Board 20: Work in Progress: Understanding Student Perceptions and Use of Generative Artificial Intelligence for Technical Writing

Dr. Amy N Adkins, North Carolina State University

Amy N. Adkins is a n Assistant Teaching Professor in the Joint Department of Biomedical Engineering at University of North Carolina (UNC) and North Carolina State University (NCSU). She received her Ph.D. and M.S. in Biomedical Engineering from Northwestern University and her B.S. in Engineering Science from St. Mary's University in San Antonio. Her technical research which relates to her PhD Dissertation is focused on utilizing novel imaging techniques to quantifying adaptation of muscle architecture in humans. She also desires to implement innovative teaching, mentoring, and hands-on problem solving to develop students' deep understanding of engineering principles and to inspire them to tackle real-world problems which can aid human health.

Dr. Naji S Husseini, North Carolina State University

Naji Husseini is an associate teaching professor and associate director of undergraduate studies in the Joint Department of Biomedical Engineering at the University of North Carolina at Chapel Hill and North Carolina State University.

Dr. Lianne Cartee, North Carolina State University

Lianne Cartee is Director of Undergraduate Studies in the Joint Department of Biomedical Engineering at the Univ. of North Carolina at Chapel Hill and North Carolina State University.

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Open generative artificial intelligence's (AI's) ability to craft human-like text concerns educators who fear students will complete assignments without meeting course objectives. Currently, AI detection is unreliable, adding to educators' concerns. While these fears are valid, we believe the best way forward is to teach students how to use this powerful technology ethically and effectively. Best practices for using AI in writing scientific manuscripts are being developed [1-2], but its use as an instructional aid for teaching scientific writing is less understood [3]. For biomedical engineering (BME), technical writing is particularly important: they need to master both engineering and scientific approaches to written communication across multiple formats to various audiences. We have previously developed evidence-based technical writing modules, tailored to BME students, and vertically integrated them throughout our core curriculum [4]. These modules were developed before widespread AI availability. To develop guidelines on instructional AI use, we first need to understand students' 1) perception on its utility and ethical use and 2) prior and current use of AI. This work in progress addresses these items to later design teaching modules on generative AI's use in writing and as a tool for providing prompt and adequate feedback.

Methods

Participants: Student participants were recruited from the Joint Biomedical Engineering (BME) Department at North Carolina State enrolled in BME 205: Biomedical Mechanics or BME 301: Human Physiology in the Fall of 2023. These courses were required courses and included laboratory sections with technical writing assignments. 100 students consented: 32 (out of 49) students who were enrolled in Biomedical Mechanics and 68 (out of 102) students from Human Physiology. NC State's Institutional Review Board approved this study under protocol #25182.

Survey: Anonymous pre- and post-course surveys were administered to participants. The pre-course survey asked students to describe their experience level with using AI (never used, beginner, proficient, expert) and prior use of AI in college for various tasks (scientific writing, humanities essays, editing their writing, STEM homework problems, and coding/programming assignments) (Table A.5). The pre-course survey also gathered their opinions on how ethical and useful AI is for common technical-writing tasks (e.g., writing drafts, writing entire manuscripts, editing manuscripts, brainstorming technical content, finding relevant scientific sources, making figures, and making tables) on a four-point Likert scale (strongly disagree, disagree, agree, strongly agree). In both courses, the instructor stated on their syllabi and in class that generative AI's use on written assignments was permitted without penalty if students cited its use. Students were asked on the assignment to include the name of the AI tool they used and describe how it was used (e.g., brainstorm, edit, make a table, etc.). The instructors of both courses demonstrated the use of AI as a tool but did not provide specific instruction to students on how to use it effectively.

In addition to the questions from the pre-course survey, the anonymous post-course survey asked students to report on a four-point Likert scale how they used AI during the course and whether they felt AI helped them learn to write effectively or if it improved their writing grades.

Statistical Analysis: Mann-Whitney U tests compared pre- vs post-course survey results and Wilcoxon signed-rank tests compared whether Likert scores were significantly different than a neutral response.

Results

Experience: The students' experience level with AI increased over the semester ($p < 0.001$). Substantially fewer students reported "never using" AI (post: 25% vs pre: 50%) but most students still reported being "beginners" (62%) leaving only 13% reporting being "proficient" or "expert."

Useful tool: Over the semester, students' level of disagreement that AI was a useful tool for writing entire manuscripts, creating figures, or creating tables increased significantly (Fig. 1, Table A.1). When asked in the pre-course survey whether AI was useful for a series of technical writing tasks, students agreed it was useful for writing drafts, editing, and brainstorming; disagreed with its being useful for writing entire manuscripts and for finding relevant scientific sources; and were neutral on its usefulness for creating figures and tables. In the post-course survey agreement that AI is a useful tool for editing and brainstorming and disagreement that it was a good tool for sources persisted (Fig. 1, Table A.1).

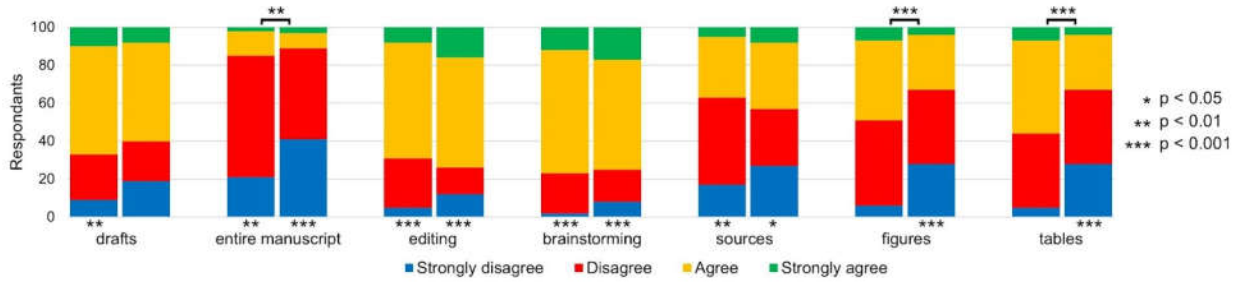

Fig. 1. Pre (left) and post (right) responses for the question "AI is a useful tool for [...]." Above-axis significance is comparing pre to post results. Below-axis significance is comparing deviation from a neutral response.

Ethics: Initially, students agreed that using AI for editing, brainstorming, figure creation, and table creation was ethical while using AI for entire manuscripts was not ethical (Fig. 2, Table A.2). In the post-course survey, students were neutral on the ethics of figure and table creation but agreed that it is ethical to use AI to find relevant scientific sources. There was higher agreement in the post-course survey with the statement that AI is ethical for editing, brainstorming, and finding relevant scientific sources and references as compared to the pre-course survey.

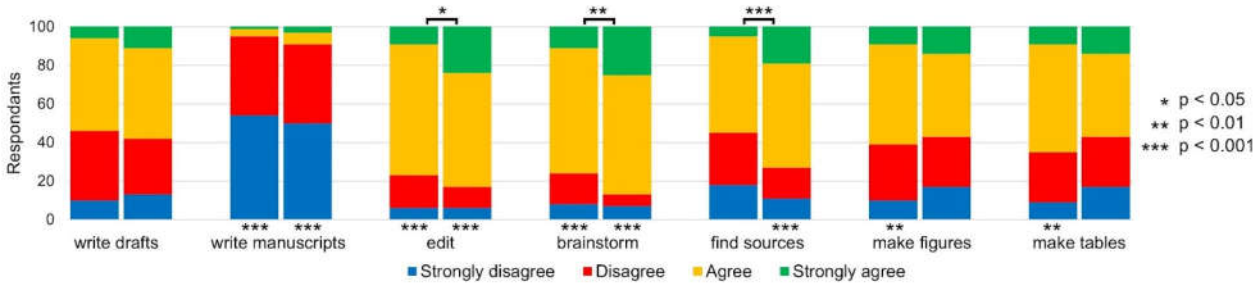

Fig. 2. Pre (left) and post (right) responses for the question "In my opinion, using AI to [...] is ethical." Above-axis significance is comparing pre to post results. Below-axis significance is comparing deviation from a neutral response.

Results Perceptions: Students significantly felt that generative AI should be taught in class (Fig. 3, Table A.3). Student perceptions on whether AI should be allowed in class significantly shifted from neutral at the beginning of the semester to agreement at the end. Students remained split on the statement that AI "prevents learning" on the pre- and post-course survey, with representative students commenting that "AI is an exceptional tool that aids learning" and others fearing that "it can be dangerous in our independence and originality of thought and word." In the pre-course survey, students were concerned about the ethics around AI and, though not statistically different, their agreement lessened slightly in the post-course survey.

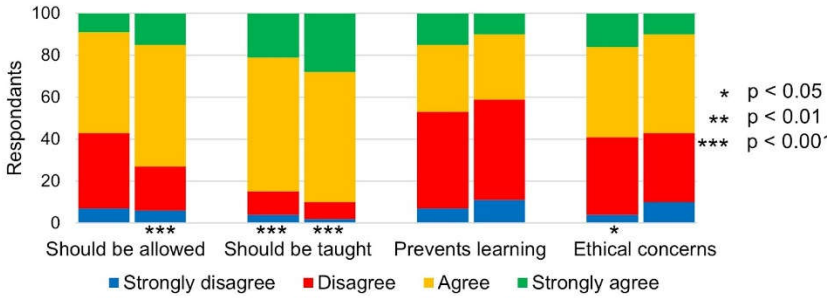

Fig. 3. Pre (left) and post (right) responses for questions regarding AI perception. Below-axis significance is comparing deviation from a neutral response. Full question prompts are in Table A.3**.**

Use in the class: The largest use of AI reported in these technical writing courses was for brainstorming (34%), editing (29%), and writing drafts (28%) (Table A.4). No students reported using AI to write their entire manuscript. Of the students who reported using AI during the semester for any writing tasks, the majority agreed with the statement that AI aided their learning ($p < 0$ .001) but were neutral on whether it improved their grade.

Conclusions

At the start of the semester, only half of our students reported having ever used a generative AI tool. After being encouraged and explicitly permitted to use AI, an addition 25% of students used AI and only 13% reported being proficient or experts. Though there was some increase in use over the semester, more than 60% of the study participants reported not using AI for writing tasks in the writing intensive courses included in this study. Furthermore, the majority of students agreed that using AI for writing tasks such as editing and brainstorming was ethical, so they are not ethically opposed to using AI for most writing tasks other than writing entire manuscripts. *Thus, we attribute the low adoption rate for writing using AI as a tool to a lack of formal instruction on how to use chatbots effectively, rather than an ethical aversion to the technology.* In fact, 90% of students agreed on the post-course survey that AI should be taught in school. Our results suggest that although more students tried to use AI, they were, for the most part, dissatisfied with its results or the ease of producing useful results for technical writing and so agreed more strongly with its needing to be formally taught. Among students who reported using generative AI over the semester, there was strong agreement that it improved their learning. A limitation of our AI survey data being anonymized is that this student-reported result on improved learning could not be confirmed with course writing data. Still, this study, which provides an understanding of student perceptions and prior use of AI, will guide future work aimed at integrating generative AI approaches into technical writing instruction.

References

[1] "Best Practices for Using AI When Writing Scientific Manuscripts: *Caution, Care, and Consideration: Creative Science Depends on It" ACS Nano* 2023, 17, 5, 4091–4093. 2023. https://doi.org/10.1021/acsnano.3c01544
[2] Leung TI, de Azevedo Cardoso T, Mavragani A, Eysenbach G. Best Practices for Using AI Tools as an Author, Peer Reviewer, or Editor. J Med Internet Res. 2023 Aug 31;25:e51584. doi: 10.2196/51584. PMID: 37651164; PMCID: PMC10502596.
[3] J. Qadir, "Engineering Education in the Era of ChatGPT: Promise and Pitfalls of Generative AI for Education," 2023 IEEE Global Engineering Education Conference (EDUCON), Kuwait, Kuwait, 2023, pp. 1-9, doi: 10.1109/EDUCON54358.2023.10125121.
[4] A. Adkins, N. S. Husseini, & L. Cartee. "Work in Progress: Technical Scientific Writing across the BME curriculum," ASEE Annual Conference & Exposition, Baltimore, Maryland, June 2023. 10.18260/1-2--42706

Appendix 1

Survey results

Tables contain average survey scores for pre- and post-course surveys. Tables A.1 through A.4 have response scores ranged from -2 (strongly disagree) to 2 (strongly agree). Wilcoxon signed rank tests determined whether individual questions were significantly different from a neutral response of 0. Mann-Whitney U test compared pre- and post-survey results.

Table A.1: Pre, post, and pre minus post results for the question "AI is a useful tool for […]"

Question	Pre	Post	Post – Pre
Writing drafts	0.35**	0.09	-0.26
Writing entire manuscript	-0.89**	-1.16***	-0.27**
Editing manuscripts	0.41***	0.52***	0.11
Brainstorming content	0.64***	0.59***	-0.05
Finding sources	-0.38**	-0.33*	0.05
Making figures	-0.01	-0.58***	-0.57***
Making tables	0.14	-0.58***	-0.72***

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

Table A.2: Pre, post, and pre minus post results for the question "In my opinion, using AI to […] is ethical."

Question	Pre	Post	Post – Pre
Write drafts	0.04	0.14	0.10
Write entire manuscript	-1.43***	-1.29***	0.14
Edit manuscripts	0.57***	0.84***	0.27*
Brainstorm content	0.55***	0.92***	0.37**
Find sources	-0.03	0.54***	0.57***
Make figures	0.21**	0.11	-0.10
Make tables	0.30**	0.11	-0.19

* = $p < 0.05$ ** = $p < 0.01$ *** = $p < 0.001$

Table A.3: Pre, post, and pre minus post results for perception of AI questions.

Question	Pre	Post	Post – Pre
Using AI in writing is the future and should be allowed	0.16	0.55***	0.39*
Effective AI use should be taught in college	0.87***	1.06***	0.19
Using AI will prevent me from learning how to write effectively	0.02	-0.19	-0.21
I am concerned about how to use AI ethically in my classes	0.30*	0.14	-0.16

* = p < 0.05 ** = p < 0.01 *** = p < 0.001

Table A.4: Pre, post, and pre minus post results for the question "I have used AI in this class to […]"

Question	Post
Write drafts	-1.22***
Write entire manuscript	-1.75***
Edit manuscripts	-0.90***
Brainstorm content	-0.75***
Find sources	-1.44***
Make figures	-1.68***
Make tables	-1.71***

* = p < 0.05 ** = p < 0.01 *** = p < 0.001

Table A.5: Pre and post results for the question "I have used AI in college in the following ways."

Question	Pre		Post	
	Yes	No	Yes	No
For scientific writing	6	94	36	64
For humanities-related writing	15	85	27	73
To edit any writing	30	70	47	53
To write emails	15	85	14	75
For STEM homework problems	14	86	26	74
For coding or programming (optional)	9	77	20	74