Board 19: Work in Progress: Towards Self-reported Student Usage of AI to Direct Curriculum in Technical Communication Courses

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1. Introduction

The use of AI by students in biomedical engineering courses has rapidly grown in the past year [1]. Courses that prioritize critical thinking and technical writing have seen students relying on AI to brainstorm, clarify questions, and improve their report writing. To investigate the ways students use AI in these situations, we introduce structured usage of AI in one lecture 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 [2]–[4].

2. Methods

Thus far, data is being collected in one lab based BME course (BE493) that includes an emphasis on developing technical communication skills, and the students are of junior year standing. Data is 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 is an observational study, and all data is 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 is 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 5.1. Students are asked to complete the survey after the first lecture is given and before students work on and submit their first assignment. Majority of the questions focus on gauging what kind of background and understanding students have with respect to technical reading, writing, and presenting. It is also interesting to see what career paths the students are interested in at the time they complete the survey and how important they think communication skills will be in their future careers. Finally, there are two questions related to student use of generative AI tools prior to the course: first about how *often* students use generative AI tools for technical communication, and second about *what* they use such tools for if they use them. Most questions are given on a 1 to 5 Likert scale [5], while others are multiple choice or open responses. For any questions that allow for open responses, we code the responses so that all questions can be analyzed by observing the distribution of answers to each question as percentages of the total number of students who respond. Students must answer all questions to submit the survey.

2.2 Generative Artificial Intelligence Assistance (GAIA) Disclosure Form

The GAIA disclosure form is provided in Appendix 5.2. On every assignment, students are required to provide a statement regarding GAIA use, stating whether they did or did not use generative AI while completing an assignment. If AI is used, students are 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 is 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 is also emphasized in subsequent lectures, scheduled course times (e.g., lab sessions, office hours, etc.), and through interactions with students. The instructors strive to create a culture that not only allows for unrestricted use of generative AI tools, but one that also embraces and encourages 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 will be tabulated, along with their reasons for choosing to use AI. Any short answers will be coded into qualitative categories for further analysis. To quantitatively analyze the curriculum areas where students rely on AI for support, we will measure the degree of complexity of the entire prompt and exchange students have with AI tools, which is submitted along with the disclosure form. We define an AI interaction complexity ratio between the volume of prompt entered to the volume of output generated (e.g., submitting a paragraph for grammar editing vs requesting an explanation to a technical question) and will generate a distribution of AI interaction ratios across all assignments. The count of how many prompts and responses each student has will also be noted as a separate measure of complexity of the interaction. Additionally, the intentions behind student written prompts are 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

One lecture will demonstrate "prompt engineering" for improving technical writing using AI. At this stage, students will have a completed written assignment to edit during the in-class workshop. The instructors will demonstrate how differently composed prompts change the AI output and how prompts can be intentionally composed to be useful in improving technical writing in a pattern-based approach, such as for word choice, word location, sentence structure, and grammar. There will also be demonstrations of how AI may lack in editing for sentence location, paragraph structure, and paragraph location. Students will then be encouraged to put in one paragraph of their own writing into an AI tool to see how various suggested prompts change the AI output. They will then be asked to grade the output and discuss strengths and weaknesses.

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

Students will be asked to complete a post-course survey after the penultimate lecture is given and before the students submit their last assignment. The post-course survey will mirror questions from the pre-course survey to see if there are any changes by the end of the course. Like the pre-course survey, open responses will be coded, and response distributions will be generated for each question. Students must answer all questions to submit the survey.

3. Preliminary Results & Discussion

88 students were asked to fill out the pre-course survey, and the instructors received an 80.7% response rate. 21.1% responded that they never tried using generative AI, meaning the remaining 78.9% have tried using AI before the course with varying frequency (**Figure 1**). The top three

ways students have used AI are: (1) for clarifying/making their writing more concise, (2) as a search engine/for general knowledge, and (3) for idea generation/brainstorming. **Table 1** summarizes the results from the pre-course survey question about how students have used AI before the class to serve as a baseline measure. The responses were coded, and it should be noted that a response could be counted toward multiple categories depending on the content of the response. For example, one student 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" and "Organize Writing/Outlining."

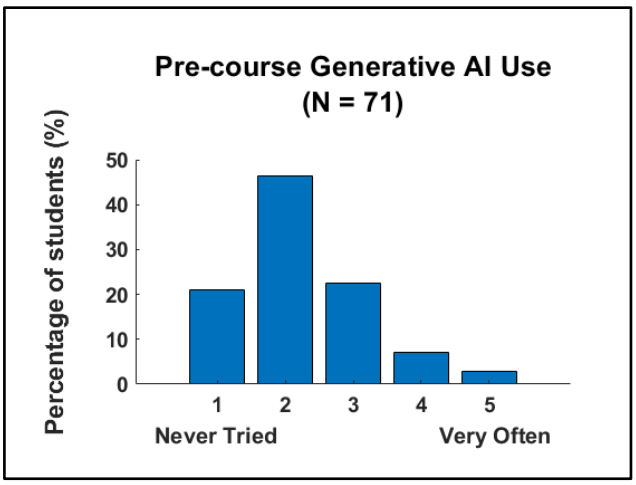

Figure 1. Breakdown of student responses on pre-course survey question about how often they use AI. Average count for a 5 (Very Often) was 15 times/semester.

Work is ongoing to analyze responses to all pre-course survey questions. Since the study is collecting responses from an ongoing course, a complete analysis is forthcoming. Thus far, collected responses show that more than 50% of students use AI, and they freely disclose use if the instructors are clear that there is no penalty. Knowing that students are willing to self-report usage of AI on assignments, as instructors we must ensure that we can properly assess student learning and competence in technical writing.

Table 1. Pre-course Generative AI Use Categories

Clarity / Brevity	19
Search Engine / General Knowledge	15
Idea Generation / Brainstorming	14
No AI Usage	12
Coding / Programming	11
Organize Writing / Outlining	8
Grammar / Spelling	7
Generate Emails / Cover Letters	5
Creative Non-Academic Pursuits	4
Problem Solving (math/science Qs)	3
Summarize Text	3

In a course that requires technical writing, the student perception of what constitutes success is less clear. Our study aims to categorize self-reported instances in which students turn to AI for support, as well as the reasons behind those decisions. While our study may incur the Hawthorne effect [6] and artificially increase the use of AI due to AI exposure in the course, this before and after change will be indirectly addressed with the pre- and post-course survey data. Importantly, the overall goal is to better understand the intention behind AI usage to potentially help instructors identify areas where students feel least supported or confident so that they can work on developing curriculum in those areas and improve student learning.

The instructors here are ultimately interested in how to best navigate the role that generative AI tools will play in the experience and learning outcomes of their students related to course objectives, such as improving written and oral technical communication skills through written assignments and class presentations. The long-term goal of the study is to collect and analyze cross-institutional data to investigate and compare AI usage by BME students from different institutions, and we are currently working towards a multi-institution IRB to do so.

4. References

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[2] C. F. Conrad, "Grounded Theory: An Alternative Approach to Research in Higher Education," *Rev. High. Educ.*, vol. 5, no. 4, pp. 239–249, 1982, doi: 10.1353/rhe.1982.0010.

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[4] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qual. Res. Psychol.*, vol. 3, no. 2, pp. 77–101, 2006, doi: 10.1191/1478088706qp063oa.

[5] R. Likert, "A technique for the measurement of attitudes," *Arch. Psychol.*, vol. 140, pp. 44–53, 1932.

[6] J. G. Adair, "The Hawthorne effect: A reconsideration of the methodological artifact," *J. Appl. Psychol.*, vol. 69, no. 2, pp. 334–345, May 1984, doi: 10.1037/0021-9010.69.2.334.

5. Appendix

5.1 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]

5.2 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: