

Finding the Balance: A Technical Writing Assignment During a Co-op Work Experience

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Abstract

The mandatory three semester co-op work experience in the engineering programs at Grand Valley State University allows students to apply their education to real engineering situations. As part of the regular assessment of the co-op work experiences, site visits are held between faculty, students, and the employers. It has very often been noted by employer supervisors that students perform well technically but still lack polish communicating in a professional setting. To address this, a project was launched to incorporate online writing instruction as academic content associated with the Co-op II semester, with a technical proposal writing assignment as the major product. Finding balance has been a recurring challenge throughout this curriculum design project. Constant attention to balance in designing and revising the course has attempted to best meet the needs of students, faculty, disciplinary and overall institutional curriculum, and industry partners.

Introduction

In order for an engineering program to obtain or maintain accreditation through the Accreditation Board for Engineering and Technology (ABET), it must demonstrate that its students have the ability to communicate effectively (Student Outcome g up to the 2019-2020 academic year or

Student Outcome 3 for the 2019-2020 academic year and beyond) ^[1,2]. The importance of communication has been noticed not only by academics and accreditors, but also by industry professionals who work on projects with students or hire the students upon graduation ^[3].

The Writing Across the Curriculum (WAC) program at Grand Valley State University has the mission to “enable students to write effectively for multiple purposes and audiences through specific instruction in Supplemental Writing Skills courses and the integration of writing across the whole curriculum” ^[4]. As with many other universities that focus on writing across the curriculum, the methods of incorporating discipline specific needs into the writing instruction is a concern ^[5,6]. For professional programs, the importance of writing for professional practice, appropriate to the particular industry, is another challenge ^[7].

Many approaches have been taken to incorporate writing instruction into engineering curricula. The Project to Integrate Technical Communication Habits (PITCH) at the University of New Haven was an approach that scaffolded writing instruction through all four years of their engineering program ^[8,9]. At Rice University the focus has been on a first-year engineering design course and technical communication as it relates to an authentic engineering design project for a community client ^[10]. Whatever the method of incorporating the writing instruction into the engineering curriculum, ensuring the proper alignment of the writing assignments and instruction in the classroom with the writing requirements of entry-level engineers will better prepare students for the expectations of professional practice ^[11].

While written and oral communication have traditionally been a major component of a liberal arts education, the importance of blending a liberal arts education with a technical education is becoming more widely recognized ^[12,13]. This paper will focus on efforts to find the balance between liberal arts and a technical education, between written and oral communication within the context of the engineering workplace, and between in-class instruction and workplace focused experiential practice.

Background: The Course and the Technical Communication Assignment

As has been reported elsewhere the current course was developed to address several desirable outcomes ^[3,14]. These included eliminating an intensive writing requirement from a lower-division (200-level) required engineering course, providing a discipline-specific technically oriented writing-intensive course as part of a requirement for students fully admitted into the major, and respecting the workload expectations placed on faculty in requiring many of them to teach some writing curriculum rather than creating a dedicated writing course managed by one or just a few instructors.

The former 200-level course still exists, and is a requirement for all pre-engineering students working toward eventual secondary full admission to the major. A significant proportion of students who embark initially in an engineering major at GVSU end up choosing other majors after failing, or even before attempting, to gain secondary admission as engineering majors. By moving the discipline-specific writing-intensive designation and content to later in the engineering curriculum, pre-engineering students and their faculty in the 200-level course can focus more effectively on the course content. By placing the writing-intensive content in a 300- or 400-level course, full engineering majors are ensured of writing instruction related to their discipline and disciplinary styles, rather than depending upon gaining writing skills from an elective in an unrelated discipline.

The solution opted for was to include and embed the written communication instructional content and assignments as part of a required co-op employment term. Within the School of Engineering at GVSU, there is an emphasis on knowledge and skills application through a mandatory three-semester co-op work experience. During their co-op semesters, students must apply their technical education to real-world problems. Each student's three semesters of co-op are generally with one employer throughout, and alternate with classroom semesters over their final two years. Course development was focused on creating the instructional and academic content, delivered fully online, to occur in the second co-op semester. And it was designed to directly reflect and engage each student with their immediate working experience and environment.

The entire academic component was developed for fully online instruction, with writing instruction delivered in the form of tutorial content. The tutorials were tailored to characteristics of each of the several smaller milestone assignments and one larger writing assignment throughout the semester. Supported by detailed assignment and grading rubrics the intention was that individual faculty with small eight-student co-op groups per teaching credit load would not have to "reinvent the wheel" by developing and delivering their own instruction. They would, of course have to grade and provide feedback on student work. In any given year, the total number of majors in a Co-op II cohort would determine the need for the number of instructors assigned to eight-person sub-cohorts.

Initially it was intended that online writing instruction and student work would touch only lightly on employer supervisors, and require little active participation in the academic component of the students' experience during Co-op II. Over several years, the awareness and engagement of the supervisors has become somewhat more active and collaborative. This collaborative effort between the GVSU School of Engineering and industry partners is providing an opportunity for

students to develop written and oral communication skills within the context of their discipline. It also allows for students to identify a project that they could undertake in their final co-op semester, giving them a greater voice in their co-op experience. In some cases, a project proposed may be of larger scope than could be undertaken by one student during a co-op semester, and an employer is able to use such proposals as an opportunity to sponsor a senior project team to work with the co-op student to complete the project.

Finding the Balance Between Liberal Arts and Technical Education

Grand Valley State University's vision statement proclaims that it is an institution of higher education "grounded in the tradition of liberal education"^[15]. The principles of liberal education are a common thread throughout all disciplines taught at the university, a growing suite of undergraduate and graduate professional programs included. One area in which this is seen is in the Supplemental Writing Skills (SWS) requirements that must be met by all undergraduates from the institution. Every student must complete two SWS designated courses with a grade of C or better. It is recommended that one of the SWS courses be within the student's major and one be outside of the major. To have a course designated as SWS, a minimum of four hours of class time must be devoted to writing instruction, each student must complete at least 3,000 words of writing during the term, and there must be opportunities for the students to revise drafts of their writing.

Through discussions with the co-op employers, it was noted that many students had strong technical skills but still had difficulty applying writing skills in a professional engineering setting. This was one impetus for development of an SWS component to be strategically incorporated into students' co-op work experience. All GVSU students must complete the university required writing foundation course (WRT 150), usually in their first or second semester at college; or have sufficient high school advanced placement credit to be waived from taking the university writing course. The writing focus in this requirement encompasses many rhetorical principles, but does not touch on technical writing as a genre. While students will also be fulfilling their SWS requirements by taking another (non-engineering) SWS course, the writing emphasis will relate to the style of that course's discipline. In the previous 200-level engineering course that was used as the engineering-specific SWS course at GVSU, the students had not yet been accepted for secondary admission into an Engineering major, or begun their co-op sequence. Moving the engineering SWS course to the 300-level as part of the second co-op course allowed for a discipline specific focus on technical writing and communication within the context of their engineering work experience.

In a study of discipline specific writing instruction at a mid-sized four-year state college, students surveyed indicated the importance of having the disciplinary context to their writing and having faculty with the disciplinary understanding ^[16]. It has also been shown that learning transferable skills such as written and verbal communication skills is supported through work on real scientific problems, rather than simply in the classroom ^[17]. In this curriculum design effort, the major writing assignment developed as the focus of the new SWS component to the co-op semester was a formally formatted technical proposal. The students were directed to identify a problem or opportunity at their co-op workplace and prepare a technical proposal to address that challenge. To balance the academic component of writing a technical proposal with the technical knowledge required to identify an appropriate problem or opportunity and a feasible method of addressing it, the SWS component was strategically added to the second of the three co-op semesters. This timing allows the students to have a first semester of familiarity with their employing company and its products and processes, and also provides the potential for the student to be involved in implementation of the proposed project later on in their final co-op semester.

During the writing and revision process, students exchange their drafts with classmates at several points, and both provide and receive peer reviews. The reviewing process and content is guided by the same rubric given as part of the assignment and which ultimately will be used for grading. By receiving feedback from their peer reviewers, students are able to develop and refine their proposals. However, an additional great benefit is also experienced by students through having the opportunity to review the writing-in-progress of other students. While developing the organization of the SWS component, it was anticipated that students would appreciate receiving the feedback from peer reviewers but would find the process of peer reviewing others' proposals to be a tedious task. On the contrary, a significant portion of students have noted that the opportunity to read other students' writing gave them a better perspective on, and ideas for, their own writing content, formatting, and style. A summary of selected student responses during post-implementation focus groups are shown in Figures 1 and 2.

After Winter 2016:

- *Liked getting feedback on first peer reviews. Very helpful. Reviewer pointed out stuff I didn't catch the first time, gave different perspectives on how to say or present things.*
- *Feedback from peers more blunt and helpful than from professors. Sometimes more helpful, in fact. Very different thing to have three students looking at your work.*
- *Helpful to see how others organize their thoughts, got ideas from each other, e.g. use of bullets. Being able to see others' papers helps you reflect on your own.*
- *Can feel bad when see how well some peers write, have ah ha moments when seeing more creative ideas like flow charts.*

Figure 1 Selected student feedback on peer reviewing, gathered in facilitated focus groups following the Winter 2016 course pilot (11 students).

After Winter 2017:

- *The revision process, peer reviewing, getting feedback was the best learning part of the process.*
- *After first draft, felt that wasn't really doing more writing.*
- *Felt peer reviews were not helpful, didn't get good feedback*
- *Felt some were kind of personal. Suggests that reviewers should get more coaching on giving more technical advice.*
- *Peer reviews were a mix.*
- *Faculty advisor feedback would be a real plus, on at least one of the draft reviews. Some got some faculty input, some did not.*
- *Peer reviewing: that was graded, too – would like the faculty advisors to provide more really critique the quality of the peer feedback more. Peer review is valuable only if it's decent. Took at least an hour to do each review, applying the rubric to each paper reviewed. Really must emphasize that the review points include a required "overall comment".*

Figure 2 Selected student feedback on peer reviewing, gathered in facilitated focus groups following the Winter 2017 first full EGR 390 cohort (~130 students).

Thus, in this aspect, the hoped-for balance and synergy between a significant element of traditional liberal education and the expectations of professional technical communication have been somewhat borne out.

Finding the Balance Between Written Communication and Oral Communication

The writing practice and instruction for this course is focused primarily on improving written and oral technical communication as it is practiced in engineering workplaces. It is highly desirable, but not required, that a student select and develop a technical proposal for a real problem to be solved or opportunity to be pursued, but it is not required; a student may, in fact, develop a purely hypothetical topic to propose. The goal is to conduct and communicate the thought experiment appropriately. Basing their communication exercises in an actual work-related project if possible provides added richness in the experience.

After implementing the technical writing component to the co-op work term in an initial small pilot section of eleven students, employer supervisors were asked about their perceptions of the students' communication skills as they pertain to the work environment. The employers noted an improvement in students' writing skills but also were firm in stating that in the workplace, many decisions are made based on an oral presentation of information during meetings. This is consistent with what has been reported in a study of software engineering professionals who hire or review the performance of recent graduates, conducted at the Massachusetts Institute of Technology. Oral communication skills were found to be the dominant expectation for communication skills among the evaluators ^[18]. A written proposal is important for documenting recommendations made orally, but the technical proposal should not be expected to be a stand-alone document. This input from the employer supervisors was acknowledged as relevant feedback, that should be reflected in a suitable adjustment in the overall course plan. In updating the SWS component for the second cohort of Co-op II students, a technical presentation was added.

During pre-proposal planning, students are directed to review their proposal topic with their employer to ensure that it would be appropriate to their work situation in principle, regardless of whether the project will ultimately be approved to proceed as proposed. In updating the SWS components, this review step has been recast from a formal memo to an oral presentation. To balance workplace emphasis on oral presentation with the university's SWS requirements for the total number of written words during the semester, a connection is established between oral and written communication for the pre-proposal presentation. In addition to submitting the presentation slide deck file to their faculty advisor for grading, students are also required to submit a script or speaker notes for the oral presentation of the preliminary proposal presented to their workplace supervisor and co-workers.

Finding the Balance Between a Dedicated Writing Course and Distributed Writing Instruction

The traditional format for a writing focused course is a single instructor, or at most two instructors where one focuses on the discipline specific content and the other on writing instruction. The co-op work experiences at GVSU are required academic courses. As such, there are academic components accompanying each of the co-op semesters. For over a decade the academic content of each co-op term was in the form of online modules and quizzes, similar to many online certification and training programs. In the current arrangement, the academic component of the second co-op term is significantly altered to meet the university's writing emphasis requirement. The past pattern, continued in the Co-op I and Co-op III semesters, is one faculty advisor assigned to a group of approximately eight students (for one credit of teaching load) to review and respond to weekly journal entries that the students submit to reflect on their work experiences. The faculty advisor also completes a site visit toward the end of the co-op semester to meet with both the student and employer in person to review the student's performance for the semester.

For the current Co-op II course, containing the SWS component, the academic component cannot be simply delivered through a series of online modules and quizzes. The faculty advisor must be involved in the coordination of the peer reviews, the evaluation of the quality of the peer reviews, and providing formative and summative feedback on writing, formatting of the proposals and other written work. This requires that a much larger number of faculty are actually involved in the SWS course instruction than if the SWS component were incorporated into a traditional style lecture-discussion course within the curriculum, in the form of a single dedicated writing course.

To address the issues that arise from the distributed instruction of the SWS co-op course, detailed instructions, writing guides, and examples were prepared, along with schedules of the deadlines for the various components and comprehensive rubrics for each of the graded components. These are all pre-populated into Blackboard, the learning management system used for the course, ensuring a level of consistency across all instructors, and eliminating any need for individual instructors to create grading standards separately for their own small group of students. The use of a standardized rubric for writing assignments across multiple classes and sections has been shown to be helpful for both faculty and students to ensure writing expectations are clear and consistent ^[6]. An example of the rubric used for the first, second, and final drafts of the technical proposal is provided in Appendix A.

Conclusion

As with any curricular changes, finding the balance between programmatic requirements, technical content, and faculty workload is always difficult. When these curricular changes are made within experiential learning settings, it allows for richer experiences but also a greater number of factors to be balanced.

The addition of a technical communication assignment to a co-op work experience has been a balancing act but it has proven to be an effective way to incorporate real-world technical communication experience into engineering curriculum. Through the continuous assessment and improvement process, the requirements of the academic content as well as the needs of the co-op employers have been addressed. The liberal arts and supplemental writing skills requirements have been able to be met while being applied to technical projects. Written communication skills are able to be developed while also developing oral communication skills needed in industry settings. The coordination of all class sections by a core team has helped facilitate the large number of individual instructors required as faculty co-op advisors. Although finding the balance between all of these factors proved difficult at times, the incorporation of a technical communication assignment into a co-op work experience has helped bridge the gap between education and industry.

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Appendix A - Scoring Rubric: SWS Technical Proposal

Scoring Rubric: SWS Technical Proposal

TP Author: _____

TP Reviewer: _____

Criterion	Points 0-3
1) Follows Prescribed Format. * How well does the document follow the guidelines for fonts, margins, layout, etc. from the first page of the Technical Proposal Guidelines? Does it look like the writer has command of the basic functions of their word processor (MS-Word or other)?	
2) Title is specific. * How well does the title convey what exactly the project will focus on? Is it too long, too "jargon-y", too vague or general?	
3) Executive Summary. * Is an "executive summary" included? Does it find a balance between being too long and detailed, or too short to be informative?	
4) Statement of the Problem. * How well does the proposal clearly state the problem to be solved? Is there sufficient background and description to place the problem in a wider context within the company, and explain the potential value? Is it clear what consequences may exist if the project is not undertaken? Are resource references included for any outside documents, web sites, etc. that have been cited?	
5) Objectives. * Has the writer clearly stated the scope of work? Is it clear that the customer's needs are being given appropriate weight? How adequate are the presentation of critical design issues, constraints, and limitations that will have to be considered in developing a solution?	
6) Technical approach. * Has the writer presented a range of possible solutions? How well have multiple alternatives been described? How persuasively has a rationale for the preferred alternative been presented, and is actual evidence included? Are planned validation tests outlined?	
7) Project Management. * Does the document include a clear description of task phases and relevant outcomes? Does it include a realistic time line and pertinent milestones? Does the document include a Gantt chart representing the project stages (it should)?	
8) Deliverables. * Does the document include a complete list of work products and documents that will be delivered to the client before or by completion of the project?	
9) Estimated Budget. * How much will this project cost? Does the document provide an estimated total with a sufficient level of details to avoid hidden or unforeseen costs later on? Is the estimated budget provided in a table format that makes it easy to read and assess?	
10) References. * Are there accurate and consistent citations for all supporting sources cited in the proposal?	
11) Overall Impact. * In your estimation, does this proposal make a persuasive business case? Speaking objectively, why or why not?--this is not your estimate of whether the proposed project is relevant; rather, it's your rationale for indicating what further changes in the written document might more effectively persuade a supervisor about the value of the proposed project.	
12) Content. * Is content developed that is appropriate to the engineering discipline, which draws upon relevant sources?	
13) Organization. * Is written material organized to suit the purposes of the document and meet the needs of the intended audience?	
14) Clarity/Style. * Does the document express ideas using language that meets the needs and expectations of the desired audience?	
15) Mechanics. * Is their evidence of the proper use of conventions associated with grammar, punctuation, usage, formatting, and citation that is appropriate to the specific writing requirement?	
16) Total points: 0-45	
17) Late Deduction – Suggested deduction of 20% for late submission of first, second, and (or) final draft	

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Scoring Rubric: SWS Technical Proposal

Reviewer comments (Take as much space as you need here to provide specific "formative" and (or) summative feedback that will be helpful to the writer):	