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Comparatively Mapping Genres in Academic and Workplace Engineering Environments

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Abstract

In the Engineering workplace, one must be able to negotiate many genres of writing: he or she must deliver updates, understand technical requirements, weigh project priorities, develop and carry out problem-solving techniques, all while using different forms of technical communication. Engineering work relies on the ability to flexibly transition between a variety of technical writing genres, while also navigating the broad array of technologies required to effectively complete these projects. However, the genres and types of writing present in the workplace do not always reflect the genres and types of writing undergraduate Engineering students complete during coursework. From a Rhetorical Genre Studies (RGS) perspective, this is a problem because genres are not preset templates but rather forms of social action and as such embody a community's way of knowing, being, and acting; therefore, a disconnect between genres indicates a disconnect between academic and workplace communities of practice, leaving undergraduates underprepared to meet the expectations of workplace communities.

The purpose of the project discussed in this paper is to develop a heuristic of common workplace genres of regional workplaces and explore whether these genres are receiving coverage in the engineering courses at a southeastern, midsize research institution. This exploration emerged from a grant-supported, interdisciplinary faculty learning community consisting of faculty from the Department of English (with Technical and Professional Writing specialties) and different departments in engineering and technology. One of the primary tasks of this community, shaped largely from a Writing in the Disciplines (WID) approach characteristic of the institution's curricular and assessment bodies, was to map the current state of technical writing genres in engineering courses and to better understand the present gaps, if identified. This task was accomplished through workshop-based discussions and cross-disciplinary collaborative research. Based on the application of RGS methodologies to the interdisciplinary faculty learning community workshop, it is suggested that a genre-based categorization of writing tasks and projects in undergraduate engineering curricula is critically formative in working toward the holistic integration of writing across courses for the sake of preparation and conceptual-based student understanding of writing practices.

Introduction

Instructors who work in Science, Technology, Engineering and Mathematics (STEM) areas are aware that their students, particularly upper-division undergraduate students, often resist writing. This happens despite various large-scale studies that emphasize the importance of writing to careers in STEM-related industries[1-3]. One cause of this resistance may be student perception of writing as an audience-driven performance rather than perceiving writing as part of critical thinking and creation of social action[4]. In data- and content-focused fields and disciplines, such as those in STEM, it is difficult to integrate different forms and genres of writing into upper-level undergraduate courses due to time constraints and concerns about coverage. Writing is seen as a separate intellectual process because there are a limited number of courses taken as core requirements from Humanities and Social Sciences, and many courses and writing programs do not demonstrate overt connections to STEM epistemologies. Although practicing STEM faculty stress the importance of writing as part of their own careers, many STEM students see writing as largely unrelated to their career goals. Many students assume that their "writing career is now over"[5] once they move into courses in their major. Put another way, student perceptions of an engineer's "community of practice" often do not include writing despite the common presence of writing in workplace "communities of practice." Genre offers a productive way to approach this disconnect.

Based on the Department of Labor's definition of workforce readiness skills[6], one of the most important "soft skills" is communication. This speaks to the need to resolve the disconnect between the perception of writing by students in upper-level undergraduate STEM courses and the skills required by them once they graduate. How can STEM faculty, knowing the importance of writing in the workplace, increase student buy-in? In what ways can Professional and Technical Communication faculty in English departments or elsewhere facilitate this work and support the needs of STEM faculty and students in designing and implementing such writing in content-heavy STEM courses? The argument is made below that the answers to these questions, and ones similar to them, reside in approaching this disconnect through the lens of Rhetorical Genre Studies (RGS), which sees the writing students and practitioners do as various forms of "typified social action" based upon recurrent social situations[7]. Students might better understand the importance of writing if it is framed as a way of acting in professional communities and not just as a task to be completed for a professor. Student apathy or disinterest can thus be challenged by refiguring writing from performance-driven to action-driven. This can begin during the undergraduate degree

Writing as Integral Part of STEM Assignments: An RGS Approach

Of the research conducted on writing in the STEM disciplines, many sources are aimed at the experienced writing instructor, outlining assignments and teaching tools with the audience of the expert in mind[8, 9]. More work needs to be done with faculty whose disciplinary expertises lie elsewhere, working with them to structure assignments in a given context so that writing can be

successfully embedded into existing curricula and appreciated by students in quantitative disciplines as a critical part of their thinking process. Hence, there needs to be a more structured approach in educational design that relates to the "writing in the disciplines" (WID) approach, wherein faculty provide students a clear, discipline-informed framework for writing that sees disciplinary differences in writing practices through the lens of genre. In this way, students receive insight into genres that will likely be part of their future workplace.

The main genesis of rhetorical genre studies (RGS) was the work of Carolyn Miller, who was the first to frame genre as a social action. Miller's work and that of many other in the fields of rhetoric, composition studies, and technical communication, challenged existing views on genres and differences in writing by placing an emphasis on the recurring patterns of social (organizational, academic, political) action as the driving force behind the concretization of genres. Genres are not driven by mere structure and typography: "rather than referring simply to sets of textual regularities or text types, genres have come to be seen, (…) as correlates or indications of larger contextual regularities – social, cultural, ideological, political"[10]. Rather than frame genres on a granular, written level, Miller and others (part of the larger "public turn" in research in writing studies) saw genres and texts as resulting from typified behaviors, knowledge, and actions of a given community of practice: "[T]o write, to engage in any communication is to participate in a community; to write well is to understand the conditions of one's own participation with that community and determine the success or failure of communication"[11]. As such, genres reflect the value systems of individual organizations (e.g., a stand alone business) and also large scale communities (e.g., engineers). Being a proficient writer means becoming intimately knowledgeable of the conditions of participation in a given community of practice. According to James Dubinsky, "our work [as professors] involves more than teaching our students strategies or forms; it also involves asking them to consider the impact of those strategies and forms"[12]. Further, Ann Blakeslee argues that "classrooms can (…) be productive sites for questioning workplace practices"[13], and Greg Wilson underscores the importance of "[imbuing] our students with the agency to interpret and negotiate both complex information and complex work contexts"[14]. Teachers and administrators must ask: to what extent are students being made aware of these conditions of participation and what can be done to address this? As WID expert Patrick Bahls points out, "incorporating writing activities and assignments into [STEM] courses will not be an effortless task"[15]. On the contrary, it requires the thoughtful altering of assumptions about the nature and role of writing in a specific discipline.

Therefore, the first step in the project presented in this paper is to identify and categorize all genres which are currently used in collaborative engineering. For that purpose, one step was to start the discussion with STEM faculty from different disciplines, map these existing genres, identify potential gaps and then move on to implementing structured activities and assignments even in courses which did not have lot of writing before (e.g. fluid mechanics and programming). Mapping genres is step one in the overall writing into STEM curriculum process, not a distinctive approach by itself.

STEM Faculty Learning Community at One Midsize Research Institution

Our midsize research institution runs a QEP faculty workshop every semester, aimed at improving disciplinary writing across the institution. Faculty enroll in the program for the purposes of professional development. Within one semester, faculty participants engage in five workshops that last for eight hours each. The mission of this initiative is to focus on the improvement of upper-division undergraduate students' disciplinary writing by exploring the ways writing, as a process, should start with research and reflection about the given topic or problem. The main goal of this workshop is for faculty to master the skills related to good assignment design. The idea is to create high quality assignments and associated rubrics that will foster better integration of writing into the undergraduate, upper-class curriculum. The QEP initiative has two main programs: faculty workshops and funding for projects aimed at enhancing student writing.

The RGS-infused heuristic we develop here stemmed from funding from this QEP program, specifically for the development of a faculty learning community, which was part of a larger "Improving Disciplinary Writing" Action Project grant funded by this midsize research institution's (MRI) Quality Enhancement Plan (QEP). One way disciplinary writing and genre can be explored is through faculty learning communities, or intentional groups of (often interdisciplinary) faculty seeking to improve some facet of practice. The project presented in this paper is funded by an Action Project designed to encourage faculty who have not previously participated in the QEP workshops to develop and implement best practices to improve disciplinary writing. The team of researchers includes three principal investigators from the English Department in the College of Arts and Letters and two faculty members from he MRI College of Engineering and Engineering Technology (Engineering Technology and Engineering Management). The team recognized the need to combine expertise from English and Engineering to help students in the STEM disciplines become more effective writers and assist faculty in thoroughly and critically integrating writing assignments into their upper-level undergraduate curriculum. Both disciplines, English and Engineering, have a goal of preparing students to become successful members of either industry or the academy. While the College of Engineering and Technology provides education focused on the application of technical training, the Department of English, through the Professional and Technical Writing program, offers a humanities-based education focused on theories and strategies for writing within a variety of contexts, audiences, and purposes. There are many areas of overlap between the disciplines, such as a focus on communicating technical knowledge, but there is little collaboration. Our project hopes to open opportunities for interdisciplinary efforts to facilitate writing instruction across colleges and departments.

This three-part workshop created a faculty-learning community for faculty in STEM and primarily focused on strategies to improve student writing in courses that are not necessarily writing intensive. The ideas presented in these workshops have the main purpose of providing

encouragement and support for teaching of writing in STEM courses by creatively integrating writing in such a way that adds value to the course and supports learning objectives. Properly integrated, instructors in STEM disciplines can better understand how writing is an effective learning tool that does not compromise time away from teaching course content, and students can learn that effectively designed writing assignments can help them organize, synthesize, and ultimately produce their own ideas in ways not possible without appropriate writing prompts and activities.

All five faculty researchers recruited eight more faculty members from various STEM disciplines to constitute a group of thirteen faculty, referred to in this project as The Faculty Learning Community (FLC). The FLC is conducting exploratory research and developing a list of STEM-based disciplinary writing conventions. Part of this research is the mapping of discipline-specific conventions for frequently used genres and the developing of activities for different steps of the research and writing process. The first two workshops were held in the Fall of 2014. The whole series is based on Dr. Patrick Bahls's research and ideas. Professor Bahls was an integral part of Workshop #1, in which he presented strategies of integrated writing assignments in regular, non-writing-intensive courses. The 8 faculty recruits were from science-related disciplines across the university. Each faculty member teaches between 1 and 3 courses that include a writing assignment. Student participants were be drawn from the faculty members' courses, for an approximate total number of 160-200 students.

Genres in Academic and Workplace Engineering Environments

Various writing genres have been identified during faculty discussions and activities over the course of the first two workshops. Some of these genres were identified from a brief list of genres made by Colorado State University[16]. Genres, as mapped by the FLC, are given in Figure 1. The genre map reflects the many different types of written communication done in engineering contexts. The next phase of the project presented in this paper is to collect data related to collaborative writing, which was featured in the second workshop in our series. The data about these collaborations will be collected in Spring 2015 and will be presented in the paper to follow. Future iterations of this project will explore more in depth the social actions associated with each genre and how genres are mediated through workplace practice and knowledge structures.

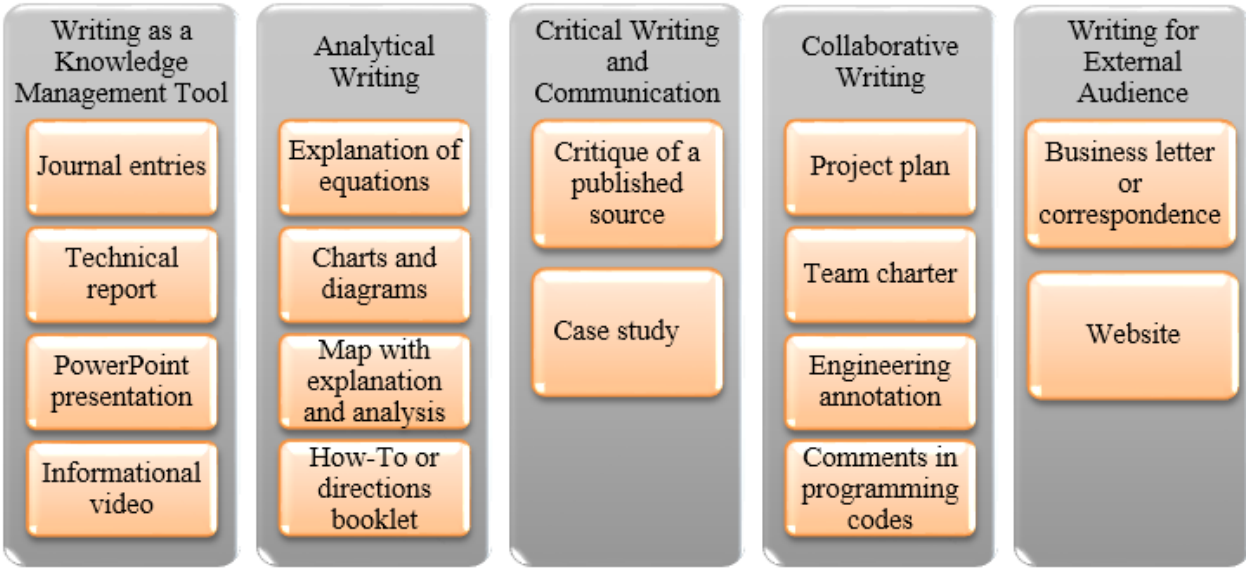

Figure 1: Genres in academic and workplace engineering contexts

Writing as a Knowledge Management Tool

The genres under this category include writing assignments in which the students have to reflect on what they learned, synthesize and explain their findings. The major goal of these assignments is to transform tacit knowledge into explicit knowledge.

Journal entries: The logbook is required in engineering for senior design projects as note-keeping records of student's meetings and discussions. The students are typically required to maintain an engineering logbook that will show day-to-day progress on the project. The logbook should include any work associated with the project such as, but not limited to, conceptual ideas, design sketches, calculations, technical references, professional contacts, component sources, software information, etc. The logbook should be dated and signed.

Technical reports: In their senior design/capstone projects students work on two semester projects. In these projects, they are usually required to design and/or build a new product, device or an engineering solution. As an output of their engineering process, they are required to submit the final report at least a week before the end of the semester. The average length of a senior design report is 20 to 30 pages.

PowerPoint presentation: Engineering students are required to deliver a group oral presentation to department faculty and fellow students during the last week of the semester. Each student has about eight to ten minutes allocated for the presentation. In addition students in engineering are required to take a course in public speaking as one of their required core courses.

Informational video: Off-campus students and distance learning students are required to present their senior projects by recording themselves talking and presenting about their projects. In some other classes, they are required to create a video which would serve as proof that they actually completed a task. One of these examples is to create an assembly of a small robot which moves as one of the projects in their design course or to record a blinking LED circuit to show them that they properly programmed and wired an electrical circuit. These videos are especially important in distance education.

Analytical Writing

Explanation of equations: Faculty members participating in the workshop noted that students generally have difficulty articulating how they solved a specific problem using equations or why they selected a specific equation. This problem is apparent in laboratory reports but also in capstone/senior design technical reports. Explicit argumentation of the rationale for the selection the equation and how it was used to solve the problem was identified as an important genre during the workshop.

Chart or diagram with explanation and analysis: Diagrams or graphic representations are often used in STEM to explain natural phenomena or to describe engineering systems. Examples include charts and diagrams describing the results from statistical analysis such as Pareto diagrams, fishbone (Ishikawa) diagrams, box plots, control charts, etc.

Map with explanation and analysis: Maps are used as a tool especially in science areas such as geography or civil engineering. In addition, they serve as methods of mapping various processes. One example of such communication method is a heat map which is a graphical representation of data where the individual values contained in a matrix are represented as colors.

How-to or directions booklet: Students in STEM disciplines are often required to create lab reports. These reports usually have to explain the experiment conducted, present data collected and describe the analysis and results. Young engineers often encounter on their jobs tasks which are related to development of training manuals, assembly instructions, service and maintenance booklets. Hence, creating assignments in which they would have to explain step by step what needs to be done to make some task completed would benefit them to understand what it takes to explain a complex idea to someone who is novice in the area.

Critical Writing and Communication

Critique of a published source: Research-based assignments are a typical part of any graduate program. The first step in scientific inquiry is to research the state of the art literature in the field using a critical thinking approach which could analyze and summarize the information presented in various journals and conference papers in the specific professional area. Familiarizing

students with the scientific method is especially important in STEM areas. These could include information related to the use of the appropriate citation method, plagiarism and copyright related information.

Case study: This form of communication is very typical for business and management majors. In STEM courses, case studies can be used to analyze specific problems such as engineering or design errors or to identify the causes that led to disasters. In addition, case studies could focus on solving specific company problems that can be analyzed through researching the company data.

Collaborative Writing

Project plan: Complex projects that involve a group of students can often include the development of a project plan. The plan includes the list of tasks over time and outlines the students responsible for each of the tasks. The plan helps students organize the work, keep track of progress and make necessary adjustments[17].

Team charter: Team charters can be useful tools used by students on collaborative writing projects. The charter is typically developed by all the students in the team and outlines roles and expectations with regards to the project[17]. Some examples of elements in the team charter can include writing style and quality of individual deliverables, norms for the team, specific roles for each team member, etc. The charter represents an agreement among team members and as such is typically signed by all team members as a formal contract would in a real project in a non-academic environment.

Engineering annotation: Engineers often use engineering annotation as a vehicle to communicate important engineering requirements and part-related information such as surface finishing, materials, weight, cost, information related to the part design ownership, quality control related information etc. These are usually being done by following the strict rules which are related to the specific engineering field (e.g. civil or mechanical engineering) or specific international standard which is used (e.g. ANSI, ISO, DIN, etc.). Engineering students are also required to implement the correct engineering annotation at their engineering drawings which presents their designs in printed, 2D version of documentation and sometimes even in 3D digital file. Mastering these skills is also important for their future careers since many modern companies are working in a work setting which requires use of the Product Lifecycle Management software tools for file tracking and access to the most up-to-date information.

Comments in programming codes: A faculty from Computer Science pointed out that in their profession, comments are an integral part of any kind of software development. Programming is often perceived as a highly individualistic activity. However, any program which is usually written by computer scientists has to be presented or given to another part of the team,

to people who will test and validate programs, and later through the legacy pathways to future scientists and engineers who will be in charge of edits. However, the current grading policy in the class does not include rubrics, which will assist students in development of high quality notes.

Writing for External Audience

Business letter or correspondence: One of the ABET outcomes is outcome (k): continuous improvement, timeliness and professional development. STEM students also have a mock job application assignment in which they are asked to prepare a resume and a professional letter - a cover letter which would match the exact job application. Furthemore, some STEM courses require students to do a certain amount of fundraising, especially for their senior design projects. These students are asked to develop letters to potential donors that often include companies. Through these assignments, students practice disciplinary forms of communication common in engineering practice using paper-based or electronic communication.

Website: Recent initiatives at various institutions have taken place in the form of e-portfolios that keep track of students' project-based assignments in different courses from year to year. Through their personal e-portfolios, students can keep a repository of their projects, showcase their skills, and develop their external outlets as a means of demonstrating what they are capable of to hiring managers. These can be in the form of personal webpages, their team web pages (e.g formula team, Baja car group, different autonomous robots competitions, etc.), blogs, wikis and different forms of web-based content which can be shared within the university or to a wider, external audience.

Conclusion

One of the key tenets of RGS is exploring how texts manifest out of social interactions. Mapping was chosen as a technique because visuals have been shown to better articulate the relationships between and among genres of writing. Mapping these genres enabled us to explore the range of practices in workplace contexts as a means of evaluating how our current curricula and assignments aligned with -- or failed to align with -- these practices. After the disconnects and subsequent needs have been identified, suggestions and strategies related to the development of writing projects and activities, which can be embedded in existing curricula to build technical writing skills of engineering students, will be identified for faculty involved in this community. The belief is that a genre-based evaluation of writing tasks and projects in undergraduate engineering curricula is the next step in working toward the holistic integration of writing across courses for the sake of preparation and conceptual-based student understanding of writing practices. The workshops presented in this paper are going to be completed in the Spring of 2015, and data will be collected from participants during this period, including artifacts like assignment prompts and syllabi, as well as student compositions. These artifacts will be examined for any

changes that may have taken place across the two semesters. The results of our analysis will be applied toward programmatic development and further faculty training.

Limitations and Implications for Future Research

The mapping of workplace genres was based upon personal knowledge and experience from faculty. In the future, it would be beneficial to conduct surveys of local employers and have them identify which genres are used most often and for which purposes. Schools and programs might also consider reviewing and adopting research in "writing across the curriculum" (WAC), an approach that can be "used to increase the number of writing activities within the tight guidelines that are driving engineering curriculum maps"[18]. What would be useful is to map out a comparison of genres across departments and fields across all disciplines, and attempt to draw meaningful connections. Based on the above exploration, administrators, curriculum designers, and teachers should consider using a genre-based approach to integrating writing into engineering curriculum if they are concerned with the integration of students into real, actual engineering communities of practice.

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References

1. Lang, J. D., Cruse, S.,McVey, F. D., & McMasters, J. (1999). Industry expectations of new engineers: A survey to assist curriculum designers. *Journal of Engineering Education,88*, 43-51.
2. Reave, L. (1999). Technical communication instruction in engineering schools: A survey of top-ranked U.S. and Canadian programs. *Journal of Business and Technical Communication, 18* (4), 452-490.
3. Wolfe, J. (2009). How technical communication textbooks fail engineering students. *Technical Communication Quarterly, 18* (4), 351-375.
4. Warnock, S., & Kahn, M. (2007). Expressive/exploratory technical writing (XTW) in engineering: shifting the technical writing curriculum. *Journal of Technical Writing and Communication, 37*(1), 37-57.
5. Gruber, S., Larson, D., Scott, D., & Neville, M. (1999). Writing4practice in engineering courses: Implementation and assessment approaches. *Technical Communication Quarterly, 8*(4), 419-440. doi: 10.1080/10572259909364678
6. DOL (2014). *Soft Skills to Pay the Bills - Mastering Soft Skills for Workplace Success,* U.S. Department of Labor, Retrieved on January 27, 2014 from: <http://www.dol.gov/odep/topics/youth/softskills/>
7. Miller, C. R. (1984). Genre as social action. *Quarterly Journal of Speech, 70*, 151-167.
8. Crannell, A. (2004). *Writing projects for mathematics courses: crushed clowns, cars, and coffee to go*. MAA.

9. Meier, J., & Rishel, T. (1998). *Writing in the teaching and learning of mathematics* (No. 48). Cambridge University Press.
10. Freedman, A. and Adam, C. (2004) . Learning to write professionally: 'Situated learning' and the transition from university to professional discourse. In J. Dubinsky (Ed.), *Teaching Technical Communication* (10-336). Boston: Bedford.
11. Miller, C. R. (2004). A humanistic rationale for technical writing. In J. Dubinsky (Ed.), *Teaching Technical Communication* (15-23). Boston: Bedford.
12. Dubinsky, J. M. (2004). Becoming user-centered, reflective practitioners. In J. Dubinsky (Ed.) *Teaching Technical Communication: Critical Issues for the Classroom* (1-10). New York: Bedford/St. Martin's.
13. Blakeslee, A. M. (2004). Bridging the workplace and the academy: Teaching professional genres through classroom-workplace collaborations. In J. Dubinsky (Ed.) *Teaching Technical Communication.* (348-371). Boston: Bedford.
14. Wilson, G. (2001). Technical communication and late capitalism. *Journal Of Business & Technical Communication 15.1* (72).
15. Bahls, P. (2012). *Student Writing in the Quantitative Disciplines,* Hoboken, NJ: Jossey-Bass, John Wiley & Sons.
16. Colorado State University (2015). A Brief List of Genres. Retrieved on February 1, 2015 from: http://writing.colostate.edu/gallery/multigenre/genrelist.html
17. Zhou, Z. & Pazos, P. (2014). Managing Engineering Capstone Design Teams: A review of Critical Issues and Success Factors. Proceedings of the 2014 Industrial and Systems Engineering Research Conference.
18. Thompson, N. S., & Alford, E. M. (1997). *Developing a Writing Program in Engineering: Teaching Writing to Teach Engineering Literacies*.
19. McKittrick, M., Richards, D., Jovanovic, V., Romberger, J., Pazos-Lago, P. (2014) "Student Writing in the STEM Disciplines: A Faculty Learning Community", ODU - Quality Enhancement Plan (QEP): Improving Disciplinary Writing (IDW) Action Project, Old Dominion University, Norfolk, VA.