Introducing Community Service-Learning Pedagogy into two Engineering Curriculums at California State University, Northridge

Ahmad R. Sarfaraz, Tarek Shraibati
California State University, Northridge

Abstract

Academic service learning is a pedagogical model through which students learn, develop, and apply academic knowledge to address the real life needs of their local communities. It is becoming increasingly important in higher education. More recently, it has been used as an effective pedagogy for engineering education. Thus, in the spring of 2001, community service-learning concept was introduced into two Manufacturing Systems Engineering senior courses at California State University, Northridge (CSUN). In the first community service-learning project, students shared their knowledge and skills gained in a senior level course, Facilities Planning and Design, with a small company located within a federal enterprise zone. The second community service-learning project integrated a senior design class with a local high school as part of the FIRST (For Inspiration and Recognition of Science and Technology) robotics organization. Engineering students mentored Granada Hills High School (GHHS) senior students in building a robot to compete in both regional and national FIRST robotics events. Through these projects, engineering students not only applied the knowledge and skills gained through academic study to real-world problem solving, but also appreciated the connections made between their academic work and real-world activities. The experience and motivation of the instructors in incorporating service-learning are discussed in this paper.

Introduction

Service-learning, when integrated with community development, provides students an opportunity to learn, develop, and apply academic skills to address the real needs of their local communities. Students are exposed to the challenge of working with people from different backgrounds, cultures, and ages. They will also be prepared to work under time constraints and to be aware of life issues. It is becoming increasingly important in higher education. In July 1999, Gray Davis, governor of California, called for a community service requirement for all students enrolled in California's public institutions of higher education. His primarily goals were to enable students to give back to their communities, to experience the satisfaction of contributing to those who they need help, and to strengthen an ethic of service among graduates of California universities. Through previous academic year, California State University, Northridge (CSUN) has been given some grants to support the development of new service-learning courses and infrastructure. Thus, in spring of 2001, two senior courses in the department of Manufacturing Systems Engineering and Management (MSEM) were used as the first attempt

to integrate service-learning into the engineering curriculum. Other engineering colleges also have used community service- learning as an effective pedagogy for engineering education[1,2].

To apply service-learning pedagogy in the engineering curriculum, Facility Planning and Design course integrated students with a small manufacturing company that needed help with facility development through the Small Business Development Center (SBDC). The second community service-learning project integrated a Senior Design course with a local high school as part of the FIRST (For Inspiration and Recognition of Science and Technology) robotics organization. Engineering students in this class mentored high school students in building a robot to compete in both regional and national FIRST robotics events. Since these two courses focus on design, impact of engineering solutions in society, communication, and teamwork, they are particularly well-suited to community service-learning where students can use their skills in workplace. In addition, improving ability in these areas is also important for ABET accreditation under the Engineering Criteria 2000[3]. This concept is also has been incorporated by other engineering schools as an approach to achieve the ABET requirements. For example, Fleichmann[4] integrated community service-learning into a senior level heat transfer class to address the professional ethics as well as global issues under Engineering Criteria. Pitchard and Tsang[5] also used community service-learning courses as an approach to teach engineering students the professional ethics and the social impact of technology.

Approaches

The concept of learning by providing necessary assistance to the community is a central theme of the Community Service-Learning program at CSU campus. CSUN has been an active participant in this program that strives to reach out to the local community as part of the educational objectives of the CSU system. It is widely recognized that CSU's connection to the community enhances student learning, advances faculty research, and supports University programs while contributing to the well being of California residents. Community service-learning courses promote student learning through active participation in meaningful and planned service experience in the community that are directly related to the content of courses. Faculty members first prepare students for working with the community. This case incorporated two different approaches due to different nature of the community service-learning projects involved.

The First Approach

The Facility Planning and Design course required students to apply knowledge and skills gained in their class to a real life facility development problem. Through cooperation with the Valley Economic Development Center, Inc. (VEDC) the class was paired with a company marked for help through the North Los Angeles Small Business Development Center (SBDC). The North Los Angeles County SBDC working in conjunction with the VEDC, is a non-profit corporation that provides services for growing companies which are owned and operated by progressive-minded business owners who wish to develop businesses in a federal economic development zone. After meeting with the SBDC staff, several opportunities for community service-learning were presented and evaluated for placing students in the workplace. Parameters under consideration included the ability to complete the project within one semester, the relevancy of the projects to the course materials, and the level of technical skill required solving the problem.

The project targeted a small manufacturing business that needed help in expanding their production and improving their process. The existing facility is located in a small industrial park and produces wiring harnesses for other manufacturing enterprises. The company is a woman-owned business that lacked the ability both technically and financially to develop a plan of their own for business expansion.

Students were introduced to the problem by touring the existing facility and meeting with the owner to define the scope of the project. They were shown the footprint of the new building and given the task of developing a facilities plan to increase production capacity. Students then arranged to study the existing facilities process capabilities by arranging several visits. These studies were complimented by lecture discussions of the various aspects of the project as they related to the course materials. After analyzing the problem, students came up with three different layout plans. Each layout was discussed with the business owner to assure that her objectives were met. Students consulted with her to choose the layout plan that she felt was most feasible for her to implement. The optimum layout plan is illustrated in Figure 1. Upon completion of the project, students developed a report and copies to the MSEM department, the business owner and the SBDC. The report included study results, the three alternative plans considered, and the final recommendation for process improvement.

It is anticipated that future projects for the facilities planning class will be identified by working through the VEDC. Faculty from the engineering college will meet with VEDC personnel regularly to identify businesses with appropriate facilities planning needs for incorporation in the service-learning program.

Lessons from the first approach

The results of this project were beneficial in several ways. This service-learning project offered students a good way to learn about the course materials and its impact on society. Student learned how to apply their skills at workplace and how working with diverse group can enhance their civic awareness. Students were much more enthusiastic about working on real problem solving as opposed to hypothetical situation posed by faculty. This enthusiasm leads to greater focus on the details of the problem and avoids the tendency of some students to treat hypothetical problems in a superficial manner. They gained professional experience under the guidance of the faculty member, which is very important for their career development. This community service-learning project involved highs and lows for instructor as well. The most rewarding aspect was that the criteria stated under the Engineering Criteria 2000 were met for ABET accreditation through community service-learning. Although some students were at first resistant to the idea of community service-learning in facility planning and design course, they became excited because they had done something worthwhile while working on a real problem. Furthermore, the University gained through this type of community outreach in building positive image. Finally, the size of this business precludes the owner from affording to hire a professional Engineering firm to do the work performed by the students.

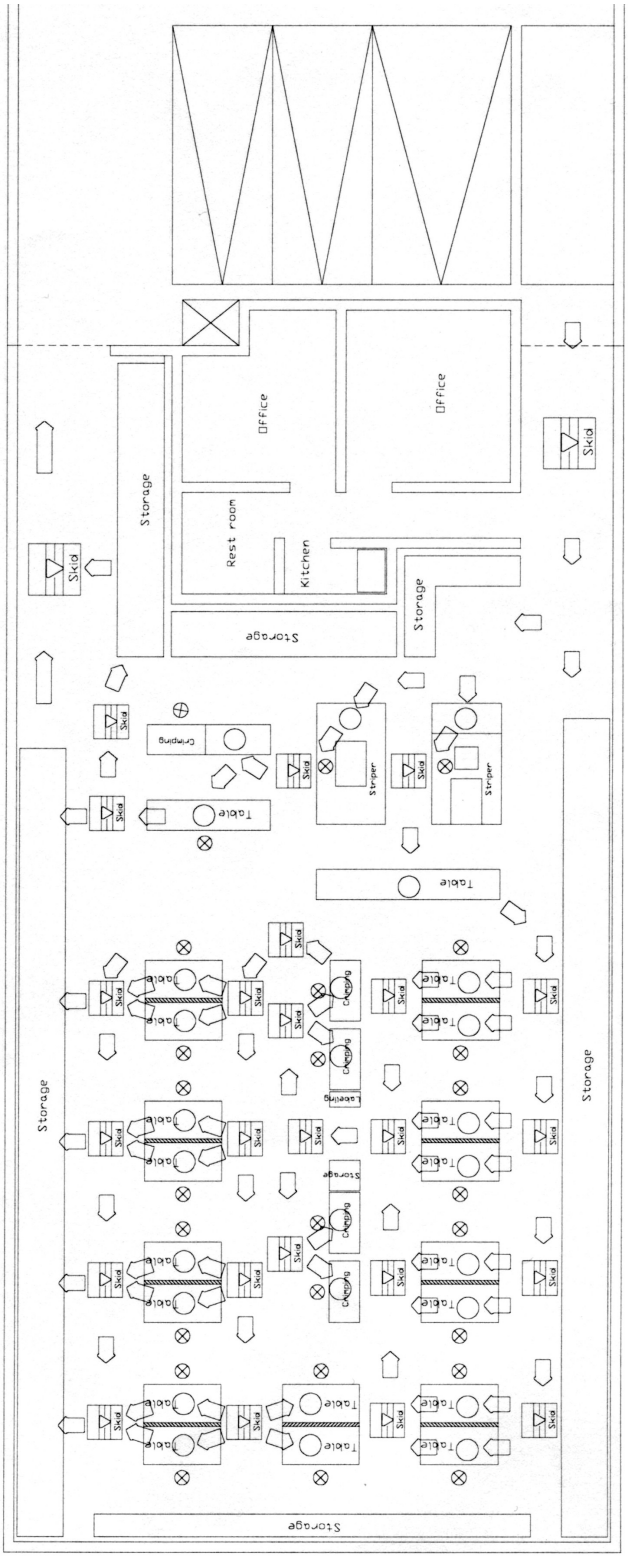

Figure 1. Optimum Layout Plan drawn by students

The Second Approach

The second community service-learning project teamed MSEM senior design students with Granada Hills High School (GHHS), a local school, as part of the FIRST Robotics program. FIRST was chosen as the vehicle for this project because of FIRST's proven track record in recruiting high school students into the Engineering profession. Due to the fact that this project involved interaction with high school students, the faculty member was required to prepare the Senior Design students before placing them in actual contact with the younger students. The Community Service-Learning Center at the CSUN has formal guidelines governing interaction between the university students and minors in the community.

The CSUN faculty advisor met with the GHHS teacher to co-define the goal of structuring a partnership that would establish a FIRST team at the high school. The senior design capstone experience requires that students apply their technical knowledge to an open-ended design project. In this case, CSUN students mentored high school students in all activities required to design, build, and field a robot for the FIRST competition. Key issues that had to be addressed included establishing a project management framework to meet a six-week time constraint. A Work Breakdown Structure (WBS) was undertaken by students to define the major tasks including learning competition rules, designing, building, and testing a robot. Brainstorming sessions were held at the first week to determine the functionality of the robot to be designed. Students were then organized into subgroups for component design/build.

A senior design student to complete the required tasks mentored each high school group. Engineering students used their communications skills interacting with high school students. They met with the FIRST team after school for two hours midweek and six hours Saturdays. Meetings took place at GHHS. The faculty member was required to make brief appearances at these meetings. Figure 2 shows the robot built by this partnership. Once the robot was built and shipped the focus shifted to logistical aspects of getting the team to competition and establishing a framework for a continuing partnership. Figure 3 shows the group effort working on the robot at the National Competition in Florida. CSUN students and the faculty advisor attended the regional and national competition with the GHHS team. The majority of the mentoring took place during the month of January which is the winter intersession at CSUN.

The CSUN student chapter of the Society of Manufacturing Engineers (SME) was set up to sponsor FIRST activities with GHHS. This allowed us to use the nonprofit status of the SME chapter to raise the $20,000 capital required to field a FIRST team. Students were required to write funding proposals to different organizations.

Lessons from the second approach

The main benefit of doing this project is that students gain experience in various professional activities including project management, manufacturing/prototyping, proposal writing and assembly. Additionally, University benefits from the goodwill created with GHHS which is located next to the campus. High school students are also exposed to the field of Engineering in an exciting program, which promotes enthusiasm in Engineering as a profession. It was necessary to remind CSUN students that the students that they would be working with had not

been exposed to the design process, basic engineering principles, logistics or manufacturing processes. This meant that CSUN students would have to focus on the assets of the high school students. This includes the fact that their lack of technical knowledge allowed them greater creativity in the brainstorming process and a high level of enthusiasm. The CSUN students were made aware of the potential assets the high school students would become in the future for Engineering profession.

The faculty workload is affected by the need to meet more often with students in the senior design class. This problem is being addressed through the development of a freshman level Introduction to Robotics course for non-majors. High school students will be eligible to take this course through an agreement between CSUN and GHHS.

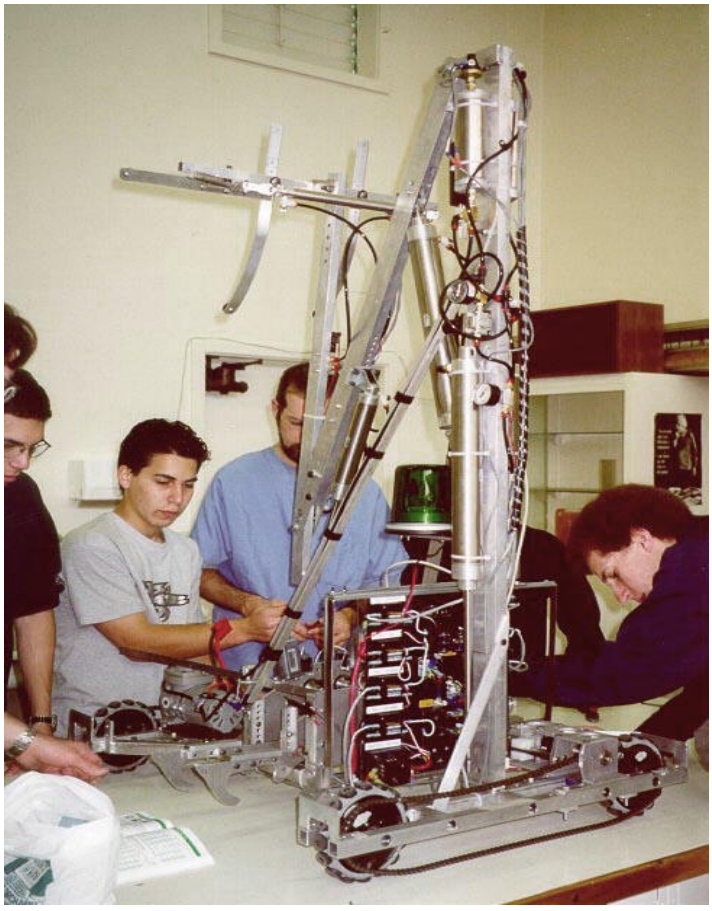

Figure 2. Building the Robot at GHHS

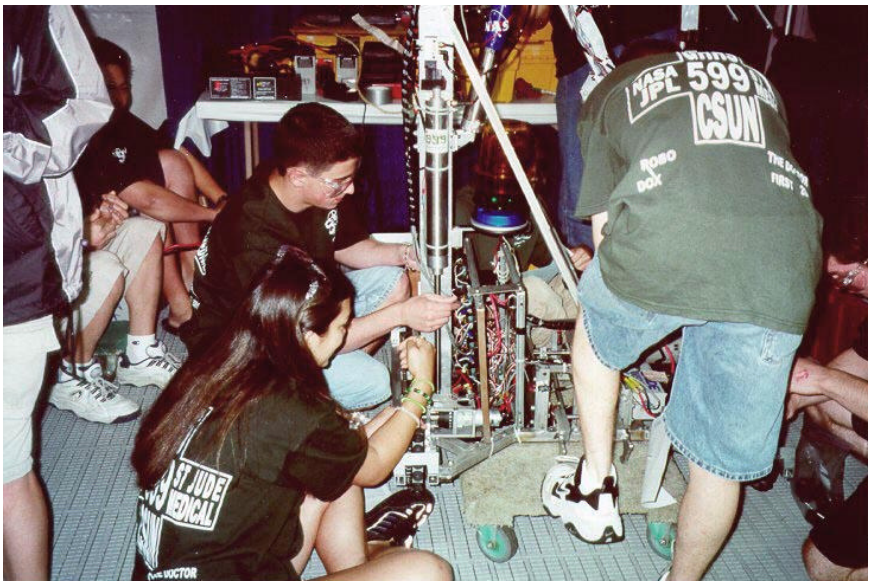

Figure 3. Students working on the Robot at the National Competition in Florida

Conclusion

The use of service-learning in a traditional engineering curriculum adds breadth to the engineering students experience while instilling the importance of service to society. Two community service-learning projects were introduced in this paper into two engineering curriculums at the department of Manufacturing Systems Engineering and Management at the California State University, Northridge. In the first one, students applied their knowledge and skills gained in a senior level course with a small company that needed help in facility development through the North Los Angeles County SBDC. In the second one, students integrated service-learning into senior level capstone course as part of the FIRST robotics organization. Since these two courses focus on design, impact of engineering on society, communication, and teamwork, students not only applied the knowledge and skills gained to real-world problem solving, but also improved their abilities in these areas which is important for ABET accreditation under the Engineering Criteria 2000. In each case, the faculty sponsor was required to take on additional responsibilities in order to facilitate the experience. Both of the faculty involved found the experience to be very positive and plan to continue incorporation of service-learning in their classes in the future.

References

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Ahmad R. Sarfaraz
Professor Ahmad R. Sarfaraz obtained his Ph. D. degree from West Virginia University in 1990. Since then, he has been on the faculty of Abadan Institute of Technology and Amirkabir University of Technology, and now at the California State University, Northridge where he is Assistant Professor in the Department of Manufacturing Systems Engineering and Management. In addition to teaching courses on Facilities Planning and Design, he has taught Engineering Economy and Engineering Project Management at the undergraduate level and Advanced Engineering Management, Engineering Economic Analysis, and Engineering Statistics at the graduate level.

Tarek A. Shraibati
Professor Tarek Shraibati obtained his MS degree from University of Southern California in 1994. He is currently at the California State University, Northridge where he is Assistant Professor in the Department of Manufacturing Systems Engineering and Management. In addition to teaching Senior Design, he has taught Facilities Planning and Design , Engineering Economy, Manufacturing Processes, and Design for Manufacturability at the undergraduate level and NDE methods at the graduate level.