

Integrating Service Learning Into Engineering Communications Courses

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Abstract

As one of the 840 participants in the National Campus Compact program, Texas Tech University (TTU) is adopting service learning as a viable learning tool for students. The College of Engineering (COE) is integrating service learning into the Industrial Engineering (IE) Communications course, helping students to develop an understanding of civic participation and how that participation augments engineering curriculum and professionalism. Service learning is easily implemented in engineering communications courses because the nature of the courses lend themselves to written and oral presentations to a professional audience, and, in the case of service learning, a community audience. In the IE Communications for Engineers course, students develop professional written and oral communication skills by writing technical documents, giving oral presentations on those documents, and writing and delivering professional emails. However, the team projects for the course are geared toward teaching students about civic responsibility by having them design, develop, and deliver exercises geared to public schools that demonstrate and teach elements of engineering. Not only must the engineering students have a product to deliver to the school and the public school teachers, they must assess how the semester's community involvement has impacted their basic knowledge of engineering, their understanding of engineering professionalism, and their commitment to civic responsibility. In addition to developing a tool for public school teachers, the project enhances the Texas Tech University Pre-college Engineering Program©. This article includes the development of the IE Communications Course; how the course satisfies ABET's criteria for communication, professional responsibility, and impact of engineering on society; industry's response to community service, and the positive feedback from public school teachers regarding the community projects. This article also describes the plan the College of Engineering has for developing a college wide engineering communications program.

Overview

Service-learning is a pedagogy that links community service and civic engagement with academic courses in order to meet the needs of the community. Through reflection students access their role in the community and their obligations to the community. Service learning does not require extra work from students, but must be integrated into the course curriculum so that it is a part of the learning process for all the students. In the *Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition*

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TTU Industrial Engineering Communications for Engineers course, students participate in writing reflections about community service on a volunteer basis; however, all the students participate in the service learning project. Currently, Texas Tech does not have a campus-wide procedure in place to recognize students' participation in service learning. Students who volunteer to write the reflection papers in IE Communications for Engineers course receive a letter, for their job portfolio, from the teacher detailing their involvement with community service. Although Texas Tech is still investigating ways to implement service learning campus-wide, we have decided that the perfect place to introduce engineering students to service learning is in a communications course. The students must interact with a community client; address client needs; design an engineering exercise, and communicate extensively with the client. Within this process, they are subjected to numerous situations where they must display professional communication skills.

Although Service Learning programs are becoming more and more familiar in many colleges and universities, they are most commonly found in disciplines other than engineering. However, some prestigious universities are integrating service learning into the engineering curriculum: Purdue's Engineering Projects in Community Service (EPICS); Illinois Institute of Technology's Interprofessional Projects (IPRO); the University of Michigan's ProCEED program, and the service learning programs at MIT and San Diego University. More and more engineering schools are looking at service learning as a viable way of introducing students to real-world experiences in engineering design, and also as a vehicle for shaping students' perception of responsibilities of a professional engineer.¹

As part of the vision to improve communication skills among the engineering graduates at Texas Tech University, the Industrial Engineering department has chosen to take an innovative approach to communication in engineering. Although IE students have taken communication courses across campus and in other engineering disciplines, the students and the faculty have not been satisfied with learning outcomes of the IE students, primarily because the focus in communication disciplines outside of engineering is relatively generic and does not focus on engineering issues, or because engineering faculty do not have the pedagogical background and expertise in the art and skills of communication. By engaging, as part-time instructors, College of Engineering professional staff who not only have degrees in speech and communication, but have doctoral degrees in English and have taught English and communication for over 16 years, the Communications for Engineers course satisfies IE requirements as well as ABET Criterion 3 requirements. Besides developing communications skills, students are introduced to engineering professionalism through community service as part of the Texas Tech University Service Learning Program. Through this partnership, the College of Engineering and the department of Industrial Engineering have piloted a successful rigorous course that steeps undergraduate engineering students in the theory and practice of communication and in service learning.

For the past six years, the TTU College of Engineering has been collaborating with Lubbock Independent School District to establish a community partnership. In order to

bring about a systemic change in the perception that people in the northeast quadrant of Lubbock have about Texas Tech University, we focus our attention on servicing and partnering with schools in the northeast quadrant. Traditionally, those economically disadvantaged and those from underrepresented populations, especially African-American and Hispanic, view higher education to be beyond their reach. Under the auspices of the Community of Learner, Educators, and Researchers (CLEAR) and the Center for Partnerships in Science and Technology (CPST), we are developing hands-on programs for students in order to establish of pipeline of students who will be familiar with engineering when they graduate from high school. Some of our programs, like the LEGO Robotics Program, begin at the elementary level and continue through our graduate programs here in the College of Engineering. ²

Development of Industrial Engineering Communications Course

The TTU College of Engineering dean and the Industrial Engineering department chair approached us to consider how we would design a communication course for engineers. Although IE students had been taking communication course in Agriculture, Arts and Sciences, Mass Communication and in other engineering disciplines, neither the dean nor the IE department chair was satisfied with responses from students nor with the outcomes that they were seeing in the students, especially in students' oral communication skills. We wanted to insure that students were introduced to written, oral, and internet communication; ethics; teamwork and service learning. ³

The first obstacle to overcome in designing the course was how to integrate oral communication, written communication, internet communication, teamwork, ethics, and service learning all into one 15 week class, and to ensure that students had ample time to practice written and oral communication skills as well as receive critical feed back from their peers and the teacher. The goals for the course are to ensure that students are able to correctly and accurately analyze audiences for written, oral, and on-line communications; construct technical documents; deliver professional oral presentations; send professional emails; work in groups; engage in on-line discussions; and apply ethical issues to engineering problems. They should also be able to describe the importance of all forms of communication in the profession. At the end of the semester students should be able to relate how community service plays a vital part in engineering professionalism.

By designing the class so that all the assignments (except for the letter of application and resume) relate to one semester project and that the introduction of theoretical approaches to the assignments are introduced through engineering issues, students are given a real-world taste of the communication requirements of practicing engineers. The semester project requires that students work with a non-profit agency to develop a product that will become the property of the agency. Because the College of Engineering has a history of working with Lubbock Independent School District, and especially schools in a relatively repressed area of town, IE Communication for Engineers students develop classroom exercises that high school and junior high school teachers can integrate into their curriculum. The hands-on exercises demonstrate and teach students and public school teachers about engineering, and especially about Industrial Engineering.

By participating in service learning, IE students must communicate with the community “client,” and must learn how to present and write to a non-engineering audience. Before the first written assignment or the first oral presentation that relates to the team projects, students engage in the audience analysis process in order to determine the technical knowledge of the client and the interest that the client has in each project. In addition, the students must use their technical skills in designing the exercises that demonstrate the application of math and science. The final outcome for the semester is a document in the form of a report that describes the exercise, including instructions, materials list, and desired outcomes. This document becomes the property of the high school or the junior high school.

For the final oral presentation, the community client, teachers and principals, as well as engineering faculty and administrators are invited to the oral presentations. Throughout the semester, students evaluate their peers’ oral presentations as well as submit self-evaluations after viewing their in-class, taped presentations.

Because the IE Communication for Engineers students are working with a real client, they become much more aware of the need for good communications skills for engineers than they might in a class where the project is not client based.

Satisfying ABET Criteria

Criterion Three of ABET 2000 lists numerous learning outcomes that the board views as critical to students graduating with engineering degrees. The Industrial Engineering Communications for Engineers course addresses almost all of the issues in Criterion 3:

Criterion 3

- *(c) an ability to design a system, component, or process to meet desired needs*
IE students design exercises that depict engineering principals, particularly Industrial Engineering principals
- *(d) an ability to function on multi-disciplinary teams*
IE students work in teams that frequently are made up of students from the four areas of classification. By teaming freshmen and sophomores with upper classmen, lower level students learn more about engineering because they are learning from upper-class peers or the upper-classmen are teaching the freshmen and sophomores, thereby learning more about the disciplines themselves.
- *(e) an ability to identify, formulate, and solve engineering problems*
The IE students in this class must design an exercise that presents an engineering problem. This forces them to be able to identify an engineering problem, and articulate what that problem is to people with little or no engineering background.
- *(f) an understanding of professional and ethical responsibility*
The IE students are introduced to ethical issues by listening to lectures from the National Institute of Engineering Education professors, evaluating

different engineering code of ethics, and reflecting on how they view their responsibilities as future professional engineers. In addition, as one of the assignments, the students write a critical analysis of an actual ethical case, and present their analysis to the class in an oral presentation.

- (g) *an ability to communicate effectively*
Besides developing a letter of application and resume and the critical analysis of an ethical case, students are required to submit a written proposal for their team project, write either a product or process description paper, design and write a set of instructions, and write a final report that will be given to the client. For every written assignment, students give an oral presentation using PowerPoint and other presentation tools. In addition, students have four email assignments, three of which relate to the team projects. Students learn to send formal emails requesting information, setting up appointments, and attaching word and PDF files.
- (h) *the broad education necessary to understand the impact of engineering solutions in a global and societal context*
Through the introduction to ethics, IE students get a better understanding of the responsibilities of professional engineers and the impact that engineers have on society in general. Because the clients are middle school and high school administrators and teachers, IE students develop an understanding that as engineers they have an obligation to society and to the communities in which they live. Because they are developing a project that will remain with the client for numerous years, they take an exceptional interest and pride in the work they produce.
- (i) *a recognition of the need for, and an ability to engage in life-long learning*
Edmund Tsang points out that “In engineering, service-learning has the potential to help students gain the skills necessary for lifelong learning and for practicing engineering in a manner cognizant of professional and civic responsibilities”.⁴ Within the framework of the service learning requirement for the class, the students write three reflection papers that address engineering professionalism. In addition, responses to the project are required on the oral presentation self evaluation form. One of the issues we discuss in class through reviewing ethical issues and service learning is how they must never stop learning and must remain informed of new discoveries and new issues that impact engineering principals and engineering professionalism.
- (j) *a knowledge of contemporary issues*⁵
IE students discuss contemporary issues during the discussion on ethics and throughout the service-learning project. The service-learning project stimulates discussions on engineering education, particularly K-12 science, math and technology education; public knowledge of education and other issues that prevail in current events.

Besides developing communication skills, students get professional responsibility experience because they are dealing with a real client to whom they must present their project and address the client’s needs. Because the client is a non-profit agency, students

also learn that professional engineers have a responsibility and obligation to the community.

Industry's Response to Community Service

Through anecdotal information from representatives from Applied Materials, Lockheed Martin, and Exxon Mobile, industry not only feels that students' participation in community service helps to develop better team players, but that by participating in service learning they develop a lifelong dedication to providing their professional service to the community. Every industry representative said that community service can be a deciding factor in which student to hire, and is definitely a deciding factor in assessing student's teamwork skills and potential for advancement within the company. By working with non-technical people, students learn that contrary to what they may think when entering college, the majority of people they will be communicating with in the non-academic or "real-world" are people with less technical backgrounds than they have, and that if information is not made perfectly clear and accessible, their audience will not be as forgiving as their college peers, faculty or fellow engineers.

Feedback from Public School Teachers

For their final oral presentation, IE students must present to an audience that is composed of engineering faculty and administrators, and to the client (in this case the public school teachers and principals). The first semester that the Industrial Engineering Communications for Engineers class was taught, students developed exercises for the TTU Pre-college Engineering Academy Program© at Estacado High School. ² The high school teachers found the exercises beneficial, and they greatly appreciated the IE students visiting the school and conferring with them on issues within the high school. The second semester, IE students designed exercises for a Dunbar Junior High School in the same quadrant as the high school, again populated by predominantly African-American and Hispanic students. The Junior High school has an engineering program in the Math and Science Academy that overlaps the high school's Pre-college Engineering Academy Program. One of the aspects of the Pre-college Engineering Academy Program© is to get TTU students out at the schools and to get students from both the junior high school and the high school visiting the College of Engineering at Texas Tech so that 7-12th grade students will become familiar with the college and will see themselves in the shoes of those students who are already engineering students at Tech. In addition, we are in the process of developing a mentoring program—college students mentor high school students; high school students mentor junior high school students; junior high school students mentor elementary students.

The principal and the teachers at the junior high school were extremely pleased with the exercises the IE students produced and said that they will be able to use them in numerous classes for numerous years. Exercises consisted of designing a roller coaster, box modifications to show creativity, designing a Rube Goldberg experiment, planning a park near the school, and designing a bridge. During the oral presentations, the principal

pointed out, after each presentation, exactly how the exercise supports concepts that they are introducing to their students and are addressing in the classrooms.

Feedback from the students, especially those working with the junior high school teachers, demonstrated that they see a value to service learning because it gives them the opportunity to contribute to the community and gives them the opportunity to practice communicating to a non-technical, “real-world” audience. One of the students said,

I am quite interested in our project, mostly because we are getting a chance to bring engineering skills into a junior high school. I wish my junior high school had a program like the one Tech is starting up with Dunbar [Junior High School]. It's exciting.

Plans for College-wide Communications Program

Because of the success of the Industrial Engineering Communications Course, Dr. James Smith, Interim Dean of the College of Engineering has asked us to develop a communications program for the entire college, thereby establishing goals and standards that will be uniform across the engineering disciplines. One of the major communication issues that is relatively unique to engineering is the number of English as a Second Language graduate and undergraduate students. We are looking at ways to address this issue so that there is no undue burden put on engineering faculty but that students become better at oral and written presentations.

Conclusion

For engineers, providing a service to non-profit organizations should be as integral a part of their profession as providing a service to for-profit industry. As Tsang notes, engineers will face substantial challenges in the 21st century in the use of technology to meet societal needs. And one of the primary issues that society faces in this century is “improving K-12 education, particularly mathematics, science and technology instruction.”⁴ The TTU College of Engineering is addressing both this issue and addressing the need for engineering students graduating with better communication skills in order to compete in a global community. By integrating service learning into a communications course, students are not required to do additional work, but get in-depth experience with written and oral communication skills and experience presenting to a non-technical audience. As we evaluate and assess this course, we will make numerous changes over the semesters; however, we plan to continue working with the schools in the northeast quadrant of Lubbock in order to bring out a change in perception that families from underrepresented populations in Lubbock have about Texas Tech University. Currently the course is not listed in the academic catalog as a communication course but as an Individual Studies course. The course has been submitted for approval to be included as a communication course, opening the classroom doors to all engineering students. From the results from the two semesters the IE course has been taught, departmental faculty and administrators have been pleased with the feedback from students and with the students’ oral presentation skills.

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