Work In Progress - Developing National Survey Instruments to Assess Engagement in Best Instructional Practices and Attainment of Targeted Student Outcomes

Stefani A. Bjorklund¹ and Norman L. Fortenberry²
Center for the Advancement of Scholarship on Engineering Education (CASEE)
National Academy of Engineering

Abstract – This paper describes the process of developing two survey instruments – student and faculty versions – to assess the extent to which engineering students are engaged in identified “best instructional practices” in engineering education and achieving certain learning outcomes desired of engineering graduates. Drafts of the survey instruments will be completed by July 2005 and piloted at a single institution in spring 2006. At the conclusion of this project, CASEE intends to make the survey instruments available for use by engineering colleges nationwide.

Index Terms – assessment, instructional practices, student engagement, student outcomes

INTRODUCTION

More than ever, today’s engineering community is concerned with and attuned to improving the processes and outcomes of educating tomorrow’s engineers. To that end, the Center for the Advancement of Scholarship on Engineering Education (CASEE), the first operating center at the National Academy of Engineering, conducts on-going research and implementation activities to foster excellence in engineering education. CASEE’s initial focus has been on extending the research base on engineering education within engineering disciplines and translating research results into practice in classrooms, internship sites, and work sites.

In recent years, educators have been trying to improve engineering education by introducing and strengthening their commitment to assessing specific approaches to teaching, learning, and student learning outcomes. In their recent article, Olds, Moskal, and Miler describe the current movement toward the assessment of student learning outcomes within the engineering community, and assert that, as recently as 1997, the engineering community had relatively little experience in conducting outcomes assessment [1]. While researchers and educators have developed a number of classroom and college-wide assessments – oftentimes in preparation for an ABET accreditation visit – no national assessments exist to measure engineering student learning outcomes and the instructional practices that support those outcomes.

MEASURING STUDENT AND FACULTY ENGAGEMENT IN ENGINEERING EDUCATION

One of CASEE’s current projects, entitled Measuring Student and Faculty Engagement in Engineering Education, endeavors to create an integrated set of survey instruments to assess the extent to which engineering students are engaging in identified “best instructional practices” and are achieving certain learning outcomes desired of engineering graduates. CASEE is in the process of completing the fourth phase of developing the instruments; this paper describes Phases I, II, III, IV, and the next steps in the project.

I. Phase I: Identifying Desired Outcomes

ABET’s “3a through k” criteria identified 11 learning outcomes expected of engineering graduates. Based on a rigorous review of the literature, the first phase of our work revealed four additional student outcomes desired by the engineering education community. Although many other outcomes were mentioned in the literature, each of the four learning outcomes was cited at least 16 times, which was also the number of times the least cited ABET criterion was referenced in the same body of literature [2]. We suggest that an engineering graduate also ought to demonstrate 1) ability to manage a project (including a familiarity with business, market-related, and financial matters), 2) a multidisciplinary systems perspective, 3) an understanding of and appreciation for the diversity of students, faculty,
II. Phase II: Identifying Principles of Effective Teaching and Learning

During the second phase of this project, we identified 10 instructional principles (and related instructional practices) thought to promote 15 desired learning outcomes [4]. The identified best principles include:

1) Encouraging student-faculty interaction
2) Developing reciprocity and cooperation among students
3) Communicating high expectations
4) Providing prompt feedback
5) Using active learning techniques
6) Emphasizing time on task
7) Respecting diverse talents and ways of thinking
8) Building on correct pre-existing understandings; dispelling false preconceptions
9) Providing factual knowledge, facilitating understanding of the facts and ideas in context of a conceptual framework, and organizing knowledge that facilitates retrieval and application
10) Encouraging students’ motivation to learn

III. Phase III: Linking Instructional Principles to Learning Outcomes

Phase III of the project provided empirical evidence from and identified the gaps in higher education and engineering education literature that link instructional best practices with the 15 desired student outcomes in engineering education. For a thorough description of Phase III of this project, refer to [5].

IV. Phase IV: Focus Groups

Survey items were developed for two separate instruments, a faculty instrument and a student instrument, based on the outcomes of Phases I - III. CASEE staff then facilitated two 90-minute focus groups (a faculty group and a student group) on each of five CASEE-affiliated campuses (i.e., Colorado School of Mines, Massachusetts Institute of Technology, The Pennsylvania State University, Purdue University, and the University of Texas at Austin) in February and March 2005.

Focus group participants received a set of survey items to review prior to participating in the focus groups. During the focus groups, participants 1) discussed the meaning of each item to ensure that every reader interpreted the item in the same way and 2) suggested additional items and alternative ways to word certain items. Refining the items was an iterative process. CASEE staff refined the items as suggested by focus group participants between visits at each campus. There was a great deal of discussion in the first few focus groups and, as the items were refined, subsequent focus group participants believed the items were clear and relevant to the instruments’ intent.

Currently, the instruments are in the final phases of development, based on focus group participants’ feedback regarding the survey items. Final drafts of the instruments will be completed by July 1, 2005, and the results of the work will be disseminated to all engineering department heads in the U.S.

NEXT STEPS

CASEE intends to pilot the student and faculty instruments at one engineering college during the spring 2006 semester in order to determine the extent to which the survey items are reliable and valid and to refine the instruments before conducting a large-scale pilot at several universities. We will continue to make available the project’s details and progress at national conferences and on the CASEE website. At the conclusion of this project, CASEE intends to make the survey instruments available to engineering colleges nationwide, with the expectation that the instruments will provide baseline data to help individual engineering colleges and the national engineering community continue our quest for excellence.

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REFERENCES