

Technical Writing Skills in STEM Academia: Bridging the Gap

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ENGL 427W

April 28, 2023

Introduction

University undergraduate STEM programs undoubtedly undermine the level of writing skills that their students need to succeed in the workplace. STEM students are stripped of the written and verbal communication skills that allow them to thrive in their field, particularly technical writing skills. The role that technical writing plays in STEM is being ignored, and this sets students up for failure. This research explores the relevance of technical writing through the question, “What are the reasons why writing courses, specifically technical writing, are often excluded from undergraduate STEM programs?”, illuminates the interdisciplinarity of STEM, and the role that technical writing plays within it.

Literature Review

In order to find out why technical writing skills of STEM students are often overlooked, it is crucial to have an adequate understanding of the discipline on its own. The term “technical” referring to “knowledge that is not widespread, that is more the territory of experts and specialists” in itself explains why STEM students should acquire technical writing skills (Beilfuss et al., 2019). The skills that students are taught in a technical writing class however, are beneficial to any discipline. The focuses of the courses are on formatting, purpose, and appropriate language, as well as putting a clear distinction between academic writing and technical writing. One of the most important aspects in learning technical writing is being able to define a clear purpose and articulating it clearly for the reader. For a STEM student writing a lab report or instructional model, articulating a purpose in an efficient matter is crucial. Looking into previous research in the realm of STEM academia, communication, both written and oral, is a recurring discipline that presents itself, going hand in hand with the STEM disciplines. Many careers in STEM involve team-based work, communication amongst other employees and customers, and those in higher positions. Professor Deborah Faye Carter at Claremont Graduate University noted that “written, oral, and graphic communication skills are considered to be part of students’ preparation” for undergraduate practice (Carter et. al, 2015, p. 366).

Though there is less of an emphasis on technical writing courses in many undergraduate STEM programs, communication courses and skills are highly valued. In any workplace or educational setting, it is clear that communication is a vital skill to have in order to succeed and move higher in a profession, and other disciplinary fields as well.

When looking at the engineering discipline specifically, the most prevalent reason why technical writing is often overlooked stems from the motivation and interest from students. Students in the field of engineering are often “rather people of action rather than of words”, which decreases their motivation and interest in technical writing (Rus, 2015). However, it is clear that written and verbal communication are skills that engineering employers look for. In fact, when called upon to write technical documents, engineers are “required to obey a set of norms which are characteristics of this type of texts” (Rus, 2015). Within the engineering discipline, the type of writing that engineers will be doing requires adequacy in technical writing due to the complicated nature of the discipline itself, which also drives students away; however, a study conducted by Dana Rus, a professor of Engineering and Mathematics, found that using authentic materials in the teaching of technical writing to engineering students increased motivation. According to Rus, authentic materials are “something that students can relate to and they can see the practical objective of the writing task” (Rus, 2014, p.1112). In this study, students were asked to write about the process of producing energy from coal, and in guided, collaborative writing, correct any mistakes. The study exemplified that students were more motivated to complete writing tasks and improve their writing skills when it was a topic specialized to their field, as well as in a group setting. Similarly, a study conducted at the FH Joanneum University of Applied Sciences finds that when a class of Engineering students were able to work in groups on writing assignments as well as peer review, this was a driving force in “the students’ perception of a potential increase in motivation and their attitudes” towards writing in general (Tatzl et al, 2012, p. 293).

When thinking about mathematics, it is obvious that technical writing is not the first skill that comes to mind, as the average student will think of numbers and computational skills; however, technical writing still serves its purpose here. When reading a textbook in a statistics class for example, there is an endless amount of information on the pages, between numbers, formulas, and explanations. When a student finds the information they need easily, “they are better able to focus on the substance of the piece, rather than its style” (O’Brien, 2001, p.34). This is where the lack of emphasis on technical writing in mathematics lies; math students never feel as if they will have to fill a reader’s expectations, as that is normally not where their work lies. O’Brien highlights that employers “advertise for statisticians who can demonstrate excellent oral and written communication skills” proving that the belief that math is solely quantitative and computational is false (O’Brien, 2001, p.33). A study at the Faculty of Engineering in Vitoria, University of the Basque Country explores the concept of Mathematical coherence, and how students should be able to “provide an appropriate interpretation of the formulas used, include all the immediate steps, and define all the units and magnitude coherently” (Cantera et al., 2021, p. 11). For Mathematics, the content is not emphasized as much as the other STEM disciplines, but rather the coherence; being able to put numbers on paper is one thing, and making them concise and coherent is another. The University of the Basque Country study still proves however that Mechanical Engineering students pay more attention to the technical or mathematical aspects of their given exercises and essays than the “linguistic and rhetorical-organizational aspects... crucial to the development of their writing skills” (Cantera et al., 2021, p. 17).

While technical writing is most prevalent in the science discipline of STEM, technical writing skills are less emphasized in their undergraduate programs, when students should be gaining the foundational skills that will serve them well in the workplace. Studies have shown that students often split science into “disparate chunks of information” rather than a cohesive discipline, due to the amount of sub-disciplines within science (Lankford and vom Saal, 2012).

However, another study conducted by Colton and Surasinghe found that biology students greatly benefit from the collaborative teaching of English and Biology. When students were able to write and revise their own papers, they were also “taught the importance of revision and communicating principles and methods more succinctly”, as well as exposure to other scientific topics, motivating them to learn and improve even more (Colton and Surasinghe, 2014, p.37). Many students from this study ended up expressing that they wished they had taken the English and Biology course earlier on in their academic career. The Colton and Surasinghe study highlights that one of the major issues in the gap between Science and Technical Writing is a lack of interdisciplinary collaboration, as most other scientific writing courses do not expose students to “additional scientific topics and exigencies” (Colton and Surasinghe, 2014, p. 36). The sociology of science is also important to include in the conversation of why technical writing is overlooked in STEM. The ongoing discussion of whether or not science is considered a social construct and the “assumptions and purposes of contemporary scientific practices” put writing’s place in the discipline up for debate (Bazerman, 2011, p.15). Charles Bazerman, professor of Education at the University of California, highlights how evidence varies from “one knowledge-producing social system to another”, and how meanings change when knowledge is moved between the two (Bazerman, 2011, p.15). This gives insight into the issues with writing in Science, and similarly to the mathematics discipline, emphasizes how important clearness and conciseness are.

Technology has continued to develop rapidly, and a growing technological industry calls for more technical writers who can tackle specialized problems, especially in computer programming and computer documentation. Undergraduate students in the realm of technology have not been introduced to course work that emphasizes the writing process and mechanics of writing, and are therefore not “acquiring the ability to communicate ideas effectively, and [integrate] these skills into the entire computer science program” (Kaczmarczyk, 2003, p. 341). In the past, efforts to reform computer science courses to be more inclusive to technical writing

have been instructor-centered, and fail to consider that “successful teaching strategies depend upon understanding student perceptions” (Kaczmarczyk, 2003, p.341). A study at the University of Texas found that delivering a class that is dedicated to technical writing, but restricted to Computer Science majors, is successful in integrating technical writing skills into the discipline. The course addresses academic and industrial technical writing, allowing students to obtain both core writing skills and specialized writing skills that will benefit them in their careers and in effect, positively change Computer Science academia.

Discussion

The literature discussed emphasizes the idea that in order for technical writing to have greater recognition in undergraduate STEM courses, its role and purpose needs to have a greater understanding. This research shows that STEM students lack the motivation to learn and practice technical writing skills because they feel that it does not fall within their discipline, or the task of writing itself seems intimidating. While STEM fields are interdisciplinary in nature, there is an obvious gap that needs to be bridged between STEM and writing, almost as if English has been alienated from these disciplines. In an interview conducted with Brent Barbachem, a software engineer, he expressed that technical writing has a large influence in his career, between professional documentation, write-ups for bug fixes, introducing new features, and interacting with customers. However, he also asserts that having employees with experience specifically in technical writing helps take the responsibility off of employees that do not have that background, and feel as if they are not writing to their best ability. Barbachem argues that the technical writers at his software company are faster at writing and catching mistakes. While hiring employees with an educational background in technical writing helps balance out the workplace, a gap still exists between those with a STEM background, and those with a technical writing background, decreasing coherence amongst teams. This communication and cooperation in teams proves successful in undergraduate STEM programs as well, as several of the studies discussed in the literature show that working collaboratively on writing

assignments increased STEM students' motivation to learn how to write, as well as improve their technical writing skills. Bridging the gap however, requires a change in academia first, as it is the curriculums, courses, and conventions that need to be changed to fit the needs of STEM students.

Conclusion

The literature, research, and arguments presented amplify the underrepresentation of technical writing skills within the STEM disciplines and the reasons why it needs to be addressed in academia. The writing discipline has been alienated as a task that is "unimportant" in STEM, and students have felt as if writing does not have a place in disciplines that are so heavy on numbers, data, hands-on learning, and computing. However, STEM is an inherently interdisciplinary field, and the cohesion of skills cannot be achieved without acknowledging this. Students become more willing and motivated to develop technical writing skills when the disciplines of writing and STEM are combined, bridging the gap that many employers of STEM related companies have noticed. When STEM students are presented with writing tasks that incorporate their knowledge in their field, whether that may be Science, Technology, Engineering, or Math, they are able to not only learn to write, but write to learn. This research concludes that overall, the unabridged gap and lack of cohesion in STEM academia has resulted in the exclusion of technical writing, but can easily be resolved when looking at how STEM students thrive in interdisciplinary environments.

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