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Virendra Varma, Missouri Western State University

Virendra K. Varma, PhD, PE, F.ASCE, is Professor of construction and Chairman of the Department of Engineering Technology at Missouri Western State University. He served as a Member of the TAC/ABET Commission from 1998-2003. He is a former President of ACI-Missouri, and a former President of the NW Chapter of MSPE (of NSPE). He has published and presented extensively. He is the Chair of the Construction Engineering Division of ASEE. He has held highly responsible roles in design and construction industry ranging from a project engineer/manager to a partner. He is an Instructor of ATC-20 course on Structural Assessment of Vertical Structures.

Internally-Developed Departmental Exit Exams v/s Externally-Normed Assessment Tests: What We Found

Abstract

Prior to 1995, the Department of Engineering Technology at Missouri Western State University was engaged in the exit testing of its graduating students using the in-house developed exit exams, and reviewed by faculty from a neighboring university, to assess the content knowledge of its students. The system worked fine but in the mid 1990s with emphasis being placed on outcomes assessment using externally-normed tests such as FE/EIT, Missouri Western also adopted externally-normed tests such as AIC (American Institute of Constructors), NICET (National Institute for Certification in Engineering Technologies), and SME (Society of Manufacturing Engineering) for its programs in construction, electronics, and manufacturing respectively. Students' performance in these nationally-normed tests did not match the competence levels reflected in the grades of the students. Soon it was discovered that the content of these external tests, especially in AIC and SME tests, was not aligned with Missouri Western's curriculum in certain areas. A decision was made to revert back to the in-house assessment exams in 2003, and performance of students since the reversal in the exit examination policy, seems to have improved. This paper addresses the key issues of the in-house developed departmental exit exams v/s externally-normed assessment tests and compares the pros and cons of the two different assessment systems. Recommendations are made to determine the exit examination strategy in the light of the objectives of the individual programs.

Introduction

Education is all about student learning. In order to insure that student learning has taken its roots, and the student has learned, educators have to do some kind of testing. In actuality, testing of student learning falls under a broad term, 'Assessment.' Assessment can have many elements and forms of testing. Before a student gets out of the halls of learning from the schools of higher education, educators want to make sure that the student, soon to be called a graduate, has mastered the basic knowledge of his/her educational program and has met the goals and objectives of the program. According to the TC2K accreditation criteria of the Accreditation Board for Engineering and Technology¹, "Achievement of goals must be demonstrated through a variety of methods, including student outcomes assessment." One way of demonstrating such achievement of goals is by requiring students to demonstrate proficiency in nationally-normed tests, or some other form of departmentally-developed exit examinations.

Exit testing of students is gaining acceptance at many institutions of higher education because of calls for accountability of education and mandatory assessment requirements of regional accreditation agencies. Exit exams can be internally-developed departmental exams or externally-normed (a.k.a. nationally-normed) tests such as FE/EIT exams. This paper addresses the key issues of the internally-developed departmental exams and externally-normed assessment tests. It compares the pros and cons of the two. Based on the direct knowledge gained by the author from administering internally-developed exit exams and externally-normed tests such as

AIC (American Institute of Constructors), SME (Society of Manufacturing), and NICET (National Institute for Certification of Engineering Technicians) tests, conclusions have been drawn to link program assessment to program outcomes, and overall educational objectives. This paper reflects on the lessons learned using the two very different types of assessment tests.

Objectives of Missouri Western’s ET Programs

Since our programs are accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology, we have a vested interest in aligning our objectives and outcomes with the TC2K accreditation criteria. The outcomes of our programs are in tune with the ABET’s TC2K Program Outcomes (a-k). Each of our programs also satisfies the Program Criteria as provided by the lead technical societies such as ASCE, IEEE, SME, etc. As such, our courses in each program prepare graduates with necessary technical and leadership skills.

Internally-Developed Exit Examinations

Based on the written program outcomes which are a part of our continuous quality improvement plan at Missouri Western, and which describe what our students are expected to demonstrate at the time of graduation, the content of the exit examination is designed to test the student learning accordingly. The following is an example of a 3-hour comprehensive open-book, 100-question multiple-choice exit examination in construction. The questions were prepared by three construction faculty in the department. The questions were prepared for each of the required courses in the curriculum with the exception of general studies, mathematics, and science courses. The questions were initially reviewed by faculty at two neighboring institutions.

Course/Subject Area	No. of Questions
Construction Materials	10
Concrete and Asphalt Technology	5
Surveying	10
Engineering Mechanics	10
Strength of Materials	5
Mechanical and Electrical Systems	10
Construction Estimating	10
Structural Analysis	5
Fluids and Hydraulics	5
Steel and Wood Design	5
Concrete and Masonry Design	5
Soil Mechanics and Foundations	5
Construction Management	5
Construction Planning and Scheduling	5
Engineering Economics	5
Total	100

The examination questions were modeled after the Fundamentals of Engineering Exam, commonly called the FE or EIT (Engineer-in-Training). A similar exit examination was developed for Electronics program area.

The success rate of passing in construction was about 70 %, and in electronics was about 60%. As a policy of the institution, students at Missouri Western are required to take the departmental exit examination, but are not required to pass it to graduate from the institution. As such, students are not motivated to take the exit exam nor are motivated to demonstrate their learning over the period of four years. Since the exit examination outcome has no bearing on their graduation, students are less inclined to prepare for the examination.

The External Nationally-Normed Examinations

Prior to 1995, all students in construction at Missouri Western were required to take an internally-developed but externally-reviewed exam. Students of electronics took a similar exam in their specialty area. Though the performance of students was less than desirable, it did give information to faculty to make changes in their instruction to enhance student learning in areas where change was needed. Then in the mid 1990s, there was a movement toward the new ABET criteria for Engineering Accreditation, now called EC2000 criteria, and emphasis was placed on outcomes-based goals and objectives. Educators became enchanted with FE or EIT exams to measure program outcomes. This trend also affected the engineering technology programs with the subsequent adoption of TC2K criteria for accreditation of engineering technology programs. Caught in the desire to serve the students in the best possible manner, the ET department faculty decided to adopt the AIC test for construction students, NICET test for electronics students, and SME test for manufacturing students. An example of AIC Test is given below to make a comparison with the previously-discussed Missouri Western’s in-house exit examination for construction program area. The distribution of the content for the Construction Fundamentals for the Constructor Qualification Examination² is as follows:

Knowledge Area	% of EXAM
Communication Skills	6.0%
Design/Engineering Concepts & Associated Mathematics and Sciences	9.0%
Management Concepts and Philosophies	4.5%
Construction Materials & Methods	10.5%
Estimating, Plan Reading, Bid Process, Codes, Insurance and Ability to Establish Work Methods	15.0%
Budgeting/Cost Accounting, Cost Control, & Cost Closeout	11.0%
Scheduling and Schedule Control	17.0%
Safety	8.0%
Construction Surveying & Project Layout	4.0%
Project Administration	15.0%

The above Associate Constructor examination consists of ten major knowledge areas. The AIC test questions relate to the knowledge required of practicing constructors at the entry level.

These AIC test questions also relate well to the educational objectives of most of the construction programs across the United States. However, there is not a 100% fit of the AIC test objectives with educational objectives of programs at various institutions. At the time the AIC test was administered to students in the late 1990s, the construction program at Missouri Western leaned more toward civil engineering technology and less toward construction management. Hence the overall performance of students on the AIC test did not reflect the true ability of students. Even on the national scene, in April 2003, out of 654 candidates tested, only 320 passed, giving a passing rate of 48.93%.

Students of electronics and manufacturing also did not produce desirable results in NICET and SME examinations. At this time it became necessary to compare the examination contents of externally-administered and nationally-normed AIC, NICET, and SME tests against the educational objectives of the engineering technology programs at Missouri Western. It was interesting to note that some of the non-traditional manufacturing students who had worked in the manufacturing sector did quite well compared to traditional students who had no work experience. The examination, it was discovered, did not quite align with the objectives of our manufacturing program. Also, since the external exams did not mirror the objectives of our ET programs in a broad sense, decision was made to go back to the updated and revised in-house exit exams for all the specialty areas.

Lessons Learned in Administering Exit Exams

The main purpose of an educational program is to prepare well-prepared and well-grounded students who are fundamentally strong, can think critically, and are able to solve problems. If they can not apply and solve problems, the whole purpose of their education is defeated. In this context, it is important to re-visit the ABET accreditation criteria for Accrediting Engineering Technology Programs, and reinforce what the definition of Program Outcomes is. “Program Outcomes are statements that describe what units of knowledge or skill students are expected to acquire from the program to prepare them to achieve the program educational objectives. These are typically demonstrated by the student and measured by the program at the time of graduation.”³ In order to satisfy program outcomes, exit examinations are necessary to gage the student learning whether it is done via externally-normed examinations such as AIC, NICET, SME, FE/EIT, etc., or by administering exit examinations that have been prepared in house by departmental faculty.

What we learned by reverting back to the internally-developed exit exams was that externally-normed tests are not always the best route to assess student knowledge due to the following reasons:

1. The emphasis of your educational goals and objectives may not match the content of the nationally-normed tests.
2. Many employers of ET graduates do not emphasize certifications from AIC, NICET, SME, etc. but it is advisable to obtain FE/EIT credentials, if allowed, at an early date. Many states do not allow ET graduates to take the FE/EIT examination, the State of Missouri being one of those that does not allow. With some work experience, some states do allow ET graduates (such as Kansas and Nebraska) to take the FE/EIT test.

Graduates of ET programs should contact the State Registration Board for Professional Engineers in their home state for further information.

3. It is extremely important to motivate students to take the exit examination with full preparation. Half-hearted attempts by students to pass the exit examinations not only hurt their own morale and self-esteem but it reflects poorly on the department.
4. Review sessions by department faculty before the exit examinations considerably improves student performance on the exit examination.
5. Let students pay for the external national tests themselves. They will have a much better chance to succeed because they will have a higher stake.

Conclusion

Every ET program must have goals that are in tune with the goals of the institution. And every program must have well-defined educational objectives and clearly-stated outcomes. Assessment and evaluation are at the heart of the continuous quality improvement plan for a program or a department to succeed. It is through assessment that we measure student learning. Whether that student learning is measured through an internally-developed exit examination, or a nationally-normed test, the important conclusion that we draw from an assessment test is that we learn from the inadequacies of our students, and make relevant instructional changes to help future students learn better. The general implication of this particular comparative study of internally-developed exit examinations and externally-normed assessment tests is that every institution should use assessment tests that provide the best relevant data for the improvement of their programs and student learning in their programs and their institution. Sharing the information that we found through trial and error over a period of more than a decade may save other institutions a great deal of time and effort to come to a similar conclusion.

Bibliography

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