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The Grandest Challenge: Models for Communication Development in Technical Contexts

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The Grandest Challenge:
Models for Communication Development in Technical Contexts

As engineering educators who teach communication, we are cognizant of the gap that exists between the content and skills that are foundational to our courses and the technical content of the rest of the engineering curriculum. That gap reinforces a misapprehension among students that the principles of effective communication—audience analysis, rhetorical awareness, and the like—are unrelated to the technical work of design. At Rose-Hulman Institute of Technology, we have recognized this challenge and have sought ways to bring communication content and technical content together in ways that are manageable by faculty who are not engineers. The course in professional and technical writing at our college is required of all engineering and computer science majors and is usually taken in the junior year. The course has undergone many transformations in content and focus since it was first developed in 1994. The latest iteration blends communication principles with technical projects that can bridge the divide and help students see how the two fields are intricately intertwined in the engineering workplace.

This paper reflects on the work-in-progress at Rose-Hulman focused on helping our students develop their communication skills in technical contexts. Currently five faculty are teaching technical communication content using five distinct approaches. The first four are variations on the conventional technical communication course. The final approach represents a significant departure from the standard course as content was developed into a new summer course team-taught by communication and engineering faculty. As we develop these approaches, we remain dedicated to sharing the work we do with others in the field of communication, particularly faculty who teach communication in engineering contexts.

Context for the Projects—A Brief Review of the Literature

Bringing technical communication instruction and engineering instruction into alignment is not a new idea, and research over the past decade has reflected a growing trend toward increased collaboration between faculty in both disciplines. In survey research conducted in the early years of ABET Engineering Criteria implementation, House *et al* (2007) gathered responses from engineering faculty in a variety of institutional settings and academic disciplines regarding their willingness to incorporate communication into their technical courses. They were generally interested in such a curricular change (or in some cases, were already engaged in these changes), but many lacked good models for such incorporation.[1] Subsequent research along similar lines reflected increasing practices among engineers that blended technical communication and engineering.[2-4] Dyke and Riley, for example, provide insight into the strategies engineering faculty use to blend communication and engineering in their courses.[5]

The project we are reporting on in this paper reflect a different direction of development than what these other authors have outlined. We are focusing on ways to bring technical content into the technical communication course, thus asking communication specialists to become better versed in engineering concepts, to work closely with engineers in team-taught courses, and/or to take models from engineering education and adapt them to the technical communication classroom. In this way, we believe that we can help engineering students see that communication is inseparable from engineering work, whether that work occurs in a design context, in a service learning context, or any other context.

Approach 1--Sustainable Engineering Project

The first variation on the conventional technical communication course was adopted at our institution in 2008.[6] At that time, faculty teaching the course discussed alternatives to the standard course that could bring technical projects into the communication classroom. The point was to address the disjunction students see between their technical and communication work. For this reason, we developed a sustainable engineering project to use as the focus for the course.

Working in groups of four, students were asked to identify a campus problem that could benefit from a sustainable solution. Problems that students identified ranged widely: paper usage on campus printers, power usage in classrooms, disposal of food wasted from the university cafeteria, and so on. Students proposed their solutions to a variety of audiences, such as campus administration, physical plant staff, students, alumni, and community members. This helped students see that their technical work had real world constituencies that should be addressed. In addition, students were able to use campus resources and expertise in their projects, connecting with offices such as facilities and campus management, with whom they would not normally have contact. Students presented the final projects to the campus at large in a public poster session, thereby allowing them to see how their work impacted the institution.

Approach 2--Keystone Pipeline Project

While the sustainable engineering project provided a site for students to align their technical skills with their communication development, we have explored variations on this project in alternative topics. One professor proposed to students that they tackle a current, controversial topic. After much discussion of both topics and formats for documents, the students decided to address the Keystone XL Pipeline proposal, which is still pending. With the goal of providing objective, credible information, students researched numerous issues related to the pipeline:

- pipeline operations, history, and safety records;
- environmental risks and rewards;
- alternatives if the pipeline is not built (e.g., what if the tar sands oil moved by train, ship[, or truck);
- and community impacts, including legal and environmental concerns.

Various colleagues around campus came to class to address their areas of expertise: an economist for assessing risk, a chemical engineer for pipeline and refining issues, an engineering management professor for project management, an instructional technologist for website design and layout, and a librarian for research methods. Learning outcomes for this course include assessing sources and audience analysis. A political hot topic generates many biased sources, and students dug deep to see who was providing information and for what purpose They also tried to provide for various audiences, giving both general overviews and technical detail.

After the research teams found the information, the professor created new teams. One team created the web site, while another team edited for style, mechanics, and grammar. Another team checked all the citations to make sure they were in the appropriate format and easy to locate. A fourth team checked the permissions on all copyrighted material; and the fifth team created rubrics to conduct usability testing. The course emphasized the design aspect of writing tasks; students designed, built, tested, and launched the site. By the end, students had served in two different teams performing very different tasks.

In addition to the research on the pipeline, students produced memos assessing their team, their teammates, and their own performance, and these assessments contributed to the grade. Student course evaluations showed that, while some students prefer a more professor-driven than student-driven project, most students appreciated the real-world part of the project, both in the topical nature of the issue and the public venue for their work. As a follow-up, the professor sent analytic data to all students, updating them on how many hits and users the site has drawn. The site can be found at www.keystonexl.info

Approach 3--Engineers Without Borders Project

The third variation on the conventional technical communication course aligns curricular and co-curricular areas for the purpose of developing students' communication skills. The approach is based on the work of Berndt and Paterson in the field of humanitarian engineering.[7-8] Collaborating with Rose-Hulman's chapter of Engineers Without Borders (EWB-RHIT) provides students a communication experience where they are contributing to a project that will actually be implemented. In addition, technical communication students work on solving an open-ended, complex real world problem which requires them to address social, cultural, and economic factors in their analysis and recommendations. EWB emphasizes community partnership and sustainable development; all their projects must be durable (for 20-30 years) and use only local materials so that the community can maintain the project. In addition, EWB members have to teach community members how to implement the project so that they can repair it if needed.

EWB-RHIT has just begun a 5 year partnership with the Gomoa Gyaman community in Ghana, and the community has requested assistance with building latrines and a solar-powered library.

In this approach, technical communication students are assisting in the researching and planning of these projects. The structure of the course aims to keep audience and purpose in the forefront from assignment design to document feedback—progress reports to keep EWB apprised of research findings, presentations that are heavily comprised of question & answer, and a final report because all EWB projects need to be documented thoroughly. Students also email their written reports directly to EWB-RHIT rather than submitting them to the professor.

Perhaps most importantly, technical communication students receive feedback from EWB-RHIT members during the course of the project. Inevitably, this feedback addresses not just technical content but the effectiveness of their communication. Because EWB members are invested in their projects, they provide feedback on the technical content as well as reminding teams when their project idea inadequately accounts for cultural values or economic constraints. In addition, technical communication students indirectly receive feedback on how effectively they have communicated their ideas or not, particularly when an EWB-RHIT member has to ask for clarification. Furthermore, EWB-RHIT members frequently ask the technical communication students how they would persuade the community of Gomoa Gyaman of their ideas to which there may be some resistance, reminding them that communication is an integral part of engineering. As part of our presentation at ASEE 2014, we will share the assignments, evaluations, and other materials that have been produced through this approach.

Approach 4--Grand Challenges After-School Project

Like the Engineers Without Borders Project, the Grand Challenges After-School Project ensures that students see their communication work in a real world context. The purpose of the Grand Challenges After-School Project is to increase 4th and 5th grade students' interest in Science, Technology, Engineering, and Mathematics (STEM). The strategy used to increase interest is an after-school project developed by students in the technical communication course and focused on the National Academy of Engineering's Grand Challenges for Engineering.[9] The Grand Challenges were formulated by an international group of leading technological thinkers who were asked to identify the Grand Challenges for Engineering in the 21st Century, the big, difficult problems that require engineers to work across disciplines and geographical borders to solve.

To begin the project, students work in teams of 3 to identify a Grand Challenge from which to develop a hands-on activity suitable for elementary-level students. This initial student teams first create a two-page proposal in which they describe the student demonstration they plan to construct and explain the technical foundation—mathematics, science, and engineering—that is the underpinning of the demonstration. Students present their proposals to the class during a brief oral report, then the written proposals are reviewed by faculty and staff members who serve on the Grand Challenges Team at Rose-Hulman. These faculty and staff come from a variety of science, engineering, and math disciplines, as well as from the on-campus student learning center; they validate the technical content of the proposal, as well as commenting on the communication effectiveness of the written document.

In the next stage of the project, each student team develops their demonstration and prepares to present the demonstration to a panel made up of elementary school teachers and members of the Grand Challenges Team. During a session conducted on a Saturday morning, each student team has 15 minutes to present their demo and persuade the review team that it would be effective in accomplishing the goals of the project with elementary students. Based on the technical review and the teachers' review, a reduced number of projects receive the go-ahead for presentation in the schools. At this stage in the project, student teams are reformed. Students whose projects are not selected for in-school demonstration are reassigned to work with approved projects. The reformed team must now complete the required components of the Final Project Package: the full demonstration that is used in the school, a teacher instruction guide (that includes materials, set-up, and references for further reading, so teachers can conduct the demo for their students), and video and/or visuals to supplement the demonstration. As the entire team works on the Project Package, a subset of the team conducts the demonstration on a designated day in a local after-school program in one of five elementary schools. We are in the process of collecting feedback from students on the Grand Challenges After-School Project, and we intend to share this feedback with attendees at the ASEE conference.

Approach 5--Grand Challenges Summer Program

The final variation is part of an entirely new program. The "Summer Grand Challenge: Solar Energy" was a pilot program conducted in summer 2013. A technical communication professor partnered up with a physics professor and a mechanical engineering professor to offer a full-time (12-credit) program addressing the National Academy of Engineering Grand Challenge to harness solar energy for economical use in developing countries. After exploring many options, students chose to produce a means of capturing and employing solar power to clean water in family-size batches for use in a rural area of Kenya. Students received credit for the required technical communication course, as well as for a science elective and a technical elective. The three professors worked closely together in curriculum design and the actual teaching and leadership of the students in the program. They used a "just-in-time" model of instruction, reviewing scientific principles, teaching technical content, and guiding communication deliverables as the need arose for students to effectively complete the work. Grading rubrics for deliverables were written by all three professors, sometimes in collaboration with students, and grading was also completed together. While this was not the most efficient model, it very effectively closed the gap between technical content and communication skill, in the perceptions of the faculty as well as the students (as found in end of program assessment surveys).

One early segment of the program involved a steam engine and a sterling engine. Students familiarized themselves with the equipment and then were prompted with questions about efficiency of the engines. To answer the questions, they needed to learn more about thermodynamics, and the technical faculty helped them through principles and equations with white board talks. The students learned the strengths and weaknesses of each engine and were able to put that knowledge to use in producing brochures for the engines that might be distributed by the manufacturer in the exposition area of a conference such ASEE. Students and faculty worked together to develop the grading rubric for the brochures. The rubric contained technical emphases, such as complete engine cycles and accurate pressure/volume diagram, as well as communication emphases, such as audience accommodation and document design. With technical faculty, communication faculty, and students all involved in producing the rubric, there was increased confidence among all parties that the rubric effectively captured what the students should be learning from this lab and how well that knowledge was applied in the deliverable.

While we have not attempted to implement this same model within the more complicated logistics of the regular academic year, the communication professor involved in this pilot has made changes to her approach to the stand-alone communication course based on what she learned. For example, having seen in the summer program how much time, knowledge, and effort are involved in really developing and testing a prototype solution, she decided to focus the students' critical thinking efforts in her 4-credit stand-alone technical communication course on understanding their chosen Grand Challenge problem (any of the 14 challenges found at www.engineeringchallenges.org) and researching and evaluating others' efforts to solve it, rather than advocating their own solution. She better understands what the students will be asked to do within their technical and scientific courses and is more confident in carving out the segment for focus in the communication course.

Conclusion

What we have discussed above represents five novel approaches to marrying communication and engineering in the technical communication context. We believe that ASEE conference attendees will leave this presentation with a clearer understanding of the possible intersections between communication and engineering. It is our hope that as a result of the session, they will be able to adapt our models to their own institutional contexts.

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