Quality-Assurance Assessment of Learning Outcomes in Mathematics

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ABSTRACT

Student outcomes are statements that describe the attributes, skills and abilities that students should have and be able to do by the time of graduation. For quality assurance evaluation, these outcomes must be assessed. In order to evaluate the level to which an outcome is met, it is necessary to select some courses where the outcome is covered. Course objectives must be linked to the student outcomes and define in terms of measurable performance indicators. Using just two outcomes as an example, this paper presents a systematic approach to assess directly and indirectly student learning outcomes in Mathematics through differential equation course, by define appropriate measurable performance indicators, build up assessment rubrics, collect and analyze data for possible recommendations and improvement.

Keywords: ABET, Assessment, Course Objectives, Direct and Indirect Assessment, Performance Indicator, Rubrics, Student Learning Outcomes

INTRODUCTION

Academic accreditation is an official recognition and validation that an institution in higher education is assessed positively against set of standards and criteria. There is two types of academic accreditation: institutional and specialized accreditations. The first one accredits the institution as whole and not a specific program in the institution as the specialized one do. This paper fits in the second type of accreditation. One of the factors of the importance of the accreditation is involving the community (student parents, employers…) in the process of assessment. Accreditation benefits students, instructor and the community. Accreditation is evidence that an academic program that leads to a degree has met certain standards essential to generate graduates who are ready to enter their professions. Students who graduate from accredited universities have access to enhanced opportunities in employment; licensure (i.e. PE), registration and certification (i.e. IIE society membership); graduate education and global mobility (student transfer acceptance, applications for graduate schools).

DOI: 10.4018/IJQAETE.2015040104
Accreditation Board of Engineering and Technology (ABET) is a non-profit and non-governmental accrediting agency for academic programs in four disciplines: applied science, computing, engineering, and engineering technology. As of November, 22 2014 ABET accredits more 3,400 academic programs at nearly 700 colleges and universities in 28 countries (USA and others 27 countries). ABET provides specialized, programmatic accreditation that evaluates an individual program of study, rather than evaluating the entire institution.

ABET accreditation process and procedures are totally voluntary and achieved through a peer review, provide assurance that a college or university program meets the quality standards established by the profession for which the program prepares its students. ABET in the USA is recognized by the Council for Higher Education Accreditation (CHEA) and by mutual agreement with many countries like Canada and Australia.

In this paper, we focus on just two outcomes as an example, and discuss the approach we used to develop an assessment methodology in mathematic courses, conform with ABET accreditation standards (ABET, Inc., http://www.abet.org/).

**LEARNING OUTCOMES**

ABET requires each program seeking accreditation to develop a clear set of student learning outcomes (referred as criterion 3), collect direct (involves looking at student performance by examining samples of student work) (http://cms.skidmore.edu/assessment/Handbook/direct-v-indirect-assessment.cfm) and indirect assessment (information about student learning by looking at indicators of learning other than student work output. This assessment approach is intended to find out about the quality of the learning process by getting feedback from the student or other persons who may provide relevant information. It may use surveys of employers, exit interviews of graduates, focus groups) (http://www.santarosa.edu/slo/assets/Methods-of-Assessment.pdf) data through several courses and surveys, determine the degree to which the outcomes are achieved, and use the results of the evaluation to improve the program. The ABET web site has several documents related to assessment (Breidis, 2014).

Criterion 3 (Student Outcomes) of the ABET Criteria -for accrediting lists- is a set of characteristics that each program must have documented student outcomes that prepare graduates to accomplish the program educational objectives of the institution. As we mentioned, student outcomes describe the attributes, skills, and abilities that students able to do upon graduating from the program. Table 1 shows the eleven student outcomes define used by ABET (well known by “a” to “k”). Every core course in the curriculum includes set of course learning outcomes, the outcomes are linked to the student outcomes (i.e. “a” to “k”). Instructors are expected to measure those outcomes using direct and indirect assessment for the courses they have taught at the end of the semester:

**ASSESSMENT TYPES**

Assessment is the process of gathering data. More specifically, assessment is the ways instructors gather data about their teaching and their students’ learning (Hanna & Dettmer, 2004). Broadly speaking, there are two types of assessment: formative and summative assessment. Formative assessment provides feedback and information during the instructional process, while learning is taking place, and while learning is occurring. Formative assessment measures student progress but it can also assess your own progress as an instructor. For example, when implementing a new activity in class, you can, through observation and/or surveying the students, determine whether
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Understanding Students' Use of Online Learning Tools through Online Learning Readiness Assessment
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