Assignment:

0. Were tool(s) used:
__ Yes
__ No (if select this option, then no need to fill out rest of the form)

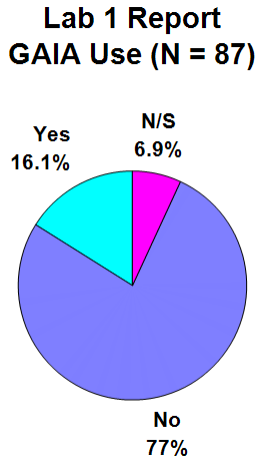
1. Name of tool(s) used:

2. How were tool(s) used (mark all that apply):
__ To clarify or summarize ideas/concepts
__ I pasted text I wrote for editing (clarity and grammar)
__ To generate elements of text (i.e., phrases)
__ To help me brainstorm on a topic that is new to me
__ To generate long stretches of text (i.e., sentences/paragraphs)
__ To identify knowledge gaps
__ To produce conceptual arguments
__ To generate visual aids or illustrations of concepts
__ To generate code used for analyses
__ To better understand code syntax / function
__ Other (please explain below):

3. Why were tool(s) used (mark all that apply):
__ To save time
__ To surmount writer's block
__ To stimulate thinking
__ To handle mounting stress
__ To check for grammatical mistakes
__ To clarify prose
__ To translate text
__ To experiment for fun
__ Other (please explain below):

4. Paste in the entire exchange with the AI tool(s) below

7.4 Example analysis of disclosure form responses of one assignment



N/S = Not Submitted