AC 2007-2600: WHAT MAKES A SUCCESSFUL SERVICE LEARNING PROJECT FOR FRESHMAN ENGINEERS

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What makes a successful Service Learning Project for Freshman Engineers

Abstract

Service learning can be a valuable educational tool for freshman engineers which helps to develop their sense of value and direction, teaches team dynamics and professional communication skills, and engages the students in the community surrounding their university. A fundamental challenge in developing a successful and rewarding experience for each student is the identification of appropriate community partners and projects. As freshmen engineers, the skill set of the students is limited; however the tendency is to select projects which are clearly marked as engineering-related, often resulting in an unattainable goal, unhappy community partners and discouraged students. .To prevent this end result, the focus of the experience should not be on the specifics of the project but rather the process and skills required to solve a problem which meets the needs of and satisfies the community partner. In this paper, we will discuss our experiences in project selection for a service learning course offered to second semester freshman engineering students at the University of Pittsburgh. The focus of the paper will be on the challenges in developing and maintaining community partner relationships, our experiences in identifying projects for the course, and examples of projects which resulted in both positive and negative experiences for either the students or the community partners.

Introduction

A primary goal in offering a service learning class to freshman engineers is to improve retention by providing an experience which is both fulfilling and enlightening. Many freshman engineering students are overwhelmed by the workload of the first year engineering curriculum, and are not stimulated by the course material. The majority of freshmen students lack the maturity or experience to understand how the engineering curriculum will be of value to them in the future. They have not yet been exposed to the variety of opportunities that will be available to them with an engineering degree, nor do they have an understanding of the skills and knowledge they will need to ultimately be effective and of value in the professional work environment. With such an imposing challenge facing them as an engineering student and little understanding of how and where it will take them, many students lack the confidence in themselves to succeed, and thus decide to choose a major other than engineering.

Pilot Projects

For the spring semester of 2006 at the University of Pittsburgh, a pilot course was offered by the School of Engineering to freshman honors engineering students titled Engineering Applications for Society. The goal of the course was to provide the students with a service learning experience in engineering.

For the pilot program, six projects were undertaken with three community organizations. The three community partners for whom the projects were performed during the pilot course were The Center for Creative Play, a non-profit play center for both children with and without

physical or developmental disabilities; Disability Resources and Services at the University of Pittsburgh; and, The Carnegie Science Center of Pittsburgh's Engineering Education weekend.

For the Center for Creative Play, one team analyzed inefficiencies associated with a unique workspace then both designed and implemented a solution, while a second team performed an acoustic analysis of the center with the goal of designing and implementing a solution to the white noise levels which prevented children with certain disabilities from enjoying the environment. The first team was challenged by several obstacles including a replacement of the primary contact as well as several changes in the specified needs for the workspace. After having several seemingly creative solutions turned down, this team actually implemented a solution which included physically cleaning out the space, re-painting, purchasing and assembling furniture financed with grant proceeds, and finalizing the solution. The students of this team reported feeling as if they merely performed manual labor without achieving the level of client satisfaction they were eager to receive. Similarly, the second team began the course with a lot of excitement and motivation, and worked hard with a faculty member to provide a design solution only to find that the center could not have the students implement such a resolution nor did they have the funds to have it performed professionally.

For the Disability Resources and Services department, two teams worked together to create an online interactive website which provided information regarding the accessibility of the entrances to the academic buildings of the University of Pittsburgh. The projects included surveying the academic buildings, measuring characteristics such as force to open doors and dimensions of an entrance, as well as design and development of the website. The results of this project were approved for use and are currently available online. The students who participated in these projects felt much more rewarded by their experiences than the other teams.

In retrospect, the differences between these projects which may have contributed to the varied levels of satisfaction experienced by the students included:

1. The location of the community partner. Disability Resourses and Services was on campus whereas the Center for Creative Play required transportation by the course instructors or by public bus.
2. Communication with the community partner was more clear and effective for the teams working on the online accessibility map project versus the office redesign and acoustic analysis projects.
3. Implementation of the online accessibility map projects required creativity and engineering-related skills, whereas the implementation of the acoustic analysis could not be performed by the students (which they had expected to be able to do), and the redesign of the office space and its implementation did not require the level of engineering-related skills expected by the students.
4. The results of the online accessibility map projects were well-appreciated and actually utilized by the community.

To effect improved outcomes for the current semester, a set of expectations were revised and augmented for the students at the beginning of the course, and projects were chosen that had characteristics more similar to those of the online accessibility map projects.

Pilot Results

The experiences of the students were wide-ranging as determined through the reflection components of the course as well as through a series of surveys. In particular, two of the teams felt much more rewarded by the experience than the others, and two of the other four were left feeling let down and unfulfilled by their projects and results. What the majority of students reported as being the greatest challenge and most important lessoned learned through their project experience was how to function effectively as a team. In fact, many students reported being surprised by how difficult yet significant a role the team dynamic aspect of the course played in conducting their projects, regardless of whether or not they felt fulfilled by their results.

Following completion of the pilot course, we concluded that the two fundamental challenges in maximizing successful outcomes of a service learning course for freshman engineers are 1) project selection, and 2) establishment, communication and reinforcement of expectations for the students, community partners and instructors. The expectations set forth should not only prepare the students for what they are intended to learn from the course but also for what constitutes a "successful" outcome.

Modifying the experience

Based on the pilot results, we modified the second year projects and the expectations presented to the students at the beginning and throughout the course. To improve the experience of the course for the students, the following expectations were communicated on the first day and reinforced as the course progressed. For their service learning projects, each student should expect…

- To have a unique learning experience.
- To solve a "real world" problem of value to a community organization.
- To learn about and be challenged by truly working as a team.
- To learn how to listen to and understand what your client really wants from you, and not what you think they should want from you.
- To develop professional communication skills and to begin to see your self as a professional that is uniquely you.
- To feel pressure by nature of the fact that your work is meaningful and of value to an organization who wouldn't otherwise be able to have this work done.
- To develop an awareness of what it takes to "do a good job" and to be of value to an engineering team.

- To develop an awareness of your own personal strengths and weaknesses with respect to working as part of a team or with your client.
- To develop an awareness of what real world engineering and problem solving is like in comparison to classroom problems.
- To know how to work towards a solution which is not ultimately available "at the back of the book", and how to evaluate if the solution you've achieved is valid and appropriate.
- To feel uncomfortable at times with your team or with your client.
- To have things go very wrong, and to have the experience of working through whatever has gone wrong.
- To feel under-challenged.
- To feel over-challenged.
- That each person and each team in your class is going to have different experiences and reactions to their experiences than you will.
- To feel more connected to the communities surrounding the University of Pittsburgh, and to feel satisfaction when you see the positive impact you can have on your community.
- To develop a sense of your potential value as a person and an engineer.
- That their clients treat them with respect and professional courtesy.

For the spring semester of 2007 at the University of Pittsburgh, these new expectations were incorporated into the following projects.

Current Community Partners and Projects

A. Community Human Services Corporation (CHSC)

CHSC is located on Lawn Street in the South Oakland neighborhood. It's fundamental mission is the revitalization of the Oakland neighborhoods which it works towards by providing a variety of neighborhood services. These services not only aim to assist local youth, families, and the homeless, but also serve to forge relationships and lines of communication between long time residents and newer residents affiliated with the universities.

Projects:

1. Development of blueprints for CHSC office space, which include identification of load bearing walls and current space functionality. Team will also develop recommendations for optimizing office organization.
2. Analysis of the four Oakland neighborhoods to develop a mapping of the hazards to pedestrian commuting. Each team will survey their neighborhood and interview residents to identify hazards. The final report will include ideas with justification for addressing the various hazards identified.

B. Hill House Association

The Hill House Association is located in the Hill District of Pittsburgh and provides a comprehensive array of services to the surrounding neighborhoods. The Hill House Association is currently working with The Community Partners Institute, to support the Find the Rivers! partnership whose goal is to generate sustainable links from within Hill District communities to the economic and recreational opportunities along the Allegheny river to the north and the Monongahela river to the south.

Projects:

1. Develop a detailed report of the obstacles blocking pedestrian access from Kirkpatrick Street to the Eliza Furnace trail along the Monongahela River. Obstacles include multiple highways and other roads at different elevations. Team will also be responsible for developing a list of possible solutions for "bridging" the obstacles.
2. Develop a detailed report of the status of the pedestrian access route from the corner of Kirkpatrick and Bedford down the hill and through Polish Hill to the Allegheny River. The team will also have the task of developing a marker system to identify the existing trail for future use and refurbishment.
3. Work with Hill House Association members to identify walking routes in the Hill District neighborhoods to promote exercise. The team will be responsible for measuring the routes, marking ¼ mile distances along routes, and developing maps which can be distributed within the neighborhoods.

C. Hazelwood Initiative

The Hazelwood Initiative (HI) is an organization who's mission is dedicated to the betterment of the Hazelwood neighborhood. HI was the driving force that lead to the development of the "Master Development Planning in Hazelwood and Junction Hollow" document which set forth a plan to work towards their goal. It's office is located at 5125 Second Avenue in Hazelwood.

Project:

Design of an accessible entrance to the Hazelwood Post Office. The team will document the existing entrance and its accessibility obstacles with photographs, measurements and interviews and provide a formal report which can be used to raise awareness of the problem and an understanding of why it needs to be addressed.

D. Pittsburgh Parks Conservancy

The Pittsburgh Parks Conservancy is an organization whose mission is dedicated to the four great parks of Pittsburgh, including Schenley Park which is part of the Oakland area in which University of Pittsburgh is located.

Projects:

1. Perform geomorphic mapping and sampling of Schenley Park water channels. Project will include identifying stream cross channels, pool riffle mapping and measurements, measuring bank-full heights, width to depth ratios, sinuosity, entrenchment ratios, etc.
2. Develop a detailed report of what occurs during wet weather events in watershed areas of concern. The team will install a rain gauge to measure rainfall, as well as measuring height of stream, velocity of water, and storm flow discharges during events to create a hydrograph.
3. Perform soil and water modeling of watershed areas that determine the amount if infiltration the soil can handle based on topography, soil characteristics and stresses, as well as where and how the water moves through the watershed.

E. Oakland Planning & Development Corporation (OPDC)

OPDC was founded by Community Human Services Corporation and Peoples Oakland in 1980 to serve as a development organization for the Oakland neighborhood. It's mission is to work with and engage the community residents in planning and development activities that benefit the Oakland neighborhoods.

Projects:

1. Documentation and evaluation of hillside erosion in the Historic District area of Oakland.
2. Intersection analysis.

F. Disability Resources and Services (DRS)

DRS is a department within the Division of Student Affairs at the University of Pittsburgh. In the spring semester of 2006, 2 teams of the pilot ENGR 0715 service learning course worked with DRS because of an identified a need for an interactive map which aided in the identification and description of the accessible entrances to all academic buildings of the university. The students designed and developed this web page in addition to obtaining and if necessary, measuring the details for each entrance. This map is currently online and can be found on the DRS home website by clicking Campus Map .

Project:

Augment the current accessibility map to include all campus buildings. Team will also work with DRS and campus community members to identify areas for improvement of the map.

G. Carnegie Science Center

Project: Develop Lego Mindstorm robots for Carnegie Science Center "Engineer the Future" weekend with the goal of finding unique ways to educate elementary and middle school students about physics and engineering, and to engage and attract them to the field.

Subsequent to this event, the team will develop an educational video utilizing Lego Mindstorm designs. The video must be presented to a group of middle or high school students for their feedback.

H. School Educators (to be identified by team)

There are too many high school students, particularly female and minority students, who do not consider the field of engineering as they prepare for college simply because they have no idea what it really is, and what engineers really do. In a recent **Pittsburgh Post Gazette** article (Page C1, November 9, 2006), a panel of engineering experts agreed that exposing students to the meaning of engineering and breaking traditional stereotypes would be most effective in increasing the percentage of female and minority engineering college students if presented to middle school children. The challenge is how to do this successfully on a large scale, low cost basis, and how to measure the effectiveness of such efforts.

Project:

This team will develop an educational video aimed tentatively towards middle school students which communicates what engineering is, what engineers do, and who engineers are. Ideally, the video will not only educate students about the field of engineering, but will personalize it through interviews of students and engineers in the field. The team will present their video to a community classroom for evaluation.

Summary

A service learning course for freshman engineers provides students with an opportunity to have a unique, challenging and rewarding educational experience during their first year through which their interest in the field of engineering is sustained. The importance students place on feeling good about a challenging accomplishment that is of value to others has been shown to increase the likelihood of their satisfaction and their continued involvement in community service [1]. In addition, the service learning experience can expand the students' perspectives regarding their potential value as engineers and the skills that are required to successfully complete a "real world" engineering project in a team environment. Such skills as how to work in and function as a team, how to communicate professionally, and how to manage a project are not learned in traditional engineering courses. Furthermore the value of such skills is difficult to impress upon students unless they are able to experience the need to learn and develop them.

Problem based learning courses have frequently been employed at the freshman level and have been shown to improve retention. An engineering service learning course has a multidimensional set of additional benefits above and beyond those observed using problem based learning. The challenges the students encounter in their service learning projects are more consistent with those that engineers are faced with in the professional workplace (the "real world"), and furthermore, the students are motivated to overcome the difficulties they encounter by nature of the project being a real problem whose solution is of value to a community

organization. In addition to the students, there are other beneficiaries of a well-organized service learning course. Non-profit organizations in the community are able to have problems solved that would not otherwise be attended to. The university itself also benefits in the strengthening of the relationship with its surrounding community, and the engineering program benefits by offering an innovative educational program which addresses specifically the objectives and program outcome criterion set forth within the ABET Engineering Criteria 2000 [2].

So far this semester, we have not ha d any of the negative experiences with the groups that we had last year. None of the projects are very challenging engineering projects yet the students all feel the experience is a very good experience and has taught them what it is like to be an engineer. Maybe not what type of problems they will solve, but what the engineering process is all about.

References

1. McCarthy, Mark D. (1996) "Chapter 5: One-Time and Short-Term Service-Learning Experiences" in Barbara Jacoby and Associates, eds., *Service Learning in Higher Education, Concepts and Practices*, San Francisco: Jossey-Bass, p. 115.
2. Lund, L., Budny, D., "The Value Of A Service Learning Course For Freshman Engineers", *2006 ICEE International Conference on Engineering Education,* Session M4B, San Juan, PR, July 2006, pp. M4B-10 – M4B-12.