Incorporating design into a class teaching technical communication skills

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Session 8: Other topics relevant to engineering education

Abstract

A technical writing class is a perfect vehicle for giving students the opportunity to be creative designers and to learn more about the engineering profession as well.

In order for our students to have more experience in brainstorming, teamwork, and product development, we have incorporated into our technical communication class participation in Suffolk University’s Business School’s New Product Innovation Competition. Students were divided into teams and spent one month of class time brainstorming product ideas and dividing work among team members. After every class, a student was required to submit a one-page journal entry about what was accomplished during the team meeting, what issues came up, and anything else that was noteworthy about the team meeting. Students were graded on the quality of their writing as well as on their content. Before the contest entries were due students were required to submit their proposals to the instructor, who would critique them, and to give oral presentations to the class. The students then would submit their re-written entries to the contest.

Students were very engaged in this assignment, which forced them to be active learners, and, in written evaluations, were very positive about this activity. In 2008, one of our teams placed as a finalist for a design of a watch that monitors vital signs, winning $1000 and the opportunity to meet with venture capitalists to discuss bringing their product to market beating out more than 200 other entries.

This class gave students the opportunity to develop other important engineering skills. Other assignments include the design of an original experiment, and summarizing talks given by visits from a Suffolk alumnus of the department who works at Canon Design Inc and a group leader from a local defense laboratory. They also explored the ethical consequences of engineering decisions in an assignment on the Space Shuttle Challenger disaster.
INTRODUCTION

The importance of technical writing in an engineer’s career is hard to overstate; engineers spend a significant proportion of their time writing reports, memos, proposals, and giving presentations, and good communication skills are part of the ABET outcomes. Therefore it is appropriate for engineering programs to include a course on technical writing.

Numerous textbooks exist on technical writing and some do an excellent job of outlining the important features of good technical writing such as writing clearly, accurately, forthrightly, concisely; knowing who the audience is and why they are reading the document; how to best transition between ideas. (I use *The Craft of Scientific Writing*; Alley, Michael 3rd ed., 1998) They discuss the features of writing such technical documents as memos, proposals, manuals, and resumes and give examples of good technical writing and bad technical writing. But what they generally do not do, unlike other technical textbooks, is give assignments. And therefore, the instructor is left to develop on his own, what assignments to give his students.

THE ASSIGNMENTS

Plagiarism is a problem

In my experience as a teacher of a technical writing class, I have found that if an assignment can be plagiarized, certain students will plagiarize, and therefore, writing instructors must do their utmost to develop assignments that cannot be copied from other sources. Although this task may prove daunting to English professors who assign papers on classics or history professors who ask students to research well known historical events, the technical writing instructor can have students write about original technical work that the student works on in class. Class time in a technical writing class needn’t be spent on having the instructor lecture about the features of good technical writing since, unlike certain technical concepts, writing concepts are not difficult to understand. They are, however, difficult to implement, and the only way for students to learn these concepts is for students to spend a lot of time writing and re-writing.

Class time can be used in creative ways to help students develop engineering skills

Class time in a technical writing class can be used for not only providing students with material to write about but also to help students become better engineers and to develop skills that are part of the ABET Outcomes a-k. This paper mainly describes how a design contest is incorporated into my technical writing class. But the assignments also include the design and presentation of an original experiment as well as summarizing talks by an alumnus who works at an architectural design firm and an Industrial Advisory Board (IAB) member who is a group leader in a defense research laboratory. They come to answer students’ questions about industry; to discuss how they use writing in their jobs; and to discuss how to successfully communicate in an interview and on a resume. Another assignment involves students understanding the ethical dilemmas faced by managers and engineers in designing the Space Shuttle Challenger. All these assignments involve students learning and gaining experience in other engineering skills besides communication such as technical entrepreneurship, design and experimentation skills, connecting with industry, and understanding an engineer’s ethical responsibility.
STUDENTS PARTICIPATE IN “NEW PRODUCT INNOVATION COMPETITION”

Suffolk University’s Business School holds a contest each fall called “The New Product Innovation Competition”, which requires students to develop a proposal for a product to bring to market. Three cash prizes worth $3500, $1000, and $500 are awarded and winners meet with business representatives and venture capitalists from such companies as Bose, Solutions F5, and M/C Venture Partners. The submission date for the contest had been in early October but this past year, the submission date was moved to the end of November, thus allowing for the contest to be the major final project of the course.

**How did it work?**

To motivate the students, and to convince them that they can develop a winning product, the organizer of the contest Dr. Sushil Bhatia of Suffolk University’s Business School spoke to the students and answered their questions at the second class meeting of the semester. I then divided the students into teams of four or five students (there are typically ten students in the class). The team had to decide on a team leader who is responsible for the overall quality of the project; each member of team needed to take responsibility for some part of the design, and to let me know what he/she is responsible for. Each team member received two grades: an individual grade and a team grade. Since the contest entry was not due until Nov. 30th, I first had the teams work on a different project for the first four weeks, that of designing an original experiment, and presenting it in both oral and written form. After that, they had two individual assignments, that of giving an oral presentation on an article on science and technology and writing an instruction manual on the basic usage of Mathematica©. During that period, teams were free to meet on their own time to work on the contest but class time was not allotted towards it.

The teams starting working on the contest in class in the seventh week of the semester and for the next five weeks, students spent a good part of each class meeting, in teamwork on developing their product. After every class, each student had to submit a journal entry on the team meeting of that day. The students were given the following assignment about their journal entries:

- **Your journal entries for your design product should be about one page long (12 pt font; double spacing).**
- **In them you should describe what you accomplished during your team meetings, and what future work you plan.**
- **Concerns or problems should be discussed too.**
- **The journal entries must be written with good English usage, in a clear and concise manner.**
- **You should write a separate journal entry, for each team meeting (2 per week).**
- **Sketches can be added on too.**
- **Each individual must write his own journal entry.**

A week before their proposals were due, students were required to submit their proposals to me and to present their proposals to the class (students are given a rubric which was taken from Northwest Regional Educational Laboratory held in1998 on which the grading of all

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1 Students became familiar with Mathematica™ in their freshmen calculus classes.
2 I also spent part of the class time lecturing about writing.
3 They had to do the same for the assignment on developing an experiment too.

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their oral presentations is based). I graded and critiqued the proposals overnight (students are also given a rubric for the grading of their writing assignments which was developed by the College of Art's and Science's Dean's office), allowing students to rework their proposal before they submitted it to the contest. In the fall 2008, my class submitted two design proposals; a health monitoring device which won second prize and a design of an alarm system which used a piezoelectric sensor. In the fall of 2009, students submitted a proposal for a device that detects alcohol in drinks and for a software tool that collects personal health information and generates tracking and trending reports for various categories. The products were judged on their innovativeness, clarity of presentation, value proposition, and feasibility as well as other criteria.

MY IMPRESSIONS

From the outset, students, in both years, were engaged by this contest. In previous years, before this assignment was introduced, I used the segments of the series *The Mechanical Universe and Beyond*, as well as other videos on technical topics as material for which the students could summarize. Students are certainly more active than when watching the videos, and they sometimes would use uncited materials in their summaries. Their journal entries are, by their nature, original and clearly demonstrate their writing deficits.

The journal entries helped to clarify their thinking and understanding of their proposal, and I believe that gave the teams an advantage over the other entries.

Although it was clear from their journal entries that not every team member contributed equally, almost all the students in the past two years did contribute. Most of the students already knew each other (we are a small department) and they did a good job picking who the leader should be, and working with him.

STUDENT FEEDBACK

Students were asked, after they submitted their proposals but before the results of the contest were known, to give feedback anonymously on the design contest experience. I wanted the experience to be fresh in their minds, and did not want whether they won or not to influence their critiques. Most of the comments were positive and the experience was described as:

- Fun
- Exciting
- Creative
- Real-life
- Great for gaining experience in team-work
- Good for allowing journal entries to keep track of progress
- An opportunity for engineering students to meet business students
- Good research experience
- Helped me come up with a senior project idea

The negative comments included:

- Difficult to meet with team mates outside of class
- Individual projects would be better
- Team member did not contribute
- One team member has a “my way or the highway” attitude
• Instructor should give more aid on the design

The appendix contains some of the student comments from 2008 and 2009.

Addressing student feedback

I don’t believe there is much an instructor can do with a student who refuses to do his part in the team except to make the teams large enough so that the other students can make up for his lack. This past semester, I had one team (the personal health record software tool) who was slow to agree on an idea. Next time, I’ll have the teams come up with a time line for their design in the first week that they work on this project, which hopefully will reduce the amount of floundering for an idea.

OTHER ASSIGNMENTS

As was mentioned, students performed a team-based project on designing an original experiment, and two individual projects: an oral presentation of an article on science and technology, and a written instruction manual. After the contest, students had two additional assignments: writing a paper on the ethical dilemmas faced by the engineers of the Space Shuttle Challenger; and summarizing a talk given by an alumnus who works in the electrical requirements of new office buildings. They also had an optional assignment to bring in their resumes which would be critiqued by one of our IAB members, a manager from a local engineering laboratory. In addition, each week of the semester, the students needed to answer questions about their text readings.

The design of an original experiment

Students often feel overwhelmed by the assignment of designing an original experiment and often need a lot of support from the instructor throughout the course of the assignment. I suggest to them that they take an experiment that they have worked on in a lab or perhaps as a research project and modify it or study another quantity that they had not looked at, and test a hypothesis about what they expect their results to be. Students have three weeks to work on this assignment. In 2009, since all the students in the class had already taken linear circuits, I suggested to the students that they choose an experiment based on linear circuit theory. The students followed my suggestions and the two experiments that had been devised were: testing the ideal op-amp model, and testing how well linear circuit theory predicted the behaviour of a low-pass filter. The journal entries that the students were required to submit after each class meeting allowed me to not only judge their writing but to correct their work and to make suggestions about their designs, analyses, and measurements. Students gave one oral presentation and were required to turn-in a re-write of their written report after it was corrected and handed back to them.

One major drawback to this assignment, and well as the product design contest, is that the work of the write-up is usually left to one or two students who feel that they need to do the write-up because their writing skills are better than those of their team mates. This weakness is somewhat compensated for by the journal entry assignments required by each student, which not only illustrate a student’s writing skills but also give an indication of the student’s contributions to the projects.
Presentation on a current topic in science and technology

Students are required to make a ten minute presentation on an article (or sometimes they choose to use several articles) on a recent development in science and technology. Students usually are very engaged in this assignment and it does not pose any significant problems in its execution except ensuring that students cite all their sources.

Space Shuttle Challenger assignment

Students are shown a National Geographic video: Challenger: the Untold Story featuring the story of Roger Boisjoly, the engineer who tried to stop the Challenger launch and then suffered as a result of being a whistle blower, and are then asked to write a two-page paper on the ethical choices that the managers and engineers faced as well as how they think they would have acted had they been in the same situation. The main drawback of this assignment is that students may over rely on what’s already been written about the shuttle disaster and not do enough original work, but students usually do a fine job on it.

Instruction manual on how to use Mathematica™ to perform basic calculations

Before 2009, I had allowed students to choose the topic for their instruction manual and I stopped allowing this because invariably a few students would plagiarize their manual. This year the topic was How to use Mathematica™ to perform basic calculations and I forbade them from using the software’s help guide in writing their manual. As a result, there were no incidences of plagiarism this year.

Alumni or representative from industry talk

Students particularly appreciate hearing from an alumnus of our department or some other person from industry. They often have many questions and get good advice on preparing for interviews and on what to expect from the working world. They are asked to write a one page summary of the talks, which cannot be plagiarized.

The other assignments

Students are eager to have their resumes screened by someone from industry, and to ensure that the weekly reading assignments from the text are done, students are required to answer questions about them. Students found answering questions to be tedious, and I plan on giving them multiple choice questions next fall.

CONCLUSION

A technical writing class is a perfect vehicle for incorporating creative engineering endeavours such as participating in a design contest. Generally students’ experiences were positive and in 2008 one team won second prize in the contest. Students were asked to

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4 The first 15 minutes or so of the video is shown in class and students are required to finish viewing it at home.
5 In those cases, I required students to redo the assignment.
6 Students had already become familiar with Mathematica™ in their freshman calculus courses.
write journal entries about each meeting, to submit for a grade their design product proposal, and to present to the class their design concept. Additional assignments included a team-based design of an original experiment, oral presentations on current topics in science and technology, an instruction manual, and a paper on the ethical dilemmas faced by engineers who designed the rocket boosters of the Space Shuttle Challenger.

APPENDIX

From: 2009

1. My experience in designing an unique product was really helpful because it gave be the ability to think in my own and come up with ideas that could help me choose a topic for my senior project. The hardest part of the design was to agree with all the different ideas that each of the member had in mind and then taking all this data and narrow it down into something convenient to all of us. The good thing about this project was that we worked as a group and nobody was trying to be better than anyone in the group.

2. The design experiment went much better than the product design contest. We continually revised the first project until we got an A. The second one never actually got completed to the level it should have been, and I'm sure our grade will reflect that. I think the effort level from the team was low on the first project, and was non-existent on the second one.

3. My team experience has been a pleasant one. Although one member is hesitant and resistant to change in any plans it makes suggesting/asking difficult. Sort of felt like he was the type of person who followed "my way or the highway." Even if the total amount of work was less, member makes it well known when he/she does any work. I know I am quiet at times, but I don't need to have everyone notice everything.

4. Overall I think both projects went well. The experiment was more of a struggle because we had to come up with a repeatable test. The product design was fun since we could show our creativity and demonstrate knowledge in coming up with each aspect of the product. I think that the instructor could check to see if everyone is working well as a group early on and possibly reassign groups or even just make sure everyone in the group knows they need to contribute.

From 2008:

1. The design contest was an amazing way to bring together the class to work towards a project that could be very helpful for future generations. This competition also helped the engineering students match up to the business schools students. This competition was fun and exciting as it made us all think of various new technology that some had only thought of as a dream that would someday take shape to reality. The team work was awesome and helped us know each others potentials and specialties. The journals helped boost our grades and were a great way to keep track of ever step of progress towards our design.

2. The design contest was a great real life experience. We teamed up to go through a design process of a new product. The meeting reports were a good decision that kept
track of what we were doing. Required a lot of research, which was great to get us familiar with new technology. Overall great task.

3. The design contest was a learning experience for me because I have never participated in such context. The good thing about it is that the context taught me how to be creative. Working on a team gave me the importance of being a team player. Two things I would change is the way they organized the proposal form, I think the contestant should have the freedom of writing it on our own format, and the instructor could also have the class compete among themselves.

4. The design contest brought team-work experience to the whole team. It has taught us what it's like to be in the real world where we have to come up with a design, prototype, and revision. Not everything were given to us; we had to research on our own and bring it up during our group meeting. Working in groups has it advantages where we all can come up with different solutions and pick the best one out of all. A disadvantage is we have all have different schedule therefore it is hard for us to meet outside of class time. I find it hard to contact other people because some of the member never reply to email or answer phone calls. I would recommend the instructor to have students work individually in the future. Student can come up with their own projects but they can seek each other for help on revision or new idea. This is fair for the rest of the students because each student can come up with their original idea and do their own work. Another recommendation is that the instructor should aid us more on the design and give us feedback.

**Biographical Information**

Lisa Shatz is an assistant professor and chairman of the Electrical and Computer Engineering Department of Suffolk University in Boston, MA. Her research interests include understanding the relationship of shape and function of sensor hairs in such biological systems as vibrissae and inner ear hair cells.

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