

# **SERVICE-LEARNING OPPORTUNITIES AT THE UNIVERSITY OF DAYTON**

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## **Abstract**

Community service activities are at the cornerstone of the University of Dayton's mission. It is the guiding principle of the Vision 2005 to educate distinctive undergraduates who will be prepared to learn, lead, and serve during the new millennium. An overview of the engineering related service-learning opportunities at the University of Dayton is presented in this paper. A variety of community services, adopted to enhance the experiential learning of students, is described along with students' assessment in the context of their reflections.

## **Introduction**

The integration of community service projects in undergraduate engineering curricula, to provide experiential learning, has created a great deal of interest among educators in recent years. Tsang (2000) stipulates that the notion of combining service with engineering design projects is not new considering that many senior design projects have provided assistive technology to meet the needs of people with disabilities. Tsang (2000) further discusses the many benefits of service-learning, coupled with design-across-the-curriculum, and the significance of integrating design at all stages of a student's academic development in a meaningful context. Evidently, this innovative pedagogy helps to achieve the desirable student outcomes described in Engineering Criteria 2000 Publication (ABET 1998).

Martin and Coles (2000) discuss the challenge of introducing a service-learning endeavor in the civil and environmental engineering program. They outline a four-step plan for implementing service-learning across the departmental curriculum including criteria for identifying a service-learning course, a mechanism to reward the faculty in relation to tenure and promotion, a mentoring program for the new faculty, and guidance on student assessment.

Jamieson et al (2000) elaborate on key features of the EPICS (Engineering Projects in Community Service), a service-learning program, that was initiated at Purdue University in the Fall of 1995. The premise of the EPICS program is that undergraduate engineering students earn academic credits by solving long-term, technology-based problems for local community organizations. The complexity and multidisciplinary implications of design projects have enabled EPIPCS to address many of the program outcomes mandated for ABET accreditation.

EPICS program has been successfully adopted by other institutions such as Case Western Reserve University and Columbia University.

The National Society for Experiential Education (Honnet and Poulsen 1989) delineates principles of good practice in combining service and learning involving an effective and sustained program. Based on these principles, the people with needs are able to define their needs and those providing the service are engaged in responsible and challenging actions for the common good. Furthermore, there are training, supervision, monitoring, support, recognition, assessment included in the process and it provides structured opportunities for people involved to reflect critically on the service experience. In particular, the reflection characteristic of service-learning endeavor distinguishes it from traditional design-across-the-curriculum activities. Moffat and Decker (2000) state that “reflection provides a vital forum for students to discuss creatively their service-learning experiences and to learn from one another – in short; it is integral to the service-learning process.” Jacoby (1996) asserts that the goal of student participation in reflection promotes “learning about the larger social issues behind the needs to which their service is responding. This learning includes a deeper understanding of the historical, sociological, cultural, economic, and political contexts of the needs or issues being addressed.”

Although students at the University of Dayton have a long history of being involved in community service and volunteerism through campus ministry and social and professional clubs and organizations, the explicit integration of service-learning in undergraduate engineering education is a relatively new initiative. A brief summary of representative service-learning activities and initiatives that have been implemented in the School of Engineering will be presented herein along with a sample of the students’ reflective assessments of these activities.

### **Integration of Community Based Projects in General Engineering Courses**

The University of Dayton (UD) is a Roman Catholic University founded in 1850 by the Society of Mary. It has an undergraduate enrollment of approximately 6,500 students and is ranked seventh among national Catholic universities, and among the top 100 national universities in the country, (U.S. News and World Report, 2004). University of Dayton is committed to service and was selected by the Templeton Foundation as having one of the nation's best service-learning programs and as one of 100 colleges and universities in the United States that encourages character development and civic responsibility UD offers ABET-accredited bachelor's degree programs in six areas of engineering including Mechanical and Aerospace, Civil and Environmental, Electrical, Computer, Chemical and Technology. It strives to develop in its students a strong technical background in engineering fundamentals as well as a broad understanding of the humanities so that its graduates will seek to holistic approach to engineering challenges that take into consideration the business, social, cultural, global, ethical, economic, environmental and systems aspects of the problem (UD website, 2005).

There are several multi-disciplinary courses offered through the School of Engineering that have incorporated service-learning into the curriculum. One such course is the Introduction to Engineering Design course (EGR 101). Introduction to Engineering Design, is a required, two-semester hour, first year, multi-disciplinary engineering course. The overall goals of this course

are to develop the problem solving and teamwork skills of the students, introduce the students to the multi-disciplinary nature of engineering design, and provide hands on experiential learning. Additionally, this course addresses topics such as information literacy, engineering ethics, environmental responsibility, self knowledge, interpersonal skills, creativity and innovation. Most sections of EGR 101 are team taught by instructors from at least two different engineering disciplines.

Since the winter of 2001, a special section of EGR 101 has been offered to students enrolled in The New Engineer Program at the University of Dayton. This program is an optional program for engineering students that provides a more holistic approach to engineering education through special opportunities and activities. Some of the special opportunities and activities offered through The New Engineer Program include professional development programs, mentoring and practical learning through multidisciplinary design projects, enriched co-op and internship experiences, and community service. A key component of the New Engineer section of EGR 101 is the Wheels for Kids activity. As part of this activity, student teams develop conceptual designs of bicycles for different users and applications, from police bicycles, to bikes for extreme downhill competition, to utility vehicles for developing countries. Additionally, students enrolled in this course organize and host a daylong program for inner-city children where the engineering students are teamed one-on-one with deserving children from the Dayton community to refurbish donated bicycles. Children participating in this program go home with a bike they helped repair themselves, souvenir t-shirt and new bicycle helmet provided sometimes by Children's Medical Center, sometimes from other donors. Additionally, the participating children get instruction on bicycle safety from AAA representatives and participate in a bicycle safety rodeo (UD New Engineer Program Website).

In the winter and fall semester of 2003, students enrolled in EGR 101 participated in a service-learning project called *kidslearn*. The *kidslearn* service-learning project required the students to research a topic, develop a hands-on learning activity on one or more aspects of the topic and then facilitate this endeavor to at least one group of middle school or junior high students. Additionally, students were required to choose a part that incorporated the basic principles addressed in their hands on activity and reverse engineer that component. Furthermore, students drafted individual research papers summarizing the reverse engineering aspect of the project. Overall, the *kidslearn project* provided a mutually beneficial learning experience to both the college age and school age students. Most importantly, this project helped the first year college students become more excited about engineering and the school age students excited about science and engineering. Additionally, it provided the school age students with positive role models.

In addition to the first year EGR 101, Introduction to Engineering Design Course, the School of Engineering recently started offering a course entitled EGR 330, Engineering Design and Appropriate Technology. This course is a one to three semester hour, multi-disciplinary engineering elective that is coordinated through the University's ETHOS (Engineers in Technical Humanitarian Opportunities of Service-Learning) program, giving engineering students academic credit for preparing for and participating in international technical service work. EGR 330 spans both the winter and summer semesters and includes language preparation, cultural immersion, appropriate technology and a six to sixteen week summer service-learning

internship doing technical or engineering related work in a developing country. The overall goals of this course are to provide undergraduate engineering students with an opportunity to experience another culture, apply the knowledge gained in other courses to solve unique engineering problems, gain a greater understanding of appropriate technology and contemporary issues related to global development, engineering ethics, program management and written and oral communication, become more proficient at a second language and develop professional competencies. Course assessments indicated that the EGR 330, Engineering Design and Appropriate Technology course, did a fairly good job at meeting its educational objectives but also identified some areas in which the course could be improved.

### **Integration of Community-Based Projects in Civil Engineering**

The Bachelor of Civil Engineering (CEE) program at the University of Dayton represents a broad-based curriculum. It is believed that a holistic approach is essential in order for students to understand and appreciate the full impact of civil engineering solutions. The 138-semester-hour curriculum of coursework has been designed to follow a logical four-year progression.

The CEE curriculum is heavily design-oriented during the first semester of the senior year which leads to the capstone design course offered in the subsequent semester. The capstone design course (CEE 450) is the “showcase” of Civil Engineering program at the University of Dayton. This comprehensive, multi-disciplinary, design course differs from other design courses in that the design focuses on a total, integrated system rather than on a single discipline subsystem. The design projects are “real-life” applications with team of students responsible for different aspects of design. There is significant interaction among student groups and practitioners. Both written technical report and oral presentations are required. Community-based service projects has constituted some of the past design projects.

A series of seminars (CEE 408) has been conducted for sophomores through seniors each semester. Traditionally, these seminars were intended to round out the education of civil engineering students with a variety of discipline-related topics as well as few presentations concerning engineering ethics, resume preparation, cooperative education opportunities, etc. There was, however, no theme associated with the seminar series in the past.

The format of the seminar series was recently revised to reflect a more synergistic and cohesive approach, driven by service-learning theme. After participating in a National EPICS Conference, sponsored by the National Science Foundation (NSF) and Purdue University, one of the authors, in collaboration with the faculty colleagues, has adapted the EPICS via the seminar series. The newly revised seminar series, designated *Civil Engineering Practice* (CEP), serves as a vehicle to identify and implement the EPICS.

The intent of the civil engineering practice is to provide opportunities for undergraduate civil engineering students at the University of Dayton to become involved in service-learning projects. The principal objective of this course is to serve as a focal point (catalyst) for identifying appropriate multiyear-multidisciplinary community service projects that involve strong technical content, significant design, and a strong communication component for teams of undergraduate students to choose from. Also, a series of guest lectures, discussions, field trips, etc. is arranged

throughout the semester. The designated projects will lead on to either proposed civil engineering electives, engineering electives, or become part of existing courses, administered by designated faculty members.

It is well known that in addition to having a sound technical background, future engineers are expected to be equipped with other non-technical tools (or “soft skills”) to be able to face new challenges. They will be expected to interact with people of varying educational and social backgrounds. Several outcomes specified in the so-called “Body-of-Knowledge” initiative, proposed by the American Society of Civil Engineers (ASCE), advocate skills in business and policymaking, project management and leadership, etc (ENR December 2004). Also, the ABET’s Engineering Criteria 2000 students’ performance outcome mandate the “knowledge of contemporary issues” and “the broad education necessary to understand the impact of engineering solutions in a global and societal context” (ABET 1998). Many of these topics are integrated within the revised Civil Engineering Practice (formerly seminar series).

Furthermore, civil engineering students are required to take three civil engineering elective courses and two technical (science/engineering) courses. Thus, there is ample opportunity for students to take as many as five community-based service-learning courses at different levels and semesters. As a result, it has been possible to vertically integrate the EPICS program both through the CEP as well as five elective courses. In addition, students enrolled in Honors and Scholars programs at the University of Dayton may pursue their undergraduate theses related to community service projects.

Representative community service projects include automation of construction plans and improvement of energy efficiency of habitat for humanity residential structures, improvement of quality of life for disabled citizens of the Dayton area via the United Rehabilitation Services, design of an environment-friendly Eco-House for the University of Dayton, creation of a nature trail through one of the local parks along with the construction of two small foot bridges over a creek, wetland restoration, and the Wright-Dunbar revitalization project, etc.

The preliminary students’ assessments of the Civil Engineering Practice (formerly seminar series) and their involvement in community-based service-learning projects have been positive. Considering that the EPICS program has been in place only for one semester in the CEE Department at the University of Dayton, it has stimulated significant interest among students and faculty. In addition to the long-term goals of identifying multidisciplinary projects, students were required to contribute to short-term community service projects and provide a one-page summary of their experience and reflections of this type of experiential learning. Students encouraging remarks regarding their experiential learning attests to the great success of this endeavor.

### **Integration of Community-Based Projects in Mechanical Engineering**

The Bachelor of Mechanical Engineering (MAE) program is 133-semester-hour curriculum that offers an optional Aerospace concentration. Similar to the CEE program, the MAE program takes a holistic approach to engineering education where students are provided with a solid

technical education that is complemented by an extensive general education experience. The main course in which service-learning is implemented in the MAE program is MEE 312/312L, Introduction to Materials and its associated laboratory.

Since the fall semester of 2002, students from the Introduction to Materials class and the Facility Management Class (Department of Health and Sport Science - HSS) participated in a joint service-learning project with the Buckeye Trails Girl Scout Council. Although the overall technical goals of this project change from year to year, they typically involve designing and building an element for a challenge course at one of the local Girl Scout camps. The educational goals of this project are to provide an experiential learning opportunity for students that would augment the content of both the HSS and MAE courses, further develop the students' teaming, leadership, research, communication and project management skills and provide students with an appreciation of working with people from diverse educational and occupational backgrounds. This project is facilitated by the HSS and MAE instructors with help from the University's service-learning coordinator and Girl Scout representatives. The health and sport science students participated in this project as the "prime contractor" to the Girl Scout organization. The mechanical and aerospace engineering students served as the engineering design firms competing to be the subcontractor for this project. Students from the two classes serve on integrated teams to design the "best" challenge course component. The teams present their proposals to the Girl Scout organization and representatives from the organization choose the design that will be built at their camp. Through this project, students from both classes are required to interact with representatives of the Girl Scout organization, retailers, student organizations, faculty members and other professionals to obtain the needed information, seek donations and facilitate construction and/or repair of the component. End of the semester project assessments have indicated the collaborative service-learning projects to provide a positive learning experience for students from both courses. Based on the results of evaluations and through conversations with the students, the service-learning projects have achieved both the course specific and non-course specific educational goals. As expected, the instructors continue to modify the project and its requirements in an effort to further enhance the educational opportunity for students.

Since the Fall semester of 2002, the Introduction to Materials Laboratory Class has been involved with a service-learning project through the ETHOS program. This project supports the work of the service organization, Aprovecho, and its associates. Typically, the technical objective of these projects has been to improve the efficiency of a wood-burning cook stove or "eco-stoves" by proper selection of the insulative brick materials or metal used to make the stoves. In this project, student teams work together to either manufacture or procure the materials and/or test samples, develop a test matrix, conduct the tests in accordance with the appropriate test standards, analyze the data and present the results through a presentation and final paper. The educational goals of this project are to provide the students with hands-on, service-learning experience to enhance their technical, program management, computer and communication skills and to expose the students to ideas of appropriate technology, environmental responsibility and ethics, cultural diversity and cultural sensitivity. Students also are provided with an opportunity to view engineering as a vocation and to consider the impact of engineering decisions on people and the environment.

## Conclusions

The community-service activities, integrated throughout undergraduate engineering curricula at the University of Dayton, have added a new dimension in relation to the experiential learning for students. They have provided numerous opportunities for students enabling them to contribute to the community while gaining hands on experience and college credits. Students' reflections of their assessments reveal the positive impact service-learning activities have had on their education.

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