Panel - Measuring the Impacts of Project-Based Service Learning in Engineering Education

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Abstract - **Project-based service learning (PBSL) has become an emergent opportunity for engineering education. There are a number of national programs that provide opportunities to incorporate PBSL in engineering. The problem - there are scant findings on the impacts of these programs on engineering education. However, preliminary findings suggest that PBSL 1) retains students; 2) increases female representation; and 3) offers an opportunity to fulfill a variety of ABET learning outcomes including students' preparation to practice engineering design. A Summit was held in early 2009 to gather, summarize, and leverage the expertise of participants to identify desired outcome metrics, quality assessment methods, and key next steps needed in understanding the impacts of PBSL. The goal of this paper, as well as the upcoming panel, is to review both curricular and extracurricular community service activities related to engineering. The panel hopes to continue and expand the discussion initiated in the recent Summit; specifically acquiring the views of non-Summit participants to augment Summit findings.**

Index Terms – assessment, community service, project based learning, service learning.

PBSL is a form of engaged, active learning where students work on real projects that benefit a community or client. Project-based learning (PBL) is learner focused with the project generally developed by the instructor and the learning path fairly predictable. PBSL adds the community as a full partner; thus outcomes are less clear.

This paper focuses exclusively on the students' educational outcomes. However, of equal importance are the impacts on community partners and faculty. The community should be a true, if not equal, partner in the process and feel ownership of the project. This will help to ensure they have reasonable expectations for outcomes and an appropriate and sustainable solution is achieved. For faculty, it has been reported that PBSL is motivating but requires more time than other pedagogies and is not rewarded in evaluation, promotion, and tenure. Thus, the accompanying panel discussion will focus on student as well as other potential outcomes from PBSL. It is hoped that both of these areas will be part of future studies.

SUMMIT

The National Science Foundation funded a Summit on PBSL that was held in February 2009 (DUE 0848636). Some of the information provided by the participants in a pre-summit questionnaire on PBSL activities and assessments at their institutions is included in this paper.

PROGRAMS INTEGRATED ACROSS CURRICULA

Two examples of PBSL that have been widely integrated across an entire engineering college include the EPICS (Engineering Projects In Community Service) and SLICE (Service-Learning Integrated throughout a College of Engineering) programs. The EPICS program, started at Purdue University in 1995, now has programs at at least 14 universities [1]. The SLICE program at the University of Massachusetts Lowell incorporates SL into existing required courses, with a goal that students have at least 1 course every semester with SL [2, 3].

The Global Perspective Program, at Worcester Polytechnic Institute, has students typically spend 2 months abroad on a project. There is evidence these projects provide strong evidence of attaining ABET criteria concerning multidisciplinary teamwork, understanding ethics and professional responsibility, lifelong learning, impact of engineering on society, and knowledge of contemporary issues[4].

I. EXAMPLES OF PBSL IN COURSES

One of the most common curricular models for PBSL is capstone design courses. Some examples include: a water project in Guatemala funded through an EPA P3 grant [5], and the International Senior Design course in Civil Engineering at Michigan Technological University [6,7]. PBSL activities have been incorporated in a variety other courses, ranging from the first-year to senior level. PBSL can be incorporated in courses with a technical focus but also serve as the main focus for a course.

II. EXAMPLES OF RELATED EXTRACURRICULAR ACTIVITIES

Although SL is by definition an activity integrated into credit-bearing courses, many extracurricular activities become curricular projects. EWB (www.ewb-usa.org) and Engineers for a Sustainable World (ESW; www.esustainableworld.org/) provide projects that fit this model; e.g., projects at the University of Colorado – Boulder

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and Lafayette College. In addition, the International Center for Appropriate and Sustainable Technology, iCAST, is another organization that matches Universities with PBSL opportunities (www.icastusa.org).

OUTCOMES ASSESSMENT

Program assessment is a vital activity in order to determine the outcomes of student engagement in PBSL. These outcomes can be grouped into five general categories: 1) knowledge, 2) skills, 3) attitudes and identity, 4) program issues such as recruitment, retention, and diversity, and (5) post-educational professional performance. Knowledge and skills are, generally, easy to directly measure by common assessments used in nearly all engineering courses; usually conducted via graded reports, presentation, and other student work. These outcomes link directly to the outcomes articulated by ABET [8], the Body of Knowledge [9, 10], etc.

Attitudes are often harder to measure, particularly within the timeframe of a single course where changes often manifest later upon self-reflection. Vast arrays of techniques have been applied to evaluate student attitudes and identity, such as the Community Service Attitudes Scale (CSAS) [11], IDI: worldview orientation toward cultural differences [12], and the Miville-Guzman Universality-Diversity Scale of cultural competency [13]. General use of these assessment tools to measure the skills, outcomes and competencies developed from participation in PBSL requires further evaluation.

There is some indication that PBSL programs can help attract and retain a more diverse population of students in engineering [14, 15]. The popularity of these experiences with women and minorities is clear, but it is unclear if this leads to any overall benefits to recruiting or retention in engineering. There is virtually no quantitative assessment of the benefits of PBSL experiences to professional trajectory. It is not fully clear if companies view this as a way to attract and retain qualified engineers, value the unique skills developed in engineers with these experiences, etc. Therefore, the impacts in this area require further study.

FUTURE DIRECTIONS

Those directly engaged in PBSL seem universally convinced of its merit. However, further work is needed to allow us to forecast the value of PBSL efforts and the sustainability of doing PBSL in engineering education. A number of items need to be evaluated with respect to the skills that the students develop by their involvement in PBSL efforts. Answers to these questions can provide evidence that PBSL is of value for a sustainable engineering education across a career. The information captured in the previous summit along with that from future efforts, will allow the voice of the engineering education community to come together to more fully understand the benefits and limitations of PBSL.

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