AC 2009-1643: COMMUNITY-BASED SERVICE PROJECT LEARNING IN CIVIL ENGINEERING COURSES

Clara Fang, University of Hartford

Community-based Service Project Learning into Civil Engineering Courses

Abstract

This paper describes and analyzes the experience of implementing community-based service project learning into civil engineering undergraduate courses at the University of Hartford, and considers the evidence of the impact of such learning on students and community organizations.
The paper begins by discussing how such a learning module has been developed and analyzes the participatory nature of this model. The module aligns with the University's vision of "a private university with a public purpose" based on connections to students and connections to the Hartford community. Using the transportation undergraduate class as example, each semester, students complete a semester project to perform a community-based traffic project, such as a traffic impact study to investigate the effect that a new development (e.g., Hartford Technology Pathway Magnet School) will have on the adjacent intersections and determine the need for any improvements on the surrounding roadway networks. Throughout the semester, along with the project, the lecture and lab sessions provide students with the necessary information to conduct the project. By the end of the semester, students have completed all components of the impact study through several assignments and compiled all necessary information in a final project report and presentation. These assignments include meeting with a community interest group, data collection and assembly, determination of trip generation and distribution, capacity and performance analysis using highway capacity software; an advanced computer program and report writing. In addition, students have opportunities to discuss their projects with practicing engineers who were carrying on-going real-life projects. An important part of these projects that students have to contend with is the possible lack of information sources; often the project will require some reasonable assumptions about different parts of the analysis. The experiential learning acquired through integrating real-life projects appears to compensate for some pedagogical weakness of classroom instruction. Some problems arising in coordinating between classroom concepts and community interests have been discussed. The major challenge faced is to select a suitable project that can fit into the curriculum and also student schedules. The faculty's long-term commitment to service learning is another crucially important element. In addition, it is critical that the needs and concerns of the stakeholders are heard and incorporated during the development of the program.

INTRODUCTION

Service learning is a form of experiential education in which students engage in activities that address human and community needs together with structured opportunities intentionally designed to promote student learning and development[1]. Past studies have shown that integration of service learning into academic teaching can benefit students and their learning in ways that other pedagogies do not. Though debated, the value of service learning includes higher student engagement in the material, expanded skill development, exposure to diversity and new experiences, and increased self-reflection.

Service learning has long been known as a useful experiential teaching approach in many disciplines in higher education. In the past few years, engineering programs have applied this method into their curricula from first-year introductory courses, capstone senior design courses and multidisciplinary graduate level research oriented courses. For instance, the University of Massachusetts - Lowell has integrated service learning into three core courses in civil and environmental engineering[2] without eliminating pertinent course materials and without a significant increase in time commitment. Purdue University has developed an engineering project in community service (EPICS) program[3] featuring a variety of real-life engineering projects,

This paper describes and analyses the experience of implementing a service learning community based project module into civil engineering surveying and transportation undergraduate courses at the University of Hartford, and considers the evidence of the impact of such learning on students and the program. The module aligns with the University's vision of "a private university with a public purpose" based on connections to students and connections to the Hartford community.

The following sections of the paper will discuss how each service learning project is incorporated into the curriculum and its associated educational advantages as well as outcomes assessment including course objectives, program outcomes, and lesson learned.

SERVICE LEARNING COMMUNITY-BASED PROJECT IMPLEMENTATIONS

As a pilot study, two civil engineering undergraduate courses have been carefully designed around the service-learning community-based model. Over the past two years, students have worked on three semester-long projects from the town of Bloomfield, the City of Hartford and the University, including traffic impact assessment on new developments and signal re-timing for Upper Albany Avenue. In order to prepare each project, a considerable amount of time was spent communicating with town engineers and consultants, and each project was designed to fit into the curriculum. Students were first given a short description of the project and a list of required tasks.

Tasks normally include field data assembly, method development, computer modeling, result analysis and recommendation discussions. I then incorporate the projects into my class lectures and laboratory tutoring so that the students have the theoretical background and necessary skills to complete all components of the project. A description of two projects is provided below:

1) Land Surveying Project in CE 250 Geomatics (*Sophomore Level*)

In the past two years, sophomore students have conducted several projects involving land surveying on the University's conservation easements. As an example, shown in Figure 1, the surveying area includes 12 sectors (A-L) and the sectors are marked with grid stakes. The project consisted of two assignments: differential leveling and traversing. Each assignment had a handout with detailed task descriptions, equipment preparation, deliverables and other guidelines for completion of the assignment. The surveying results have been submitted to the University and used to compile a baseline map of the easement.

The weekly lectures provided students with the necessary information to complete the surveying project. An important part of this project that students have to contend with is the complexity of the surveying area; students work around some natural obstacles, such as bushes, trees, bodies of water, stakes, poles, etc., by surveying additional points. For each project, students also had opportunities to work with two professional surveyors from an engineering company to gain real-life engineering experience. In addition, two undergraduate student assistants were available to facilitate students in the field work. The projects benefited the University by providing necessary traverse and leveling surveying data to help create a baseline map for the easement. The projects were integrated into the curriculum as service-learning to enrich the student learning experience. It has accomplished an education goal by engaging students in a real-life project applying the skills and knowledge learned from the class. As presented in Figure 2, students used advanced surveying equipment including total stations and automatic levels to measure the elevations, angles and distances of six surveying stations, and their field data have been calibrated and analyzed with an engineering procedure in the class. It is expected that the projects will move forward to continue building the mapping database for the University each year.

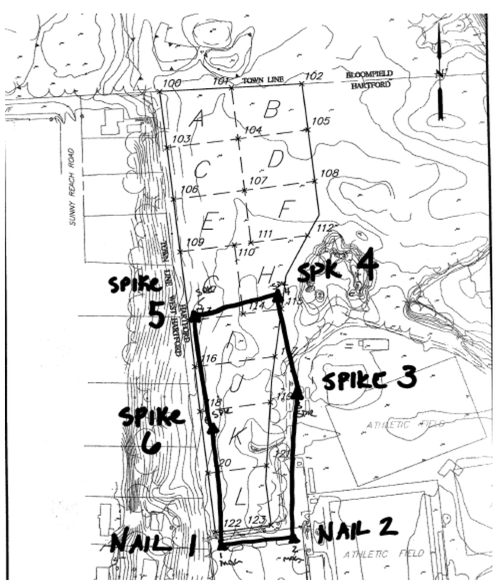

Figure 1. Surveying Grid of Conservation Easement "A"

Figure 2. Students Working on the Surveying Project

2) Traffic Impact Study Project in CE 452, Transportation Engineering (*Senior Level*)

A development of the Pathways to Technology Magnet School has been proposed placed on the southeast corner of the intersection of Broad Street and Farmington Avenue (Figure 3) in a business district as defined by the City of Hartford in Connecticut's zoning ordinances. The site is currently open land with a gravel path connecting Broad Street and Asylum Street and bordered by or adjacent to I-84 entrance and exit ramps, which increase the complexity of traffic operations in the area.

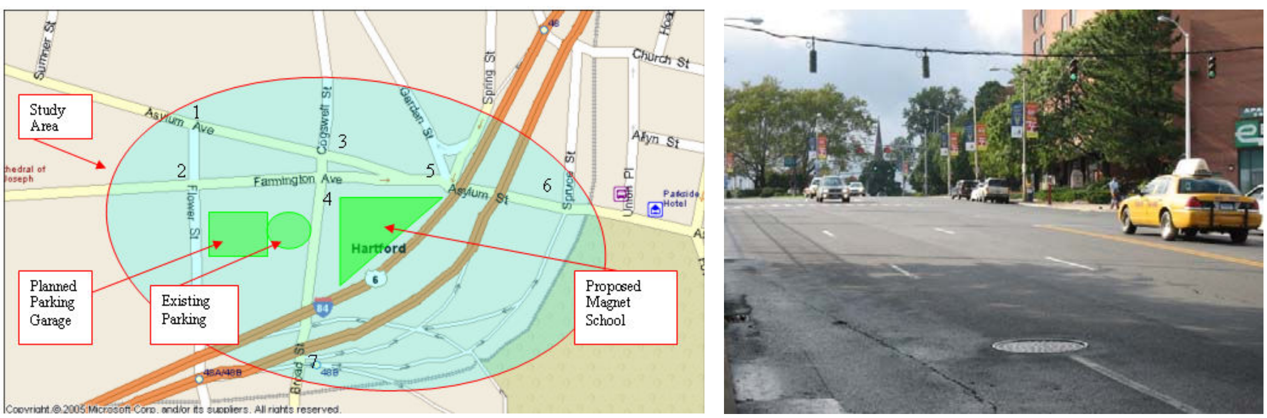

Figure 3. Project Study Area

The students in the class, working in groups of three or four students, complete a semester project to perform a traffic impact study to study the effect that this new development will have on the adjacent intersections and determine the need for any improvements on the surrounding roadway networks. As presented in Figures 4 and 5, the work efforts included field observation, discussion with a focus group, collection of traffic volume data, analysis of current, future no build and future build conditions, projection of traffic demand, and capacity and level of service analysis using highway capacity software (HCS). The students completed all components of this impact study through a series of assignments throughout the semester, and compile all necessary information in a final project report and presentation. Some examples of project deliverables included data collection and assembly, trip generation and distribution computations, a meeting with community summary, a redesign of intersection geometry and signal timing (Figure 6). Each assignment has a handout with detailed guidelines for completion. As a final project deliverable, each group prepared a formal report of their activities, analyses, and results. Along with the service learning project, a writing tutor worked with students on the technical writing for each of their assignment reports and the final report. Students were also given the list of requirements for the final report including the details such as that the body of the report should be paginated and each table and figure must be numbered and titled.

Figure 4. Site Visit and Data Collection by Students

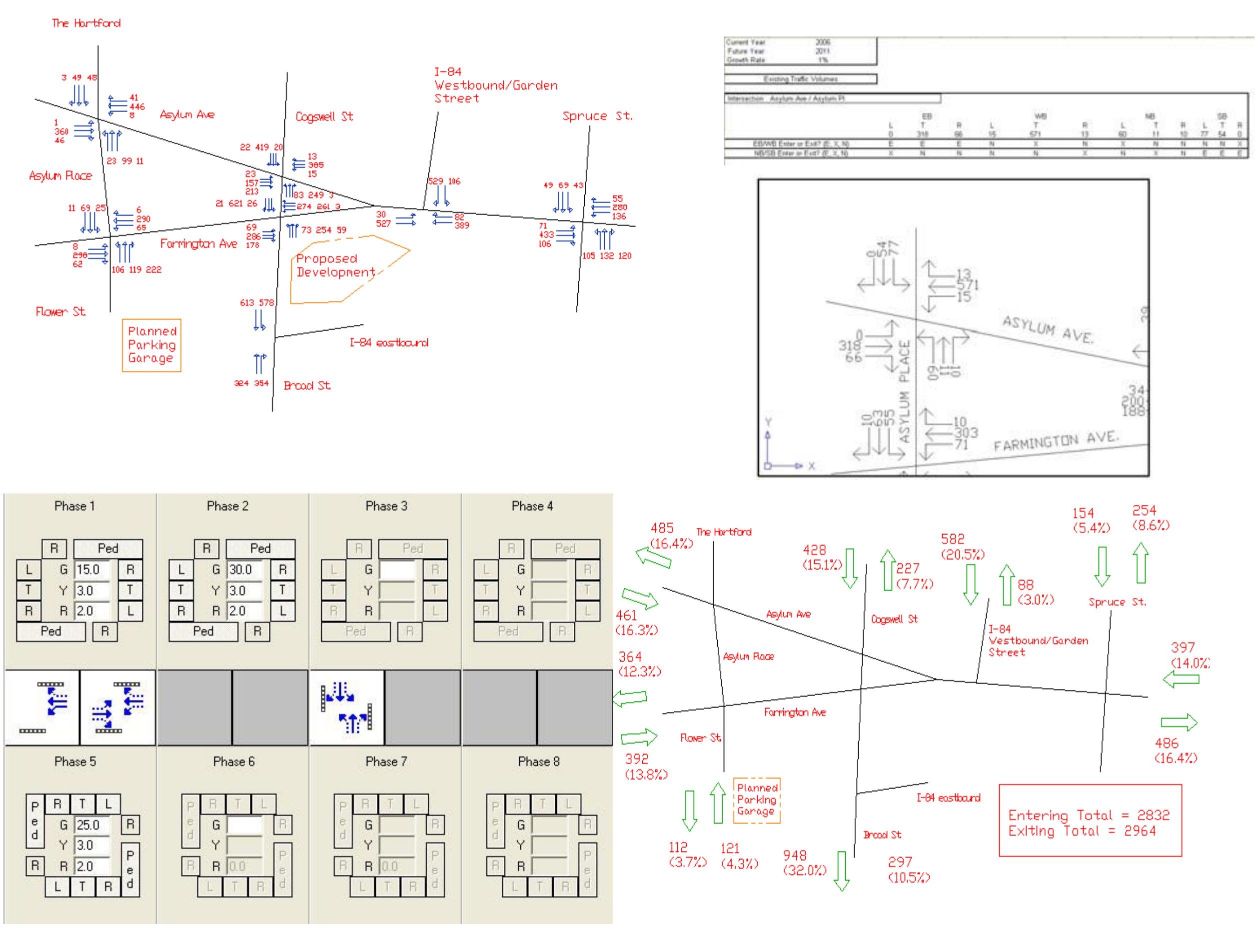

Figure 5. Student Work on the Service-Learning Project

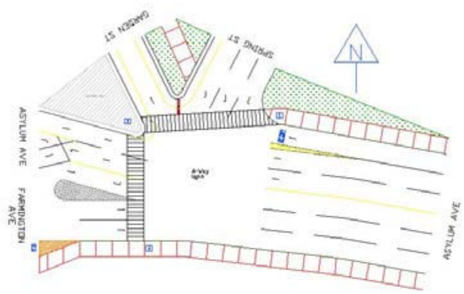

Figure 6. Intersection Geometry Re-design

ASSESSMENT

The project results were disseminated by students making formal presentations to the sponsors, city and town engineers, and the University's Undergraduate Research & Creative Colloquium. The presentations are required to include visual aids that add to the clarity of the demonstration. Each guest or attendee also had opportunity to assess student performance at the presentations through a performance evaluation sheet (Appendix A). The assessment covers general presentation, the analysis, findings and results and recommendations.

In the end of semester, students were surveyed through questionnaires about their experience in conducting these service-learning community-based projects. Approximately 30 students have answered the surveys over the past two years. The questionnaires are centered around the following questions:

1) In the service real-life project, I have applied knowledge learned from this class.
2) In the service real-life project, I have applied knowledge learned from previous engineering classes.
3) I have spent more effort and time on the class with service learning project than on other classes without service project.
4) It is important for me to work on projects that can solve real problems.
5) Through the service project, I have learned how to work with other people.
6) Through the service project, I have learned how to manage the project effectively.
7) The service project has enhanced my communication skills.

Feedback from questionnaires conveyed that students gained valuable experience throughout the project. Many students stated that their service-learning experience made learning more relevant to real-life issues and they felt that helping other people is an important part of their life. Students found that they were able to apply what they learned in the class out in the field and bring their field experiences back to the classroom. They learned new skills and improved existing skills in communication, team building, leadership, organization and technical areas (i.e., technical writing, database development, and technology applications). For instance, for the traffic impact study, students felt that they were making a meaningful contribution by serving the community to make streets safer. They perceived that their work and time was utilized well.

This integration is expected to enhance the program outcomes. These real-life service learning projects helped students accomplish the following outcomes. The successful graduate will be able

- analyze, evaluate, and design transportation system components;
- interpret and use experimental and field data;
- understand the principles of surveying for accurate positioning and property description;
- work as a member and leader of an engineering team;
- make oral and written presentations of analyses and designs to supervisors, other engineers, potential and actual clients, and the general public;
- understand the ethical requirements of the profession, the need for lifelong learning, and the impact of civil engineering activities on society.

CONCLUSIONS

This article discusses the potential for incorporating service learning and its associated educational advantages in civil engineering undergraduate courses. Meeting specific objectives and outcomes of the initiative and feedback from students indicates that overall the projects are successful. Service-learning benefits a student in many ways: It deepens understanding of course content; builds a bridge between theory and practice; increases a sense of social responsibility; and sharpens abilities to solve problems creatively and to work collaboratively.

However, the implementation of these real-life projects also allows faculty to reflect on some major challenges uncounted. Good co-ordinations between faculty and community project sponsors, time management and long-term planning and faculty members' involvement are the keys to sustaining a community-base service-learning program. The major challenge faced is to select a suitable project that can fit into the curriculum and also student schedules. The selected service learning project has to be designed to fit into the curriculum and meet program outcomes and course specific objectives. Project design and planning must also consider a school's schedule, such as breaks, mid-term exams, inclement weather, etc. The faculty's long-term commitment to service learning is another crucially important element.

Many service-learning civil engineering projects, such as highway geometric design, bridge design and traffic impact studies cannot be recycled used for future years. Once these real-life projects start construction, site conditions would have changed and the projects are no longer suitable for students. Then faculty have to take extra time and efforts to plan another project requiring a long-term commitment to the sustainable community-based service-learning program. In addition, communications with the project sponsors are essential to the success of the project. It is critical that the needs and concerns of the stakeholders are heard and incorporated during the development of the program. In the traffic impact study project, this need meant working more closely with town planning and engineering departments, business owners, land owners, and others. The community was always invited to participate in the workshops and forums that provided opportunities for open discussions.

Bibliography

1. Jacoby, B., and Assoc. *Service learning in higher education.* (San Francisco: Jossey-Bass, 1996).

2. Zhang, X. Q., Gartner N. and Gunes, O., *Integrating Service-Learning Projects into Civil Engineering Courses*, International Journal for Service Learning in Engineering, Vol. 2, No. 1, pp. 44-63, Spring 2007, ISSN 1555-9033

3. http://epics.ecn.purdue.edu/, last accessed March 20, 2009

APPENDIX A

Group Name _______ **CE 452 Transportation Engineering I** Group Members
Date ______________ **Fall 2008** _______________

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Evaluation Form for Final Presentation – Traffic Impact Study _______________

General Presentation **(10 pts)** 2 4 6 8 10
Comments: ____

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Introduction **(10 pts)** 2 4 6 8 10
Project Title: ____

Project Description: _______________________________________

Summary of Analysis **(50 pts)** 30 35 40 45 50
Area Map: ____

Intersection Schematics: ____________________________________

Traffic Volumes: ____

Delay and LOS Analysis: ___________________________________

Suggested Improvements: __________________________________

Any Expected Findings / Conclusions **(20 pts)** 12 14 16 18 20
Comments: ____

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Organization/Format **(10 pts)** 2 4 6 8 10
Comments: ____

Comments: ____

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