ABET 2000 and Community Service Projects for Engineering Students

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Abstract

ABET 2000 criteria require that students show a knowledge of professional ethics as well as a knowledge of cultural and global issues. These topics are not often easily addressed in traditional approaches to engineering courses, however they are a natural part of community service projects. The author will discuss how community service projects have been used with great success in the ASME student section at Grand Valley State University and how two different service projects (in two different semesters) were successfully integrated into a senior level heat transfer class. Finally the author will discuss how to approach service work within the context of overly busy faculty and student schedules.

"The habit of apprehending a technology in its completeness: this is the essence of technological humanism, and this is what we should expect education in higher technology to achieve. I believe it could be achieved by making specialist studies the core around which are grouped liberal studies which are relevant to those specialist studies. But they must be relevant; the path to culture should be through a man's specialism, not by-passing it…
A student who can weave his technology into the fabric of society can claim to have a liberal education; a student who cannot weave his technology into the fabric of society cannot claim even to be a good technologist."
(Lord Ashby, Technology and the Academics)

Introduction

Why is service work important for engineering students? One needs only to scan the statements of codes of ethics and/or canons for the various professional engineering societies to note that concern for "the public welfare" is a major issue. In some cases professional societies were formed partly to fill the need to protect the public. For example, one of the earliest activities of ASME was to produce the boiler code in answer to the enormous loss of life due to frequent boiler explosions. Concern for the general public who have little (if any) control over design decisions that do affect them, has long been a central component of the professional engineer's code of conduct. Boiler explosions, bridge failures, and similar disasters no longer occur with regularity – thanks to the volunteer efforts of many engineers who work on codes and standards, and these efforts are taken for granted by the general public. This does not diminish the need for

engineers to develop concern for public welfare. In fact, increased dependence on technology by much of the general public coupled with little understanding of it actually increases the engineer's responsibility and increases the need for engineers to take the public welfare seriously. It is a matter of responsible citizenship in the communities where engineers live and work. The mental habit of placing the needs of others in society in clear view and acting to assure public welfare is a matter of character development. As engineering educators we are responsible to assure technical competence, but we are also responsible for character development on a professional level. The question is, where do we assure that this is an essential part of each engineer's preparation? The quote by Lord Ashby provides an ideal for the relationship of a supporting general education program to technical courses in a curriculum. Unfortunately, most engineering faculty have little control over general education courses taught by different departments. This is also not the only way – or the best way – to assure something that is important to us. Lord Ashby indicates that the path to culture should lie *through* a student's specialty (engineering), and so this becomes something that must flow from engineering. The ABET 2000 criteria clearly indicate that the engineering curriculum should include an understanding of ethical responsibility (criterion f), that engineers should understand the impact of engineering solutions in a global and societal context (criterion h), and that engineers should have a knowledge of contemporary issues (criterion j). These contexts (ethical, societal, global, economic…) are complex and part of the new challenge in the ABET 2000 criteria is to teach engineering within those contexts. In addition to the concepts that we have always taught and the many new tools/techniques that constitute modern design practice, we must also include such context as an essential part of our curriculum. Because service learning offers an opportunity to practice the application of engineering to complex human/social problems, service work that is relevant to engineering studies can provide the required context and it becomes one answer to the new curriculum challenge of ABET 2000.

Where to Begin – Searching for Relevant Work

One of the reasons why it may be difficult to begin service work is that our mental habits do not include a sensitivity to the needs of people different from ourselves. In fact, many of us have very little contact with people in very different life circumstances. There are many needs, but seldom do the needy ever approach us. Their paths do not cross ours and they may not realize what we could do to help. Service work will be most meaningful if it meets a local need, so begin by walking through the neighborhoods that surround your university. Grand Valley has a new and growing campus in the center of Grand Rapids. While there are many "trendy" shops and entertainment places, there are also community centers, shelters for homeless people, and a large neighborhood of families that live in or on the edge of poverty. One place to start is to approach the community centers, missions, schools, or other organizations that already serve the community and look for areas where engineers can contribute. Our first project was to design and build the playroom for a local mission that was adding a center for homeless women and children. Our ongoing program, Bikes for Kids, provides bicycles, helmets, and locks for children whose parents cannot afford a bicycle. We have worked with a local community center to identify the children who will receive bikes, and currently we

are working with the local elementary school. Since most of us are already very busy and because we are often strangers to the people we hope to help, working with organizations that are already in place can help us to identify the needs and also to most effectively deliver the required help. Reading local newspapers and attending neighborhood association meetings are two other ways to change our paths so that they cross the paths of those in need.

Once you have assessed the needs that exist in your community, assess the strengths and interests of your students and the faculty interested in participation. In our case, Grand Valley had a number of engineering students who were serious cyclists. They provided the expertise that we needed to begin fixing bikes and they provided contacts to a local bicycle shop that now provides materials at a discount and provides additional expertise. We also have a number of students who need exposure to the use of hand tools. Changing tires is a wonderful way to start in this program, and most bicycle repairs are quite easy to learn. Even students who have never worked on a bike and know little about hand tools can come and learn from their peers in a very non-threatening environment. The same students are able to gain important skills while doing something to benefit other people. This kind of opportunity can be a powerful tool to retain women and minorities who sometimes need this kind of learning and who also struggle to build a meaningful identity with the engineering profession.

Building on strengths and interests is also important because you will need at least one faculty/staff member and a few students who are willing to be committed to the project that you choose. Since this most likely will involve volunteer effort and since most students and faculty are very busy, there must be a core of people who will make this a priority.

While it may be important to stretch for a goal, it is also important to be realistic about your resources in the form of time and finances. The bike project works well because students can stop in and spend 30 minutes or an entire day fixing bikes; either way they are making a positive contribution. The project does not require large blocks of tightly scheduled committed time. As we approach a "bike give-away" event we do schedule a workshop – often on a Saturday morning, but even these events allow students to drop in to work for the length of time that is comfortable to them. It is important to have help for this kind of a project, but it does not require that the same people come to help all the time. This allows many students to participate at a level that they find comfortable.

Finally, it is important to provide an opportunity for reflection and discussion. When we built the playroom at Mel Trotter Ministries (Homeless Women and Children Center) I most often worked with a small group of students. This was (and is) a working mission with an active program for homeless men that has been in place for many years. We were often invited to join the residents for meals and as we worked there were many opportunities to discuss what we were doing and the impact of this work. When my Heat Transfer class worked with Coit School in Grand Rapids we had a number of brain-storming sessions and we had a final project discussion. Although it was a bit awkward (engineering students are sometimes not comfortable sitting around a conference table for

a discussion of largely non-technical issues), it did provide important closure for the project. Even the students who did not make major contributions or who felt uncomfortable in a discussion session benefited from hearing the discussion and from seeing the impact of applied engineering in a social context. This is one purpose of criteria f, h, and j of the ABET 2000 criteria.

Case 1 – Bikes for Kids

For the past 2 years the ASME student section at GVSU has been involved in Bikes for Kids. We have received funding from Michigan Campus Compact, an organization that provides seed money to encourage service learning at the college level. We advertised a request for used bicycles that could be donated to us and we were quickly overwhelmed with donations. Through a local community center with an active after school program, and most recently through the local elementary school, we were able to identify local children who would like to own a bike but whose parents could not afford it. Those children fill out a request for a bike that includes essential information such as their size, gender, and name, but they are also asked to write a short paragraph or draw a picture showing why they would like a bike. My students are able to review these requests and get to know the children that they will serve by donating their efforts. We then match donated bikes to children requesting bikes and we begin to repair and restore the bikes. Students insisted that safety equipment be included, so we provide a helmet and a lock with each bike as well as a brochure about safety and basic care of the bike. At the "give-away" events we provide bikes for a large group; my students participate by doing the last minute seat adjustments as required, sizing helmets, providing instruction on how to use the locks, and providing assistance to the police department in registering the bikes. To date we have given away close to 100 bikes. The reactions of the children are more than adequate reward for my students who see the benefit of their mechanical skills in a social context.. For this reason and for other reasons described above, this program is a win-win program and we look forward to continuing it.

Case 2 – Playroom at the Mel Trotter Ministry Center for Homeless Women and Children

This was our first service project. Mel Trotter Ministries had served homeless men and provided emergency services for families for many years but they had never been able to offer long term help to homeless women and children. They were finally able to purchase the required facility and local groups assisted by adopting the new rooms in this facility. We adopted the playroom which meant that all of the furnishing of the room would be our responsibility. We decided to design and build a castle play-structure with a built-in puppet theatre, turret, twisting slide, and many small hiding places. That, plus the toys, plus anything other than basic white wall paint, plus other play-structures were our challenge. This required both time and money.

We decided to do a fund-raiser in which engineering students would build light-weight temporary structures using as much recycled content as possible and utilizing at most, one passive heating device. Designing and building the structures was a required heat transfer lab project. We tested the structures by having volunteers sleep in them one night

during national engineers week. Periodically throughout the night inside and outside temperatures were recorded for each structure. Companies and individuals sponsored us for the temperature difference that we could maintain in the structures…and we were able to raise close to $2000. The structures could potentially be used for disaster relief; they were subject to an extensive list of design constraints that were ultimately used to assess each design. The class was informed about how the shelters would be tested and the use to which the funds raised would be applied. They were encouraged to join us in the testing, but it was not required.

The design and building of the playroom was a volunteer student effort that involved many different students over the course of the project. When it was completed, the playroom was very well received. In fact, administrators from similar institutions came to look at our work and to use it as an example for their institutions. I was able to work with many different small groups of students as we completed this project. Even the students who were not involved in the actual work were interested in our progress, and I kept the students informed through regular updates. We were amazed to learn about the problem of homelessness in our own community. At the same time students were able to use design and building skills and we worked within building codes and ASTM standards for playground equipment. The project provided many rich opportunities to discuss and to model service to others using engineering skills.

Case 3 – Coit School Heat Transfer Analysis

This is an example of the serendipity that seems to exist in so many service projects. Last winter a number of articles appeared in the Grand Rapids Press about the run-down physical conditions in Coit School, an inner city school not far from the center of Grand Rapids and not far from the GVSU downtown campus. Snow sifted into the classrooms through openings in the windows and students started the cold winter weeks wearing coats to class. From the articles in the paper it seemed to me that this might provide a wonderful application of heat transfer principles, so I contacted Grand Rapids Public Schools and was able to schedule a visit with the director of physical plants for the school system and with the principal of Coit School. The school was, in fact, in painfully poor physical condition. It had a new boiler system but the large windows were mostly single pane plexiglass in wooden frames so badly dry-rotted that one could easily push the bottoms of most of the panes out at least 1/8 inch or more. The principal and I decided to have my students come to the school during the lab periods scheduled for the class. Students would make the observations and measurements needed to complete a heat transfer analysis of the building and they would come up with a plan to make the building more comfortable. There were 3 scheduled lab periods – each 3 hours long. For each lab the principal met with the class and gave the students an overview of the school, the neighborhood in which it was, a short history of his work and commitment to the school, and an overview of how physical plant changes occur in the public school system. For the first 2 lab sections school was in session so the lab section was split into 2 groups. One group provided “magic carpet” rides (a wildly fun engineering experience) in the gym for each of the classes while the other group made measurements in the now empty classroom. My students rotated activities on a roughly one hour rotation. We were able

to provide rides for each student in each class, and we were able to survey each classroom. The last lab section met when the children had a holiday, so this section had access to the attic and the basement in addition to access to all of the classroom areas. My students had an opportunity to see the physical plant, meet the staff of the school and observe them at work, and they had an opportunity to interact with the children.

In the next lab we discussed our findings and started to brain-storm a list of improvements. Most of the students were shocked by the physical condition of the school and our discussion was able to include a discussion of the conditions under which many of the students of that school lived…as well as the structure of the public school system as it is related to state revenues, equity, etc. Such discussions would probably never have occurred if this had been posed purely as a technical analysis with no direct contact with the people involved. The best technical solution might have been a new building or at least serious renovations that would require vacating the building. Our discussions with the principal enabled us to see the complexities of an inner city neighborhood school that also functions as a social center. From the very beginning I was very honest with the students and I told them that I really had no idea where this project would lead. I hoped that we would be able to make improvements, but there were no guarantees that this could occur

While we were able to provide a prioritized list of suggested improvements and we hoped to be able to actually provide some of those improvements, the same stories that informed us about this school led to discussions by the school board about the possibility of closing and consolidating schools in the city. Coit School was one of the schools under consideration so there was little sense in putting time and effort into a building that might not be used in the next school year. (In fact Coit is closed this year.) As a class we followed the reports on TV and in the newspaper with far more interest than we would have had if we did not know the children and the staff involved. It was frustrating to be unable to move beyond the discussion stage in this project; however, this is sometimes the nature of service work. It leads you into unexpected territory and it seldom fits neatly into a semester or a class.

I felt that it was important to reach a sense of closure for this project so the last lab session was a planned discussion. The questions were supplied in advance and written response was required before the lab session. In this way there were no surprises for students who felt uncomfortable discussing feelings and reactions. There were two parts to the discussion: for the first part I asked the students to work on a simple transient heat transfer model of the school building and to identify the most important factors that should be addressed in making the building more comfortable. In the second part I asked them to respond to a list of questions directed at the service work aspects of this project – here I did ask them about their own reactions and opinions. Because they handed this in before the lab session, I was able to read their responses, respond in writing, and hand back the report at the beginning of the lab. The technical discussion was completed first and it was the easiest for the students. The service work aspects of the project were the most difficult for the students and the discussion was awkward at the beginning. In one lab section this discussion was really quite short because I could not draw the students

out, but in the other sections the contributions by the students were phenomenal. We were able to discuss social responsibility in a way that might not have been possible if we had not shared this experience. I am convinced that every student in this class gained valuable insights into the responsibilities that accompany the practice of engineering.

Summary

As engineering educators we strive to assure that our students are highly competent when they graduate. That competence must be tempered with compassion if our graduates are to be able to "weave technology into the fabric of society". The ABET 2000 criteria require that students learn engineering within the context of practice and application. Service projects are an important vehicle by which this context can enter an engineering curriculum. In chapter 2 of their book, "Where's the Learning in Service Learning?" Janet Eyler and Dwight Giles[1] discuss how service learning builds citizenship and leadership, how inter-personal skills are enhanced, and how understanding and tolerance of other cultures can be outcomes of service learning. They also discuss how personal and professional growth can occur with the important outcome of greater motivation for continued learning within the discipline. This certainly addresses the life-long learning criterion of ABET 2000. Reference 2 below, "Projects that Matter – Concepts and Models for Service Learning in Engineering" is part of a series of books published by the American Association for Higher Education (AAHE) on service learning in various academic disciplines. This volume specifically addresses ABET 2000 criteria and also provides more case studies and success stories for engineering educators.

Finally, there is one more benefit of service learning in engineering that has been only briefly mentioned. Many of us are concerned about the retention of under-represented groups in engineering. Service work can provide these students (and in fact all students) with a sense of purpose and identity in their studies. In their book "When Hope and Fear Collide – A Portrait of Today's College Student", Arthur Levine and Jeanette Cureton[3] found that while many students are afraid of forces out of their control, they are quite hopeful about being able to change their own immediate environment for the better. When students are able to apply what they have learned to produce tangible improvement for others, excitement and commitment to a professional identity often result. This is discussed by Janet Eyler and Dwight Giles in their book[1], " Where's the Learning in Service Learning?".

In this paper I have provided some guidance for beginning to include service projects – based on my own experience. The possibilities are literally endless, but to recognize them we need to view the world around us with a sensitivity to those possibilities. By providing three short case studies of projects attempted by the Padnos School of Engineering at GVSU, it is my hope that you will recognize some of the unique opportunities in your own community. Note that if there is no fit with a particular course, student sections of professional societies are a natural place to begin your efforts. Finally, above my desk I have this quote: "Where the world's greatest need meets my deepest joy – there I find vocation". We will all be able to find work but joy springs from vocation.

Bibliography

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