Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025
Paper ID #47805

From Journal to General: Teaching Engineers to Write for All Audiences

Amanda Dawn Hilliard, The Johns Hopkins University

Amanda Hilliard received her MA in Teaching English as a Second or Foreign Language and PhD in Applied Linguistics from the University of Birmingham in the UK. She has taught writing and communication courses abroad in South Korea, Vietnam, and Ecuador, and in the U.S. in Georgia, Texas, Arizona, and Maryland. She currently teaches in the Center for Leadership Education at the Johns Hopkins University.

From Journal to General: Teaching Graduate Engineering Students to Write for All Audiences

Abstract - The Accreditation Board for Engineering and Technology (ABET) identifies "an ability to communicate effectively with a range of audiences" as a critical learning outcome for engineering programs. This underscores the importance of engineers learning to articulate their ideas clearly, not only to peers within their field but also to non-specialist audiences. While recently developed generative AI tools offer support for crafting written documents, they are not a substitute for mastering the foundational skills necessary for clear and effective technical communication. Moreover, students frequently find themselves unprepared for the advanced writing demands of graduate school and professional work.

In response to these challenges, this paper introduces a technical communication course for graduate engineering students that guides students through the writing process for both expert and general audiences. After reading and discussing several published examples in class, students are tasked with writing an academic journal article based on their research, which they then adapt into a magazine-style article intended for a broader, non-expert readership. The class concludes with a poster session where students present their work visually and orally. Using these assignments, the course takes a genre approach and emphasizes both the writing process and audience, key principles of technical writing applicable across different formats. This paper further offers sample classroom activities to teach these principles and provides practical strategies to assist students in effectively modifying their written communication to suit different audiences.

I. INTRODUCTION

The importance of effective communication in engineering has long been recognized. In 1916, for example, the Cleveland-based engineering educator Barker wrote: "To be successful in engineering, training in mathematics and science is absolutely necessary; a good knowledge of written and spoken English is a further requirement" [1]. In its report on "The Engineer of 2020," The National Academy of Engineering listed communication skills as a key attribute of future engineers. "As always," the report stated, "good engineering will require good communication" [2]. As of 2025, the Accreditation Board for Engineering Programs (ABET) lists "an ability to communicate effectively with a range of audiences" as its third student outcome [3]. Undoubtedly, engineers in all fields must possess strong communication skills to succeed.

Yet, writing continues to cause anxiety amongst graduate engineering students. Graduate students face high-stakes, long-term writing projects like journal articles and dissertations, and may suffer from poor time management, procrastination, fear of criticism, and lack of confidence [4], [5]. Moreover, the pressure and trepidation students feel around academic and technical writing can be compounded for students whose first language is not English [6], [7]. Furthermore, developing writing expertise requires students to build knowledge and skills across

several interconnected domains, including metacognitive awareness of the writing process, an understanding of the values and expectations of specialized discourse communities, and command of specific rhetorical aims and genres [8]. Because mastering these complex and often unfamiliar areas takes time and guided practice, many students struggle to develop confidence in their writing abilities and feel unprepared to meet the rigorous standards expected in graduate school and beyond.

To address this fear of writing and build students' communication skills, many graduate programs require coursework in technical writing. For example, [9] describe a graduate-level course centered around research proposals for new chemistry graduate students. Their course teaches technical writing in the context of a proposal with a heavy emphasis on structure and peer review. [10] describe a similar course for PhD students in Biochemistry, Cell, and Developmental Biology at Emory University. Graduate-level students develop their writing skills by working through multiple drafts of a grant application with frequent feedback from peers and instructors. These two courses also meet the criteria outlined by [11] to develop graduate students' science communication capacity and confidence; namely, having students write early and regularly in multiple genres with frequent review.

Adding to these courses, this paper introduces a technical communication class for graduate engineering students that guides students through the writing process for both expert and general audiences. In addition to emphasizing peer review and frequent feedback from the professor on drafts, the course includes analysis of published papers to highlight features of different genres. Moreover, by challenging students to write for different audiences, the class guides students to consider the expectations, motivations, and purposes of their readers.

II. THE COURSE

"Technical Communication" is an 8-week graduate level course at the Johns Hopkins University Whiting School of Engineering designed to help scientists and engineers learn to communicate clearly and effectively with a wide variety of audiences. The main written assignments for the course are a 3,000-4,000-word technical paper and a 1,000-1,500-word scientific magazine article. To help prepare to write their own articles, students also lead the class in a discussion of a technical and non-technical article they select. In addition, students complete weekly discussion posts and present their research in a mock poster session on the last day of class.

In Fall 2024, most of the enrolled students (9) were majoring in Chemical and Biomolecular Engineering since the course meets a technical writing requirement for their Master's program. In addition, one Phd student in Geography and Environmental Engineering and one Phd student in Electrical and Computer Engineering also enrolled in the course. 7 female students and 4 male students took the course, and most (9) were international students.

A. Leading a Class Discussion

Before writing any drafts, students selected a technical research article and an article on the same topic for a general audience for the class to read for homework. Then, they prepared

questions and led a class discussion on how the articles target different audiences and incorporate concepts from class.

Several themes emerged from the class discussions. First, all groups analyzed how the content changed between the technical and non-technical articles. They mentioned that the technical articles included more detailed methodology, specific numbers, and complex data visualizations while the non-technical articles used more personal quotes, stories, and practical applications. Next, all groups explored how the structure changed between the two types of articles. They noted that the technical articles utilized a typical journal structure, starting with an abstract and review of the literature emphasizing a research gap before going into the methods, results, and discussion. On the other hand, the non-technical articles were more flexible but still needed an engaging opening, often including a story or interesting application from the research, and a satisfying resolution at the end, such as a call to action or solution to a problem posed earlier in the article. Finally, all groups discussed the use of visuals, noting that the technical articles employed graphs, charts, data visualizations, and layouts that conformed to the journal guidelines while the non-technical articles used more relatable and "catchy" images, such as pictures of scientific researchers.

Overall, these articles served as models for students' written assignments and the discussions helped students reflect on how they might write differently for an expert audience and a general audience, building their knowledge of discourse communities, rhetorical aims, and specific genres. Moreover, this activity can be considered a student-centered and inductive learning approach as students discovered writing strategies by analyzing real-world examples.

III. WRITTEN ARTICLES

Once students had discussed the example articles, they were ready to write their own drafts. For the first assignment, students chose a specific scientific journal to prepare a manuscript on their current research. Their manuscript had to follow the journal's author guidelines, appeal to its audience, and be written in a clear, academic style. Students submitted two drafts with in-class peer review and completed a one-on-one writing conference with the instructor before submitting their final draft.

For their second written assignment, students took their research topic and wrote a non-technical article for the readership of a specific scientific magazine. This article had to appeal to the magazine's audience and be written in a clear and approachable style for someone outside their field. As with the technical article, students completed two rough drafts, attended two in-class peer review sessions, and met with the instructor before submitting their final article.

A. Writing Process

To help students develop the metacognitive and communications task processes domain knowledge required to build writing expertise [8], both assignments focused on the writing process. Most of the students had no experience with formal academic peer reviews and were concerned about how they might respond to reviewers' feedback. So, after writing the first draft of their technical articles, we discussed the peer review process in class. Students practiced the

process for a peer using a template that included a summary with evaluation of fit for the journal, strengths, weaknesses, and recommendations for the author. While the students gave strong recommendations for each other, some students were farther along with their research and manuscripts than others; the peer review process was more effective for those with more developed first drafts. In addition, the peer reviews didn't always focus on the "big picture" enough – evaluating whether the content fit the journal and included novel, significant contributions for their readership. [11] suggest that facilitative feedback and feedback focused on higher-order concerns, such as audience or organization, improve writing better than directive feedback or feedback focused on lower-order concerns, such as grammar or punctuation. Perhaps future iterations of the course could incorporate these concepts into the peer review class discussion so that students give more "big picture" feedback, especially on these first drafts.

For the peer review of the non-technical articles, students paired with a partner who had not read their technical article and was not familiar with their research. This way they could give each other feedback on whether their article would appeal to a general reader and whether their technical information was easy to understand. [12] found that the lab reports of a peer evaluated section of students received higher marks than those from a section with lab reports graded by a teaching assistant or instructor. They hypothesize that the process of evaluating another students' written communication can help students develop their own personal writing ability. Likewise, the peer review in this class allowed students to share their own experiences and insights with each other as they reflected on their own drafts.

After the first round of peer reviews, students were given a list of editing strategies to help them revise their first drafts. The most popular strategies were reading aloud or using a text-to-speech tool to listen to their papers (8 students) and taking a break before re-reading and working on their paper later (6 students). Most students (7 students) also chose multiple strategies, even recommending a specific order or "layered proofreading process" for their classmates.

In class, we also discussed how generative AI like Chat-GPT could aid in editing. Using a student example, we saw Chat-GPT could provide a reverse outline of an article for students to check their organization or could be used to shorten or expand a section like an abstract. We also used Chat-GPT to brainstorm titles for the articles and asked it to recommend strategies for adapting the technical article to a general audience. When asked about Chat-GPT, students said the main benefits were to save time and improve their writing. However, they also raised concerns that writing with generative AI could be inaccurate, unethical, or unoriginal. Indeed, hallucinations and made-up references are a well-known issue with scientific works written by AI [13]. Therefore, students preferred to use generative AI to brainstorm ideas before writing or for editing and revising rather than for drafting an article.

A final step in the writing process was meeting with the instructor one-on-one to discuss both articles. This gave students a chance to ask individual questions about their writing. On the end of semester survey, all students strongly agreed that feedback on their work was useful. They appreciated the frequent peer review and comments from the instructor as they worked through multiple drafts for each article.

B. Focus on Audience

Another key characteristic of the course design was the focus on audience, which helped students build domain knowledge in critical discourse, discourse community, and rhetorical aim [8]. As mentioned above, students analyzed how different articles targeted different audiences during the "leading a class discussion" activity. They could then use the articles they had read as examples and the themes from the class discussion as strategies when they wrote their own articles. In addition, we frequently discussed audience during in-class peer reviews and one-on-one writing conferences, highlighting practical considerations such as following author guidelines, meeting the expectations of peer reviewers and editors for journal publication, or capturing a reader's interest in a scientific magazine article.

This focus on audience also led to an emphasis on writing style. We used exercises from the book *Writing Science in Plain English* [14] to teach a reader-friendly style students could apply to either article. The main lessons were to start with a strong character for a sentence subject rather than an abstract nominalization, to use action verbs and active voice whenever possible, and to place the subject and verbs close together (see fig 1 below). Once students could use these principles to write clear and concise sentences, they worked on cohesion by making sure to start sentences with old information that connect to the previous sentence and place new, interesting information in the stress position at the end of the sentence.

Exercise 1: In each sentence, underline the subject and circle the verb. Is the subject abstract or concrete? Rewrite the sentences choosing concrete nouns as subject and making their actions the verbs.

Example: Processes undertaken by diverse plants and animals are responsible for such ecological actions as nutrient cycling, carbon storage, and atmospheric regulation.

Revised version: Diverse plants and animals cycle nutrients, store carbon, and regulate the atmosphere.

Exercise 2: In each sentence, circle the main verb. Revise the sentence by substituting strong verbs for weak verbs. Replace abstract nouns where you can.

Example: Photographs from space taken by satellites are indicators of urbanization and just one of the demonstrations of the human footprint.

Revised version: Satellite photographs indicate the spread of urban areas and demonstrate the human footprint.

Exercise 3: In each sentence, underline the subject and circle the verb. Revise by placing the subject and verb close together. Replace abstract nouns where you can.

Example: Environmentally sensitive solutions to the problems associated with continued population growth and development will require an environmentally literate citizenry.

Revised version: To develop sustainable solutions to the problems of human growth and development, we need environmentally literate citizens.

Fig. 1: Excerpts from a class activity for teaching writing style. While revising the sentences, students learn to start with a strong character for the sentence structure, use action verbs when possible, and place subjects and verbs closer together for a reader-friendly style.

For the final class, students invited friends for a mock poster session of their research. As [15] point out, a class poster session can increase the amount and sources of feedback students receive on their research, allow students to share their work with a wider audience, and help students develop important communication skills. Therefore, the poster session for our class gave students yet another audience and format to consider.

C. Focus on Genre

Finally, the course took a genre approach to writing. For homework, students read chapters from the course textbook, *Writing Science: How to Write Papers that Get Cited and Proposals that Get Funded* [16]. This book emphasizes structure and breaks a typical journal article into four main sections: opening, challenge, action, resolution. In class, we reviewed key concepts for each section, discussing good examples from the book, revising weaker examples from the book, and analyzing new examples from published papers (see examples in Fig. 2 below).

Effective Openings: Look at the opening below. How does it 1) identify the problem that drives the research, 2) introduce the characters, and 3) target an audience?

Example: **Current** public health guidelines in the United States, the United Kingdom, and Australia recommend that women consume a supplemental does of 400 μg of folic acid per day in the month preceding and during the first trimester of pregnancy to reduce the risk of neural tube defects in children.

Less Effective Openings: What makes this an example of no direction? What do you think the paper might be about?

Example: In meiosis, genes that are always transmitted together are described as showing "linkage." Linkage, however, can be incomplete, due to the exchange of segments of DNA when chromosomes are paired. This incomplete linkage can lead to the creation of new pairings of alleles, creating new lineages with distinct sets of traits.

New Published Examples: Does the opening below achieve the three goals (identify the problem, introduce the characters, target an audience)? Is it clear what the paper is about? Does it frame the problem?

Example: "The Spread of True and False News Online" – in *Science* - Foundational theories of decision-making (1-3), cooperation (4), communication (5), and markets (6) all view some conceptualization of truth or accuracy as central to the functioning of nearly every human endeavor. Yet, both true and false information spreads rapidly through online media.

Fig. 2: Excerpts from a class activity for teaching the opening of a technical article. By discussing the examples, students learn to open a technical paper with an explicit problem that targets a specific audience.

For the non-technical articles, we emphasized the "lead-development-resolution" structure from *Writing Science: How to Write Papers that Get Cited and Proposals that Get Funded* [14]. While these articles allow for a wider range of approaches, students were encouraged to start with an attention-grabbing "lead" to open their article and a satisfying "resolution" to end their articles.

The “leading a class discussion” assignment also required students to analyze different genres and provided model examples for students as they wrote their own technical and non-technical articles. As noted above, students used rhetorical analysis to understand how the writers achieved their intended purpose for a specific audience. For a technical article, authors must convince critical and knowledgeable readers that they have found significant and novel results and interpreted them accurately. For a non-technical article, authors must entertain and interest readers by including catchy titles, images, and stories, as well as by making scientific research relatable and applicable to their everyday lives.

Finally, throughout the course, students were introduced to the principles of effective visual communication, an important component of discourse knowledge, rhetorical aim, and genre in the digital age [8]. As part of the "leading a discussion" assignment, students carefully analyzed the use of visuals—such as graphs, charts, diagrams, and illustrations—in the articles they selected. In their analysis of technical articles, students often observed that data visualizations were unclear, overly complex, or overwhelming. They recommended strategies for improvement, such as reducing the number of visualizations, focusing on a clear main message, simplifying the data presented, and enhancing design elements through better labeling, consistency, and clarity. In contrast, when analyzing the non-technical articles, students found that writers included fewer visuals. They thought some well-designed, audience-friendly data visualizations could enhance credibility and improve readers’ understanding. Building on this analytical foundation, students then applied their insights by incorporating thoughtful and well-designed visuals into both their writing assignments. To further support their development, we dedicated a class session to visual design principles and poster preparation, ensuring students were equipped with the skills needed to create clear, effective, and professional-quality posters. These activities helped students recognize visual communication as a rhetorical tool, not just an aesthetic addition, enhancing their ability to communicate complex information clearly and persuasively.

IV. CONCLUSION

This class offers a framework for teaching technical communication to engineering students at the graduate level. First, students can analyze published works to extrapolate strategies to target specific audiences and discover important features of different real-world genres. Next, students learn by writing their own works. Ideally, students can choose some aspects of what they write, such as the journal for publication, so they feel motivated and the class assignments feel realistic. Furthermore, students should write in multiple genres and formats that emphasize different audiences. Finally, writing instruction should incorporate the writing and peer review processes. This allows graduate engineering students to learn from each other and to work through the peer review process in a low-stakes environment before trying to publish their own papers.

That said, the class also had a few drawbacks. First, students complained that the class had a lot of assignments and wished the drafts were better spaced out. This course used to be a 3-credit, semester-long class that included several presentations with slide decks, so the drafts were spread out over a longer period. Nevertheless, since the engineering master’s programs only require 1.5 credits of communication courses, the class was shortened to an 8-week course. One solution might be to use smaller, scaffolded writing assignments rather than full drafts [10]. In addition,

students came to the class with diverse research and publication experience and in different stages of research. Students who had just joined a lab or just started a research project found it more difficult to write their drafts.

On end of the semester surveys, students were very satisfied with the course, with all students strongly agreeing that feedback on their writing was useful. One student commented, “the most important thing I learned is the concept of ‘making the reader’s job easy’ using various methods to guide them through the writing.” Another student wrote “I think this is an essential course for any scientist or technical person to communicate well and to identify flaws in their styles of communication. For many people in STEM, technical communication is something they struggle with, and this course breaks that struggle down pretty well.” A genre approach emphasizing the writing process with frequent feedback from peers and instructors can help prepare graduate engineering students to meet the rigorous writing standards expected in graduate school and beyond.

REFERENCES

[1] J. F. Barker, “Vocational guidance,” in *Engineering as a career: a series of papers by eminent engineers*, F. H. Newell and C. E. Drayer, Eds., New York: D. Van Nostrand Company, pp. 181–93, 1916.

[2] National Academy of Engineering, *The engineer of 2020: visions of engineering in the new century*. Washington, DC: The National Academies Press, 2004.

[3] ABET, “Criteria for Accrediting Engineering Programs, 2024 - 2025,” ABET, https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2022-2023/ (accessed Jan. 1, 2025).

[4] L. Z. Bloom, “Why graduate students can’t write: implications of research on writing anxiety for graduate education,” *Journal of Advanced Composition*, 1981, vol. 2, no. 1/2, pp. 103 – 117, 1981.

[5] B. Holmes, T. Waterbury, E. Baltrinic, and A. Davis, "Angst about academic writing: Graduate students at the brink," *Contemporary Issues in Education Research (CIER),* vol. 11, no. 2, pp. 67-72, Apr. 2018, doi: 10.19030/cier.v11i2.10149.

[6] Y. Lee, “The understanding of L2 writing anxiety in graduate students and its research implications,” *The New Studies of English Language and Literature*, vol. 75, pp. 167-185, Feb. 2020, doi: 10.21087/nsell.2020.02.75.167.

[7] F. Liang, and J. E. Turner, “Writing anxiety among Chinese graduate students in an American educational setting,” *Journal of ethnographic and qualitative research,* vol. 16, no. 2, pp. 139–158, 2021.

[8] J. A. Corrigan and D. H. Slomp, “Articulating the Sociocognitive Construct of Writing Expertise for the Digital Age,” *Journal of Writing Analytics*, vol. 5, pp. 142-195, 2021, doi: 10.37514/JWA-J.2021.5.1.05.

[9] B. D. McCarthy and J. L. Dempsey, “Cultivating Advanced Technical Writing Skills through a Graduate-Level Course on Writing Research Proposals,” *Journal of Chemical Education*, vol. 94, no. 6, pp. 696–702, May 2017, doi: 10.1021/acs.jchemed.6b00903.

[10] R. A. Kahn, G. L. Conn, G. K. Pavlath, and A. H. Corbett, “Use of a Grant Writing Class in Training PhD Students,” *Traffic*, vol. 17, no. 7, pp. 803–814, May 2016, doi: 10.1111/tra.12398.

[11] E. R. Harrington et al., “A new approach for increasing graduate students’ science communication capacity and confidence,” *PeerJ*, vol. 12, p. e18594, Dec. 2024, doi: 10.7717/peerj.18594.

[12] W. Jensen and B. Fischer, “Teaching Technical Writing through Student Peer-Evaluation,” *Journal of Technical Writing and Communication*, vol. 35, no. 1, pp. 95–100, Jan. 2005, doi: 10.2190/mbyg-ak7l-5ct7-54du.

[13] S. A. Athaluri, S. V. Manthena, V. S. R. K. M. Kesapragada, V. Yarlagadda, T. Dave, and R. T. S. Duddumpudi, “Exploring the Boundaries of Reality: Investigating the Phenomenon of Artificial Intelligence Hallucination in Scientific Writing Through ChatGPT References,” *Cureus*, Apr. 2023, doi: 10.7759/cureus.37432.

[14] A. E. Greene, Writing Science in Plain English, Chicago, IL, USA: The University of Chicago Press, 2013.

[15] G. R. Hess and E. N. Brooks, “The Class Poster Conference as a Teaching Tool,” *Journal of Natural Resources and Life Sciences Education*, vol. 27, no. 1, pp. 155–158, 1998, doi: 10.2134/jnrlse.1998.0155.

[16] J. Schimel, Writing Science: How to Write Papers that Get Cited and Proposals that Get Funded, Oxford, UK: Oxford University Press, 2012.