# AC 2009-2133: USING MOBILE TECHNOLOGY TO IMPROVE COURSE AND PROJECT OUTCOMES IN A SERVICE LEARNING COURSE FOR FRESHMAN ENGINEERING STUDENTS

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# Using Mobile Technology to Improve Course and Project Outcomes in a Service Learning Course for Freshman Engineering Students

**Abstract:** This paper will discuss a project designed to advance a service learning course offered to engineering honors students in the second semester of their freshman year. The course, which is titled Engineering Applications for Society, is a unique learning experience through which students develop valuable skills necessary to succeed as engineers by solving real problems of value to local community organizations. Despite its many benefits to both the students and the community, the course has proven very difficult to manage. The arrangement of the many necessary meetings and presentations in the classroom has been very difficult to implement effectively. To address this issue we redesigned the course by adding HP tablet PCs into the environment. We are now also teaching the students how to effectively use mobile technology to make on-site proposal and final project presentations, and to collect and process data for their projects more efficiently and effectively by being able to enter it on-site directly into a spreadsheet for immediate analysis and plotting. This paper will discuss how we taught the students how to be more productive by learning how to use mobile technology during their freshman year so they can develop ways to utilize these skills in their subsequent course work and summer work experiences. This project is in the development phase.

## AMBIGUITIES OF SERVICE LEARNING

The literal meaning of "service" and "learning" and the relationship between the two can vary among the disciplines for which it is used. The meaning of "service" is straightforward, though the degrees of service can vary from volunteering in a soup kitchen, participating in a Habitat-for-Humanity build, traveling to and contributing to a third-world community, participating in K-12 education, etc. "Learning" is more ambiguous – it can refer to learning about community service, learning about the organization for which the service is being performed, learning about the population served by a non-profit organization, learning about how to perform a specific service, learning about various aspects involved in performing a service, or some combination of the above.

The relationship between "service" and "learning" can therefore be both direct and indirect, i.e. learning about service versus learning through service. The characteristics of a course, the project, and the community organization often lend themselves to one or the other. The challenge is to prevent students from feeling as if they've merely volunteered their time and learned nothing about their discipline in doing so, or from becoming absorbed only in the course material related to their project and not gaining from their involvement with a community organization.

We have found that service learning can be a valuable educational tool for freshman engineers if it is designed to develop the students' sense of value and direction, teach skills such as team dynamics and professional communication, and help engage 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.

## SERVICE LEARNING FOR FRESHMAN ENGINEERS

Very rarely have service learning courses been conducted entirely by a team of freshman level undergraduate engineering students. There is a preconceived expectation on the part of students, instructors and community partners that the primary value of a service learning project for a team of engineering students should involve some form of engineering analysis or design which results in a deliverable of value to the community partner. Although this can be a valuable facet of such a course, it is an inherently difficult expectation to meet for a team comprised entirely of first level engineering students. It establishes an expected outcome which can very easily result in dissatisfaction from the perspective of both students and community partners, as was our experience with one of the projects performed in our pilot course.

We concluded that the specific problem a team attempts to solve, the possible engineering skills required to address the problem, and the expected deliverables should not be the focus of the course, but rather a motivator. The expectations of the community partner should be clearly spelled out to communicate that they will be working with and contributing to the development of a team of first level engineering students, and in return should expect professional courtesy and communication, specific and limited time requirements, and the potential for the solution of a problem of value to their organization. The elements of the students grade are based primarily on how they interacted with their client, how they functioned and developed as a part of their team, how well they worked to solve their problem, and the level of satisfaction felt by the client; it should not be based significantly or at all on whether the intended deliverable was achieved as proposed. This conclusion leads to the question - what value does a service learning course for freshman engineers provide?

## THE VALUE FOR STUDENTS

Based on our experiences, and student surveys and reflections from the students participating in the course, we found the students top learning experiences were the challenges of functioning in a team environment, the need to learn how to communicate in a technical setting effectively with a client, and the positive feeling they had because of their impact on the community. The fact that their project was part of a service learning course served more to motivate the students and to make them aware of their ability to solve a problem of value to their community, compared with the value of the specific methods of engineering analysis or design learned to solve the various problems. Of course the principles of the design process were introduced to the students as part of the curriculum which provided them with a framework for attacking each of the specific projects. The more beneficial elements of the curriculum, however, were the aspects of team development and performance, communication both written and verbal, the procedures for

documentation using a journal notebook, and reflection on the experiences of each student with their project. In other words, the value of the course is that the students learned both in the classroom and through experience the "soft skills" necessary to function effectively as engineers upon completion of their degree.

## THE VALUE FOR AN ENGINEERING PROGRAM

A service learning course for engineers provides a unique methodology for improving engineering education by providing students both a classroom and real world environment for effectively learning skills beyond traditional course material that will increase their effectiveness as engineers in the work force. Furthermore, by teaching these skills through service to a community organization, not only is the public becoming involved with and benefiting from the student's education, they are also learning more about the role of engineers in society.

In fact, these "soft skills" which are very effectively taught using a service learning course address specifically the objectives and program outcome criterion set forth within the ABET Engineering Criteria 2000.

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global and societal context
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Including all of these criterions as course outcomes is very difficult in the typical discipline specific topic course, however, we found that these are the topics that should be taught in a freshman service learning course. Introducing the concepts and true importance of professionalism, communication, team work and problem solving to freshman level engineering students serves as a wake up call that focuses the students on how their engineering education can and will be used not only following graduation, but also during summer internships or coop programs. It prepares students for what to expect when put in a work environment, rather than experiencing the sink-or-swim approach.

Another value in offering a service learning class to freshman engineers is improved retention by providing an experience which is both fulfilling and enlightening [1]. 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. 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. Thus, a service learning environment can help restore the student confidence and lead to an increased retention.

## THE CHALLENGE FOR AN ENGINEERING PROGRAM

The most immediate challenge is the establishment of community partners through which appropriate projects must be identified that fit the needs for freshman engineers. The second fundamental challenge is that of setting forth the desired outcomes of the course, and developing the means by which these outcomes will be achieved. While the challenge of developing community partnerships and appropriate projects are a necessity to conduct such a course, and can be very difficult, it was found that the most critical challenge in successfully implementing and sustaining the course was the latter. Identifying the desired outcomes of the course involves evaluating the needs of not only the students, but also the community partners as well as the instructor. This challenge can be summarized by the following three steps:

1. Determining what the students should expect to learn from the course, as well as the processes through which they will achieve these expectations.

2. Determining the expectations of the instructor in terms of not only the standards by which the instructor will grade the students, but also of student behavior in class and with the community partners.

3. Identifying what the community partners should expect to contribute and expect to gain by agreeing to become involved with the course.

Though these elements seem somewhat vague upon first review, the expectations and course outcomes must be carefully laid out and communicated from the first day of class in order to maximize the level of satisfaction experienced by not only the students, but also by the community partners and the instructor(s). Furthermore, it is also vital to reinforce these

expectations and evaluate whether they are being met at various points during the course via survey and reflection. Although the community project is the fundamental tool with which a service learning course is conducted, the specifics of each project are incidental; it is through determining, clarifying and reinforcing the expectations that all parties involved will have a positive and valuable experience.

## A Mechanism For Implementation of Reflection In Service Learning

A fundamental component of any service learning course is that of reflection. It is a critical mechanism to help the students grow from their experiences and to evaluate what they are in fact learning in the course. Despite its importance, however, reflection can be a difficult component to incorporate and utilize effectively. At the University of Pittsburgh, the non-honors engineering freshman take the second semester of an Introduction to Engineering Analysis course in which a writing component is implemented by requiring the students to write, submit and present a conference paper for the annual Freshman Sustainability Conference held at the end of the spring semester. The paper is graded by a member of the university's writing center and counts for 20% of their course grade. To incorporate the same writing component in the freshman honors service learning course, we have each team submit a paper to the same conference. The service learning papers include a summary of the community organization and the project, a review of an aspect of technology involved with the project, and reflection on their experience with the specific project as well as the concept of service learning. The paper evolves in components and is also graded by the writing center. The first component is an individual essay on service learning and initial project experiences. The second component is the team's project proposal submitted to the client for review six weeks into the semester. The final component is the conference paper at the end of the semester submitted by the team in which the reflection component is revisited.

Utilized in conjunction with journals and classroom discussions, the conference paper has proved to be an extremely effective means of implementing reflection. The students are not only graded on the quality of their reflection at the midpoint and end of the semester, but must also present their project and service learning experiences to their peers. The students must therefore address reflection more critically and in so doing are able to understand and learn from its benefits. It is a challenge to give freshman students the perspective with which to judge the value of what they are learning, and the use of reflection in an effective way meets this challenge.

## Pilot Projects

In the spring semester of 2006, a pilot course was offered. 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.

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 Resources 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.

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.
- Each year we must provide support for the undergraduate students involved with the

In the spring of 2007 we had 66 students in 17 different research projects, that included:

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. The project is assigned the task of mapping out the CHSC building.

B) The Hazelwood Initiative (HI) is an organization whose Mission and Goal 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. The project was to help design a system to make the Hazelwood Post Office handicap accessible.

C) 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 Denys Candy, the managing partner of 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. One of the project's main objective was to connect Pittsburgh's Hill District to the Eliza Furnace Trail. The other project was to develop a route from the Hill District on Bedford, down to the Allegheny River. The final project was to identify walking routes in the Hill District neighborhoods.

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. One project was to perform a geomorphic evaluation of the stream, which involves analyzing the water, sediment, flow, and curve of the stream among other things to accurately describe the present state of the stream. A second project was to measure the rate of erosion on the hillside and along the edges of the creek bed. The final project was to collect data relating to wet weather events and the effects of those events on the Panther Hollow 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. OPDC is located at 235 Atwood Street. One project was help prevent hillside erosion in the Historic district of Oakland by analyzing the hillside and delivering an

inexpensive solution. Another project was to complete an intersection analyses and mapping pedestrian hazards of several selected intersections in Oakland.

F) Disability Resources and Services (DRS). DRS is a department within the Division of Student Affairs at the University of Pittsburgh, and is located in RM 216 of the William Pitt Union. In the spring semester of 2006, 2 teams of the pilot ENGR 0715 service learning course worked with Lynett van Slyke of DRS, who had 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.

G) Carnegie Science Center's "Engineer the Future" weekend on February 18, 2007. The project was to design two robots that will be used to promote engineering to middle/high school students. After this event, the second phase will involve constructing our own robot design, or improving the Science center robots, to possibly give to a local high school robot building team. This portion of the project may also include the creation of an educational Lego Mindstorms video.

In the spring of 2008 we had 64 students in 17 different research projects, that included:

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. The projects are: Blueprint Development & Analysis of Robinson Street Facility; ADA Analysis of Robinson Street Facility; and Heat System Analysis of Robinson Street Facility.

B) The Hazelwood Initiative (HI) is an organization whose Mission and Goal 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. The project was to help the Design of Trail Head Connection to Eliza Furnace Trail.

C) 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 Denys Candy, the managing partner of 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. One of the projects was the Design of Green Space Trail. The final project was the Development of Hill District Walking Routes. This project was highlighted in an article in the local Pittsburgh newspaper.

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. The project was a Soil & Water Modeling of Schenley Park 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. OPDC is located at 235 Atwood Street. One project was Envelope Analysis of Robinson Street Facility. Another project was an Intersection Analysis for Hometown Streets Project.

F) Disability Resources and Services (DRS). DRS is a department within the Division of Student Affairs at the University of Pittsburgh, and is located in RM 216 of the William Pitt Union. The students designed the Development of Online Shuttle Bus Selection Program.

G) Carnegie Science Center's "Engineer the Future" weekend in February 2008. The project was to design two robots that will be used to promote engineering to middle/high school students. After this event, the second phase will involve constructing our own robot design, or improving the Science center robots, to possibly give to a local high school robot building team. This portion of the project may also include the creation of an educational Lego Mindstorms video.

H) Sustainability Subcommittee of University Senate. The project is redesigning the Sustainability Subcommittee of University Senate website. We have been given the task of creating a website to help define The University of Pittsburgh's stance on sustainability and to facilitate the subcommittee's goals of improving sustainability in the university, the city, and in the world.

I) Civil Engineering Department. Department of Civil and Environmental Engineering requires students to take a course in fluid mechanics (CEE 1402) with and accompanying lab. This course teaches principles that prepare engineers to basic design fluid mechanic design, such pumping systems, pipe systems, open channel flow, etc. The project was to help in the development of laboratory experiments designed to improve student learning of basic fluids concepts. Project will involve design and construction of various experiments requiring the use of the machine shop.

J) Freshman Engineering Program, University of Pittsburgh. The project was to Design & Develop an Online Interactive Scholarship Information Website

Based on the experiences and the modifications the students had with these projects and our new goals, we found that a service learning course for freshman engineers should concentrate on teaching the engineering design process, and if done correctly will still result in more serious students who are better able to appreciate their skills as engineers, and the value of their education to themselves and to their community.

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 [2]. 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.

## INTRODUCING MOBILE TECHNOLOGY

In the spring of 2009 we have 65 students in 16 different research projects, that include:

A. Community Human Services Corporation - The Community Human Services Corporation's Lawn Street health clinic is a poorly designed space that creates an unorganized, unprofessional, and inefficient workspace. While the employees seem content with their present situation the director of the organization, Adrienne Walnoha, believes improvements are necessary. The client wants to rearrange the health clinic space in order to provide the proper environment for a modern health clinic. Our community partner wants the new space to be both aesthetically pleasing and functional; making use of the limited space to meet their storage needs.
B. Oakland Planning & Development Corporation - Evaluate the future use of Aliquippa Place housing facilities that best fits the mission of the OPDC. Determine whether to renovate housing facility up to livable conditions, to demolish current housing and build more, new housing facilities, or to sell the property and use the profits to benefit the OPDC's other programs
C. Oakland Transportation & Management Assoc. - Work with OTMA to update their 2008 Walk Challenge map and website to include elevation analysis and calorie expenditure. In doing so, we hope to get the Oakland community more physically active and expand upon the existing program. The second project is to update and improve upon OTMA's current online parking map to account for changes in rates, times, congestions rates, and enable the online parking map to obtain an interactive element. In doing so, OTMA intends to facilitate the parking process for commuters in the Oakland area, by not only providing information on designated lots, but also by suggesting adjacent lots, should the designated lot be filled.
D. Hill House Association - Create awareness and accessibility to existing and proposed Green-up lots and Hill district walking paths. Designing and distributing a website, signs, and brochures for the project while incorporating historic and cultural aspects of the Hill district.
E. Hazelwood Initiative - Find a location for, and design a public garden for the Hazelwood community. Consider factors such as irrigation, sunlight, the type of plant life to include in the garden, soil samples at the prospective garden locations, as well as people traffic (including type of people), and the amount of upkeep needed to sustain the garden.
F. Pittsburgh Parks Conservancy - Research the erosion of the Panther Hollow Watershed, by analyzing the changes in elevation using arc-GIS technology and collecting water samples at

six locations within the Panther Run stream during both wet and dry conditions. These measurements, along with cross-sections at each point, will be used to analyze the possible erosion of the stream bed. As an additional task, we aim to indicate which areas of the park's trails are in need of the most repairs.

G. Carnegie Science Center - Design a robot aimed at gradeschool age children out of Lego Mindstorms for exhibition at the Carnegie Science Center during Engineers' Week 2009. In addition, our team will be creating a series of summer courses for the Carengie Science Center's Summmer Camps.
H. Artificial Heart Program - Perform a parametric analysis of the emergency hand pump used to drive a commercially available pneumatic artificial heart device used in patients at the University of Pittsburgh Medical College. Observe patients' fatigue levels after a given time and create a chart to display fatigue levels. Determine standards for pressure and flow within the pump system.
I. Quality of Life Technology Center - To create an engaging 30 minute-or-less video describing a day in the life of a person with blindness and how they use assistive technologies to accomplish everyday tasks and live independently, as well as how engineering research can enhance the quality of life of the user. Accompanying the video would be either a lesson plan describing in further detailing the assistive technology in a scientific way targeting high school students or a hands-on activity showing the importance of the technology targeting 4th through 8th graders. The purpose of both the video and lesson plan/activity is to encourage the students to pursue a career in science, engineering, or technology.
J. Dept of Civil Engineering - Complete the government required report on damage caused by mining in Western Pennsylvania to comply with PA Law Act 54. We are to analyze data from a state database and enter the information in Excel spreadsheet format. After entering the data for a mine we will analyze said data to see if there are any correlations or irregularities in the data.

Based on our previous experiences, we felt the one component missing during the projects was the use of computers and improving computer skills in the completion of the projects. Thus, this year with the aid of an HP grant we introduced 20 tablet PCs into the classroom.

One task the students have is to post all their work online. The course web site was modified to allow the students to add their material directly to the course web page. Thus, the students are using the new tablets to not only design a web site for their projects but to link that to the course web site. The laptops have allowed us to use non-computer classrooms to hold the class meetings in and still provide access to the internet. In addition, the tablets are providing the students the ability to work in a group setting and instantly post their group work online. Thus, instead of one person doing all the work, or waiting days to get their daily activities posted, now the group performs this task as a group during their class meetings.

Each student group is required to present their preliminary proposals and their final recommendations to the clients. In the past we had to bring the clients to the university to perform this task. Now with the use of the laptops we can bring the presentations to the clients. Since the presentations are typically given to just one person, we do not even need projection equipment for most of the presentations. The tablets allow us to rotate the screen so we can

place the computer in front of the client and give the presentation. This has greatly improved the logistics of this component of the course.

Another valuable addition is the ability to customize the laptops for each project. We can now install the required software on given machines and allow the students to check out the computers. Whether it is GSP software for the Parks group, or video editing software for the Quality of Life group, or A/D conversion software for the Heart group, or the Lego mindstorm software, or the Date base software for the Mining group, or various mapping packages for the rest of the groups, we are able to provide a custom laptop for each group. This has not come without a number of administrative problems that we are still trying to solve, but it appears at first glance that the added value is worth the extra work.

## SUMMARY

We are only four weeks into the semester at the time of this writing, but so far this semester, we have not had 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 is teaching 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.

Is it the use of the new tablets that is causing this improved experience, or the fact that we are just getting better at doing our job as instructors? Hopefully we will have an answer at the end of the semester and can present these findings at the conference in June. Thus, this paper is truly a work in progress and additional feedback will be provided in the final paper and at the conference presentation.

## REFERENCES


1. 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.
2. 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.