

2007: EVOLUTION OF THE TECHNICAL WRITING IN SENIOR DESIGN - A CASE HISTORY

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Abstract

Seattle University has had a year-long, industrially sponsored senior capstone design program for the past 20 years. Technical writing is an important component of the capstone experience. Student teams prepare a written proposal in the fall quarter and a final design report in spring quarter for the sponsoring agency. This paper discusses the evolution of the writing component of the senior design program within the civil engineering department over the two decades. Engineering and English department faculty, writing center student consultants, professional technical writers and professional engineers have helped to shape the writing portion of the program. The paper shares the experience, benefits derived and the lessons learned over the years. It is hoped that sharing this information would be helpful to other design programs.

Introduction

Technical writing is vital for engineers. It is estimated that a typical engineer spends one third of each day writing¹. Also, there is an increasing demand from industry employers that students improve their technical writing skills. Engineering documents have to be professional, well organized, reader friendly, accurate in the information it provides, clearly written, concise, and grammatically correct.

Students usually lack confidence in writing. Most students decide to go into engineering because of their strong math and science skills and not because of their passion for writing. This dislike for and fear of writing is exacerbated because the students are not familiar with the subject/project they are still learning about themselves and also with the conventions and genre of technical writing². To alleviate the troubles of the engineering students and to make them better technical writers, academia has come up with creative ideas of providing resources to students.

Student peer review has been used effectively to improve technical writing³ and to expose students to scientific peer reviewed publication⁴. Several universities have established interdisciplinary technical communication courses between the English (or communication, humanities or journalism) department and other technical disciplines⁵. Some universities have writing centers where undergraduate and graduate tutors provide help to their fellow students by providing feedback on one's written work⁶. Engineering practitioners, alumni of engineering programs, and industrial advisory boards of engineering departments have also participated in technical writing projects at selected schools⁷⁻⁹.

The capstone program at Seattle University's college of engineering has been in existent for the past 20 years. Over the years various constituents have participated in improving the technical writing component of the program. Seattle University Writing Center (student) consultants, English department faculty, technical writers who have experience in science and/or engineering consulting, and practicing engineering professionals have participated in this process. The aim of this paper is to discuss the evolution of technical writing within the Civil Engineering

Department over the past two decades and to share the experience and the lessons learned over time. It is hoped that sharing this experience will help other design programs.

Overview of senior design program at SU

Design projects that could be completed within an academic-year are solicited from local industries prior to the beginning of each academic year. Teams of three to four students work under the direction and supervision of a company liaison and a faculty advisor to solve a real life engineering problem.

The fall quarter is spent meeting with the company liaison(s) and the faculty advisor, visiting the project site (if applicable), understanding the overall goal of the project, brainstorming ideas for solving the problem, and defining the scope and final project deliverables. This preliminary work results in a written proposal which is submitted to the sponsor at the end of November. The students spend winter and spring quarters working on the project. The project culminates in spring with a written final report to the sponsor.

The proposal covers the project background, problem statement, project objective, scope of work, plan of implementation (task break down and deliverables at the completion of each task, if applicable), project schedule, budget, references and bibliography and team member resumes. The final report consists of project background, team's solution to the problem, external constraints controlling the design (such as political, social, economic and ethical issues), relevant calculations, engineering drawings (whenever applicable), conclusions and recommendations to the sponsors.

Several internal and external constituents have contributed to shape the technical writing component of the capstone experience. The evolution of this development and the lessons learned are described below.

Development of Technical writing component

a) Collaboration with the English Department

Since the inception of the design program engineering faculty have worked with the English department faculty to develop strategies to improve the writing of proposals and final reports. Their collaboration resulted in the development of a set of writing guidelines for the proposal and the final report. These guidelines provide templates for proposals and reports which teams customize as appropriate, explain the purpose of each section in the two documents, discuss the audience for the documents, and provide reference formats for the various sources such as books, journal articles, maps, reports, personal communication, and websites. Furthermore, the faculty developed a rubric that is used by various entities to evaluate the documents. The writing guidelines have gone through several revisions over the years. Copies of the writing guidelines are distributed to the students and faculty advisors at the beginning of the academic year. This document does not in anyway look like or replace a text book on technical writing. However it brings some degree of uniformity to the documents prepared by the various engineering disciplines, while allowing flexibility to customize the documents to meet client needs, and helps

the students to understand the expectations of the written documents. These writing guidelines can be accessed online¹⁰.

Seattle University has a Writing Center run by the English department faculty. Students who exhibit strong writing skills from various departments are hired as writing consultants. These students have a diverse background but none are science or engineering majors. They hold office hours to help students with various writing assignments. Writing consultants who have an interest in technical writing were chosen and assigned to engineering design teams to review and critique project documents. These writing consultants were coached by the English department faculty on technical writing and were familiar with the set of writing guidelines discussed previously. Each senior design team was assigned a writing consultant for a whole academic year. Design teams were required to submit their work at various stages to their writing consultant and get feedback. This system did not work well for many reasons. The writing consultants wanted several days, sometimes weeks, of advanced notice on when the drafts would be turned in for review. Being students themselves, the consultants did not want the reviews interfere with their own course work. They typically needed a couple of days up to a week to review the document. The design team members were trying to balance their course loads, work outside the school, meet sponsor needs and the tight project deadlines. Therefore they needed the writing consultants to review the document at short notice and expected the reviews to be performed quicker. Furthermore, there was conflict between the engineering teams and non-engineering writing consultants on the genre of technical writing for engineers. Technical writing is informative. However the student consultants were used to persuasive writing and were therefore unable to provide constructive feedback. Therefore, after several years of trial the design team-writing consultant partnership was suspended.

In the early years of the project center, an English department faculty gave a few lectures on technical writing to the senior design class in early fall quarter. In 1998 the lectures were replaced with some workshops sessions during which student teams could write the various pieces of a proposal in a team setting. With time it evolved into a system where all the teams (about 20-25 teams from electrical, civil and mechanical engineering) submitted a particular portion of their proposal (eg. introduction or list of references) to the English department faculty prior to a class meeting. The instructor reviewed the write-ups before class and used the class time to critique them. He projected a few of the writing pieces on the screen and discussed the strengths and weaknesses and how to improve it. These sessions were helpful to see where information was unclear or lacking to a reader who was unfamiliar with the project. However, the disadvantage of this method was that there was not enough time to go over the work of all teams within the short time span. Due to cost consideration, the English department faculty could only spend limited amount of time in fall quarter and could not extend his services for other quarters.

b) Collaboration with Industry through a Technical Editor

In 2003-04 the English department faculty who was conducting the technical writing sessions for senior design took a sabbatical leave. The engineering departments wanted to try something different during this year. A technical writer from a local civil engineering consulting firm was willing to volunteer her time to review the proposals and provide feedback. Proposals were

submitted to the technical writer in two instances: once at an early stage of development of the proposal and next at a more mature stage of the proposal. She reviewed the proposal drafts prior to the class meetings. On the day of the class session, she projected selected proposals on the screen and critiqued them.

Although the technical writer did a fantastic job at reviewing the proposals, coming from industry she did not hesitate to harshly criticize poor or unclear writing. It was a rude awakening to the students who are not used to such criticisms from faculty.

Students were surveyed twice, once in the middle of the fall quarter and then at the end of the fall quarter, to get feedback on the effectiveness of having a technical writer review the proposals. The middle of the quarter feedback was negative. Students did not like her projecting their work on the screen and critiquing. Some students felt that because the technical writer came from a civil engineering consulting firm she did not understand electrical and mechanical engineering projects. However, when the students were surveyed again at the end of the fall quarter, most felt that having a technical writer was effective and resulted in a better proposal at the end.

3) Hiring of a Part Time Instructor for Subsequent Years

In 2004 the engineering department decided to hire a part time instructor to assist in technical writing of the proposal. The person hired had a science background and had prior experience working as a technical editor. She spent an hour every week with each of the engineering disciplines: Civil, Mechanical and Electrical engineering. This section will discuss the experiences of the Civil Engineering department.

The first year, fall 2005, the part time instructor had a mix of lectures on technical writing followed by feedback session on the student work. We followed the same format for the proposal reviews as with the technical writer from consulting. Students submitted parts of their proposal to the part time instructor prior to class several times during the quarter. The part time instructor reviewed the submittals and critiqued all civil engineering projects during class time. Because the review sessions were discipline specific, the part time instructor could spend more time on each proposal during each critiquing session. Nevertheless the students felt horrified when their work was being projected on the screen and critiqued. Student feedback on having a part time instructor review their proposals was quite similar to the ones received the previous year with the technical writer from industry.

In fall 2006 we changed the format for the reviews. Students submitted parts of their proposal to the part time instructor on a Friday or over the weekend. Individual review sessions (typically lasting about 20-30 minutes) were scheduled between the part time instructor and each team the following week. The faculty advisor was required to attend these sessions during the early stages of the proposal. But once the proposal started taking shape the faculty advisor did not have to be present. Feedback from teams on these review sessions has been overwhelmingly positive. Student did not mind harsh criticism of their writing from the part time instructor within their own team setting. The presence of the faculty advisor at the meeting was to answer questions that students could not answer. Again due to cost issues the part time instructor could not be hired to review the final reports in spring quarter. However, we hope that multiple review

sessions between the teams and part time instructor in fall quarter have helped improve students' technical writing skills to a point where they can write the final report with feedback from the faculty advisor, project liaison and the Senior Design subcommittee. The senior design subcommittee is discussed next.

4) Input from Civil Engineering Advisory Board

For the past decade the Seattle University Civil Engineering department has had an active industrial advisory board consisting of about ten practitioners. The board meets quarterly to discuss curriculum, student recruitment/retention and senior design project issues. A subcommittee within the advisory board, the Senior Design subcommittee, is dedicated to senior design project issues. The four subcommittee members have a diverse civil engineering background (environmental, geotechnical, structural, and water resources). One of their major tasks is to evaluate the written proposals and final reports.

The proposals and final reports are sent to the Senior Design subcommittee members when the documents are close to completion. The subcommittee members spend less than a week to review the documents and provide written feedback on strengths and weaknesses of report, areas of improvement, technical deficiency and clarity of the document. They also evaluate the documents using the scoring rubrics developed by the faculty. The student teams address these comments before finalizing the project documents.

Lessons Learned

We have learned several lessons from the multiple partnerships we have had over the years. The important lessons are summarized below.

- The writing guidelines have been extremely useful in conveying the expectations for the proposal and the final report. It also has brought some degree of uniformity in the document across the various engineering disciplines.
- Writing center student consultants who review technical writing should be familiar with engineering writing genre. Unless the student consultants have written such documents themselves it is hard for them to serve as effective reviewers.
- It is advantageous to have external reviewers, such as technical writers, part time instructors and engineering practitioners, review the documents. Faculty advisors and project liaisons are too close to the project and tend to fill in their minds the missing pieces of information when reviewing student work.
- Writing is very personal. No body wants to be criticized in a larger setting. The technical writing tutor has a challenging balancing act of providing constructive feedback while building the students' confidence and making them better technical writers. Sessions with the writing instructor and individual teams resulted in better tutor-tutee partnership.
- Senior design programs need to budget the time of a technical writer if they are considering hiring one. Thorough review of a technical document takes time and person carrying out the review has to be compensated.
- Review of documents by the professional engineering community requires detailed coordination. Dates for reviews have to be picked well in advance (at the beginning of the quarter) so that they do not conflict with travel plans and/or other project deadlines of the

practitioners. The large file sizes of the project documents have posed difficulty in sending them electronically. This problem was circumvented by setting up remote FTP (file transfer protocol) server that can be accessed by the practitioners.

Summary

Seattle University senior design program has partnered with various internal and external constituents to improve the technical writing skills of the students. English department faculty, technical writers, and the professional engineering community have helped shape the writing component of the design experience. It is hoped that the lessons learned over the past 20 years will be helpful to other senior design programs.

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