AC 2009-2034: AN INTERACTIVE PANEL SESSION ON MEASURING THE IMPACTS OF PROJECT-BASED SERVICE LEARNING ON ENGINEERING EDUCATION

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Interactive Panel Session on Measuring the Impacts of Project-Based Service Learning on Engineering Education

ABSTRACT

Through both planned and organic developments, project-based service learning (PBSL) has emerged as a powerful force in engineering education over the past decade. This paper highlights efforts to provide much needed clarity to the design, implementation, and assessment of PBSL. In February 2009, a national Summit was held in Washington, DC to begin a year-long synthesis of wisdom, experience, and evidence among PBSL implementers and assessment experts. Following recommendations from the Summit a series of national dialogues is to be held to engage a broader community of PBSL scholars; the 2009 ASEE annual conference is one of four such venues.

1. MOTIVATION

American engineering capacity is in tumultuous waters. Enrollment trends are flat overall, and worse, declining when considering citizens only. Social dynamics may be further straining engineering education. Top concerns include the diminishing interest in engineering among American high school students, the continued lack of diversity within the field, and the retention of underrepresented groups within the engineering profession (NAE 2008). If engineering continues to poorly recruit diverse students (females and minorities) these trends will worsen in coming years (National Academies 2007). Added to these challenges, expectations of engineers are increasing, both academically and professionally (ABET 2007, NAE 2004). The response to date among institutions has often been along traditional academic lines of program development: need identification, program design, marketing, and implementation. One problem, of many, with this traditional approach to program design is its unresponsiveness to micro- and mega-trends affecting engineering education. There is little or no opportunity for stimuli external to the minds of university faculty to influence the development process. For example a recent study by the Council on Competitiveness (2008) presents four facets needed in modern engineering and science training to rebuild the American competitive advantage: (1) more integrative thinking, (2) more entrepreneurship, (3) more business-savvy service orientation, and (4) more computational skills. Few traditional academic programs have been re-designed to meet these, or similar, challenges.

Amidst these struggles, there is hope. National programs like Engineers Without Borders (EWB) and Engineers for a Sustainable World (ESW), and service programs created at the university level (e.g. international senior design programs, EPICS, etc.) seem to be delivering a new breed of engineers: culturally-aware, community-minded, entrepreneurial, service-oriented. While these programs cover a spectrum of features, the most popular share two in common: projects and service to a society, usually in a culture very different than the student's. Project-based service learning (PBSL) programs are defying most engineering education trends by exhibiting explosive involvement, diversity, and excitement for the profession.

Yet, these project-based service learning opportunities are complicated by their rapid grassroots development; much of the findings today on their impacts are anecdotal and qualitative. A few faculty have begun to assess their programs, but comprehensive and rigorous outcomes assessment strategies have not yet emerged. In addition, the numbers of students participating in

these activities at any one institution or program may be small, making it difficult to draw conclusions that can be generalized. Well-designed assessment re-defines the engineering program development process (Figure 1), providing multidirectional feedback to all key steps in the process. While there have been considerable efforts to understand these steps -- need for engineers, the design of engineering programs, the marketing of the engineering profession, and ways to offer engineering education -- there is remarkably little on the connective fabric: assessment. While considerable resources exist on assessing domestic and international education (Bolen 2007; LeCompte and Schensul 1999), there are few comprehensive efforts targeted to the specific needs of engineering (Atman and Sheppard 2008), and none when PBSL is added to the equation (Smith et al. 2005; Prince and Felder 2006). Coupled with the remarkable emergence of PBSL on so many campuses, a *Summit on Measuring the Impacts of Project-Based Service Learning on Engineering Education* was held February 19-20, 2009 to stimulate broad beneficial impacts for engineering in the United States. If the programmatic elements key to the success of PBSL can be identified, measured, and "genetically engineered" throughout engineering education, the profession and nation may face a brighter future.

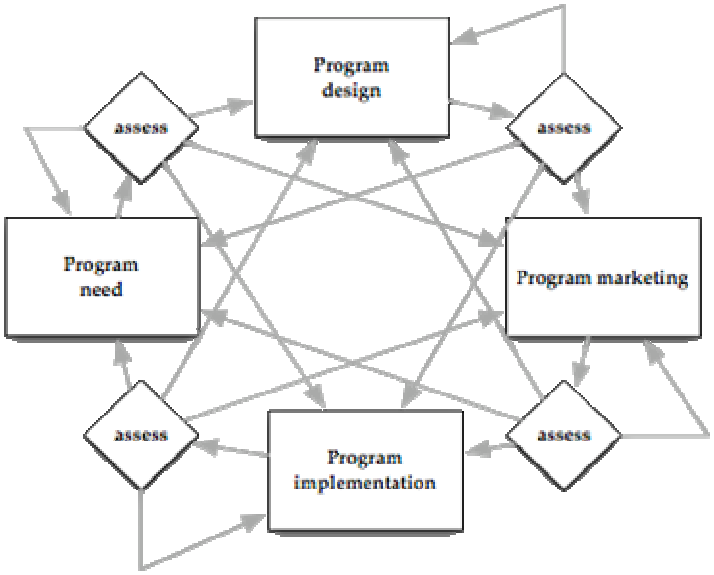

Figure 1. *Engineering program development catalyzed by meaningful assessment creates a framework to support student development*

2. OBJECTIVES

The goal of the Summit was to identify the impacts that project-based service learning is having on engineering education. Approximately twenty university education leaders with expertise in the administration or assessment of project-based service learning were invited to a one-and-a-half day Summit to contribute their experiences to this goal. Specific objectives included:

1) Creation of a pre-Summit report on the *State of PBSL in Engineering Education*
2) An examination of project-based service learning programs' participation demographics, trends, and outcomes; comparison of international (or culturally different) and domestic PBSL; comparison to project-based programs without service learning; comparison between similar programs

3) Review of assessment strategies capable of revealing outcomes of interest for project-based service learning programs
4) Creation of tangible next steps for assessment of PBSL

Two post-Summit objectives leverage interaction with the broader PBSL community of scholars at national meetings and conferences, including:

1) Feedback to the National Science Foundation regarding effective assessment strategies for project-based service learning programs, as well as elements critical to the success of these programs that could be infused into traditional engineering programs
2) Preparation of a report, *Measuring Impacts of PBSL on Engineering Education*, covering the assessment information and methods identified in this workshop for dissemination through national and international meetings and organizations

3. THE SUMMIT

The *Summit on Measuring Impacts of Project-Based Service Learning on Engineering Education* was held February 19-20, 2009 in Washington, DC. Twenty-two participants from eighteen institutions participated. Roughly half were assessment experts, the other half PBSL program experts. A diversity of universities were represented, private and public, large and small, research-oriented and teaching-oriented. All participants were required to complete several tasks ***prior*** to their arrival at the summit, including contributing to the pre-Summit report on the *State of PBSL in Engineering Education*. This collaborative report is based on a review of the scholarly literature and education conference proceedings, and supplemented information collected from the Summit participants. The report summarizes PBSL programs, assessment methods, and assessment findings and was used as a starting point for the Summit. Upon completion it will be made publicly available via the Summit web site.

The first day of the Summit (Table 1) focused on the identification of measurable impacts (Table 2) and relevant assessment methods (see Table 3 for some examples), and gap analysis. While student outcomes were the primary focus of the morning, impacts to faculty, institutions, and partnering communities were the focus of the afternoon. The day concluded with the identification of gaps in the ability to produce meaningful outcomes evidence.

The second day of the Summit (Table 4) shifted to implementation issues, starting off with case studies where assessment resulted in positive impacts. Participants then more deeply examined critical issues identified on Day 1: (1) what this kind of educational activity should be called, as it often does not fit the strict definition of project-based service learning, (2) what theoretical frameworks support these activities, and (3) what resources are needed to replicate successful models? The bulk of the second day centered on determination of next steps in order to translate the focused energy to tangible and beneficial consequences for as many stakeholders as possible.

The interactive session at ASEE will focus on elements identified at the Summit as rich grounds for further discussion: (1) gaps in the assessment of such programs, (2) the identity and framework of these programs, (3) identification of key research questions that should be resolved, and (4) establishment of a scholarly community for future collaborations. This input will shape the post-Summit, or final, report.

Table 1. *Agenda for first day of the Summit on Measuring the Impacts of Project-Based Service Learning on Engineering Education (February 19, 2009)*

Time	Session
8:00-8:30 am	**State of PBSL Highlights**. Organizers summarize the findings of what's being done in PBSL, as ascertained from the pre-Summit report research.
8:30-10:00 am	**Impacts**. Group identifies ways that PBSL could/should influence engineering education.
10:15-12:15 pm	**Assessment That Works**. Groups explore the assessment of students -- linking impacts to methods, identifying advantages and challenges.
12:30-1:30 pm	**Program Showcase**. Each participant has three minutes to share a project-based service learning (or assessment) program they lead.
1:30 - 3:30 pm	**Assessment That Works (cont'd)**. Groups explore assessment of anything other than students -- program leaders, courses and curricula, extracurricular programs, institutions, community partners.
3:45-5:30 pm	**Gap Analysis**. Group identifies what's needed but missing in the field of PBSL assessment.
7:00-9:00 pm	**Synthesize**. Summarize major discoveries of the day.

Table 2. *Identification of impacts that PBSL could have on engineering education*

Focus	Possible Impacts
Student Knowledge	Facts, procedures, connections, metacognition
Student Skills	Design (application, invention, creation), communication (speaking, writing, listening, visual), observing, needs assessment, resource assessment, problem definition and analysis, collaboration, interpersonal, intercultural, project management, impact analysis, feasibility, foreign language
Student Attitudes and Identity	Confidence, empowerment, engineer as citizen, ethics, culture, professional, disposition to serve, image of engineering
Other	Student recruitment and retention, diversity, faculty involvement, faculty promotion and tenure, university reputation

Table 3. *PBSL assessment methods identified at the Summit, grouped by impact focus area*

Focus	Possible Methods
Student Knowledge	Content analysis, concept inventories, tests, exams, journaling, community feedback, employer feedback, interviews
Student Skills	Reflection statements, self-assessments, community feedback, employer feedback, critical thinking assessment tool, photographs, videos, design artefacts, observation, oral presentations, performance review
Student Attitudes and Identity	Intercultural development inventory, community service attitudes scale, journaling, photographs, videos, peer review, conversation analysis
Other	Longitudinal studies, surveys, ethnographic study, interviews, focus groups, reflection

Table 4. *Agenda for second day of the Summit on Measuring the Impacts of Project-Based Service Learning on Engineering Education (February 20, 2009)*

Time	Session
8:00-9:00 am	**Success.** Case study presentations from participants regarding how assessment was used to create meaningful change.
9:00-10:00 am	**Pre-Design.** An examination of critical foundational issues that must be resolved for the PBSL community.
10:15-12:15 pm	**Action.** Based on workshop findings, this session will create concepts for critical next steps in understanding PBSL impacts on engineering education, and how to leverage PBSL successes to date. Research programs, multi-institution collaborations, assessment workshops, and conference panel sessions discussing the summit's findings are all possible.
12:15-1:15 pm	**Group Results.** Presentation of assessment results for summit participant group.
1:15-2:45 pm	**Catalyze.** Summarize major findings and next steps from the Summit.
2:45-3:00 pm	**Summit Assessment.** Participants provide feedback.

4. POST-SUMMIT ACTIVITY

The results of the Summit will be refined and disseminated in two forms: interactive conference sessions, and a final report. Panel presentations at national meetings (e.g. EWB-USA, ASEE, FIE, and EPICS) will be used to report preliminary findings and stimulate conversation to a wide range of audiences. The panel session, led by three Summit leaders, is structured to provide an overview of the Summit efforts and findings. After these short summaries, presenters will engage small breakout groups into guided inquiry of gaps and challenges identified at the Summit.

The presentation of the pre-Summit report and preliminary Summit findings will help provide guidance to common concerns aired at past ASEE International Division sessions, specifically that there is little evidence to support the many stories regarding the impacts of PBSL. The ASEE conference is a blend of assessment practitioners and researchers, and will be a rich audience to add input to the Summit efforts. The Summit topic fits well with the current ASEE President's platform to transform engineering education, diversity, and international experience.

Through the interactive sessions, a mailing list will be compiled for those interested in the final report, *Measuring Impacts of PBSL on Engineering Education*. The report will focus on the findings of the Summit and input from the interactive panel sessions at conferences. Whereas the pre-Summit report focuses on what has been done by the academic community, the final report will focus on what *works* and what needs to be done. The report will be made available in digital form via a special Summit web site by December 2009. As allowed by the budget, a limited run of paper copies will be created for dissemination to contributors in the knowledge mining activities for the report. Everyone on the mailing list compiled at the conference presentations will automatically be notified of the availability of the report when it is placed online.

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