
AC 2011-2810: EET NATIONALLY-NORMED ASSESSMENT EXAM: FIRST EXPERIENCES AND THEIR RELATIONS TO ABET OUTCOMES

Ilya Grinberg, Buffalo State College

Ilya Grinberg graduated from the Lviv Polytechnic Institute (Lviv, Ukraine) with an MS in EE and earned a Ph.D. degree from the Moscow Institute of Civil Engineering (Moscow, Russia). He has over 30 years of experience in design and consulting in the field of power distribution systems and design automation. Currently he is Professor of Engineering Technology at Buffalo State College. He is a Senior Member of IEEE, and a member of ASEE

Ronald E. Land, Pennsylvania State University, New Kensington

Ronald ("Ron") Land is an Associate Professor in the School of Engineering Design, Technology & Professional Programs (SEDTAPP), a department of the College of Engineering at Penn State University. He works at Penn State's New Kensington campus where he serves as the campus' representative to the College of Engineering and is Program Coordinator for the baccalaureate degree program in Electro-Mechanical Engineering Technology (EMET). His main teaching responsibilities include courses in electrical machinery, basic electrical circuits, and linear electronics. He is also one of three faculty responsible for organizing and conducting the capstone design course for the EMET program.

Ron received a baccalaureate degree in Electrical Engineering from the Georgia Institute of Technology in 1971 and an M.S. degree in Electrical Engineering from the California Institute of Technology in 1973.

Thomas M. Hall, Jr., Northwestern State University

Tom Hall has retired from Northwestern State University having served for ten years as Professor and Head of the Department of Engineering Technology. He was a member of the management team that drove the development of the EET Assessment Exam discussed in this paper.

Kelly Ann Lacroix, Society of Manufacturing Engineers

One SME Drive PO Box 930 Dearborn, MI 48121 313-425-3230

Steve Macho, Buffalo State College

Steve Macho is currently an Assistant Professor of Technology Education for SUNY at Buffalo State College. He completed a BS at St Cloud State University, and M.A. & Ed.D. in Technology Education at West Virginia University. Steve is a Minnesota farm boy who has been involved in technology his entire life. He has worked at Los Alamos National Laboratory, New Mexico Highlands University, and on various grants funded by the US Department of Education, NASA, and Microsoft. He became a member of the Oxford Roundtable in 2008 and presented at the roundtable again in 2010. Dr Macho recently began to collaborate with the China National Institute for Educational Research on matters of technology, engineering and design education.

Mike Eastman, Rochester Institute of Technology (CAST)

Mike Eastman is Department Chair and Professor of Electrical, Computer, and Telecommunications Engineering Technology at Rochester Institute of Technology. Mr. Eastman spent six years as a hardware design engineer with Intel corporation before entering academia to specialize in embedded systems design. Most recently he has been involved in curriculum development and academic calendar conversion at RIT. He has a BS in Electrical Engineering Technology and a MS in Computer Science from RIT.

EET Nationally-Normed Assessment Exam: First Experiences and Their Relations to ABET Outcomes

Abstract

In 2010 the first production run of the EET Nationally-Normed Assessment Exam developed by IEEE, SME, and Electrical and Computer Engineering Technology Department Heads Association (ECETDHA) took place with 19 different programs participating. The intent of such an exam was to provide programs with a reliable direct assessment tool to be used in the continuous improvement process within the realm of ABET accreditation¹. Major emphasis in preparation and development of this exam was given to competencies in core technical areas of electrical and electronics engineering technology. It is clear that such an important assessment tool provides objective measurements of students' competencies in these areas as well as allows for benchmarking and identifies the areas of programs' improvements.

Organizing and administering the EET exam revealed several opportunities for expanding the value of the test beyond that of simply an objective test of students' technical competence. It became clear that the exam also provided strong indications of students' application of several essential non-technical skills.

Students volunteering for the exam displayed characteristics of team work (study groups during preparation for the exam), engagement in life-long learning, as well as commitment to quality, timeliness and continuous improvement. These important outcomes, if not initially intended, manifested themselves during the process.

The paper will concentrate on the importance of the exam in assessing continuous improvement metrics from a technical perspective. Additionally, the potential opportunities to connect the exam to some of non-technical skills associated with employability are also investigated. Finally, faculty observations and student experiences will be described. The paper incorporates quantitative and qualitative data organized in mixed method study design.

First Experiences

Two EET programs from State University of New York, College at Buffalo (Buffalo State) and Rochester Institute of Technology (RIT) participated in the study of the first production run of a nationally-normed EET assessment exam. The exam was administered in spring 2010 and provided programs with an array of data suitable for use in ABET-related assessment processes. Buffalo State underwent a TAC of ABET visit in the fall of the same year and successfully used the results of this exam to demonstrate achievement of "appropriate mastery of the knowledge, techniques, skills, and modern tools of the discipline" (Criterion 3a) as well as an ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology (Criterion 3b). Both programs have also documented areas of potential developments as part of the continuous improvement process. Identification of these areas resulted from comparison of exam results for student groups as a whole with national average results in corresponding areas. Obviously, subsequent runs of the exam will enable EET programs to

compare results not only with national averages but with the results achieved by their own programs in previous years. The exam covers technical competencies in such core areas as basic concepts of electricity, AC circuit concepts, basic circuit analysis methods, digital electronics, analog electronics, microcontrollers and microprocessors, and instrumentation and measurements. These areas fit well in the curricula of both institution and are fundamental for further study in specialized parts of their programs. In program administrators' opinion, exam structure, comprehensiveness, rigor, and breadth are well designed and are appropriate for students of EET programs.

As anticipated, the exam clearly provided a direct assessment tool for outcomes 3a and 3b of the ABET assessment criteria. Assessment results were evaluated by program faculty, and areas that require attention were identified. The examination analysis report provided by the SME proved very useful and allowed comparison of the test results to the national average score. Such comparison by the program faculty and the analysis of results fit well in existing continuous improvement processes.

A significant benefit of the exam is that it allows a venue for accelerated data collection within the continuous improvement process. In the traditional data gathering process, direct measurements are being collected over the period of several semesters from a variety of courses covering the core EET areas. The assessment exam provides program administrators with additional assessment data collected in a shorter time frame (within one term or one academic year depending on the frequency of administering the test). As a result, programs can analyze more data sets and make more competent decisions for program improvements and/or changes.

In addition to directly measured outcomes 3a and 3b as related to core areas of EET programs as a whole, it was deemed important for program administrators to perform indirect assessment in the form of a student survey to identify the success of the test from the students' perspective. Seventeen students responded to the survey with 11 students from RIT and 6 students from Buffalo State. Due to relatively small number of respondents the authors consider this survey to be a pilot study. At the time of the writing the number of students who volunteered to take exam in May 2011 almost doubled and survey results bank will be more comprehensive during presentation of this paper at the conference.

The survey question addressed the students' view of the fairness and validity of the exam as a measure of their technical knowledge. Seventeen respondents rated the statement: *I believe this examination is a fair and valid measure of my technical competencies*, with an average of 4.00, and a standard deviation of 0.970. These results are illustrated in Figure 1. Most respondents indicated their belief that the exam was a fair and valid measure of their technical competencies.

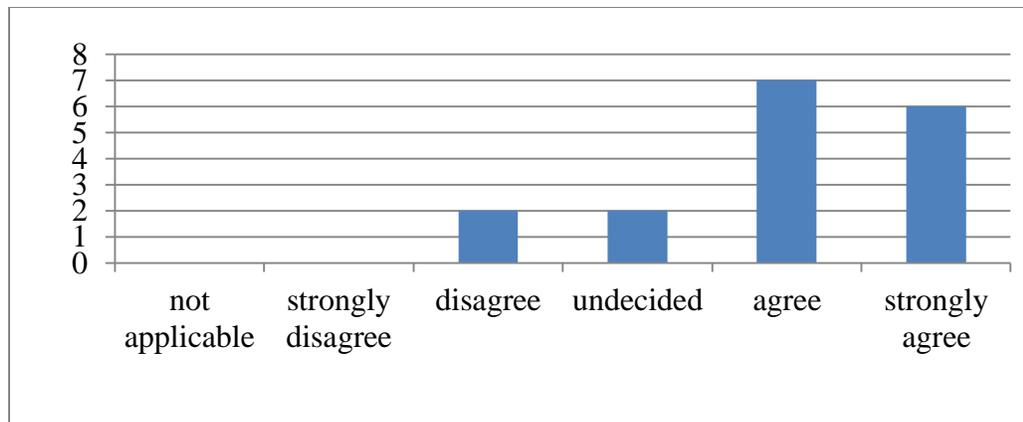


Figure 1. Survey question: I believe this examination is a fair and valid measure of my technical competencies

Discussion of student comments

Three students participating in the examination process provided written comments in response to this question. The comments indicated their belief that the exam was a good measure of technical competencies. For example, one comment indicated that “The SME EET exam was undoubtedly an honest assessment of technical knowledge specific to our field.”

Two out of three students who provided comments expressed concerns with the time allowed on the exam: “Many of the problems on the exam were of the sort that, given sufficient time, each one of us could have solved them.” Another comment was “The format of the exam (over 100 questions in the time span of approximately 3 hours) is rapid-fire multiple choice, and though many problems could be worked out, the time allotted does not allow it.” This comment continues with appreciation of the rigor of the exam relative to time allotted: “Because that amount of time does not fit into the exam's structure, the students have to rely on a deeper understanding.” One student commented: “I found when given the option to bring materials to reference I could not help but check to make sure all my answers were right before moving onto the next question. This of course is not the best method for a timed test and resulted in not providing an adequate view of what I know, rather proved I am too picky to do anything in a timely manner as I must make sure everything's right. Overall I really liked this test and believe it would be a great benchmark for students. The test could be utilized by students to find what subjects they need to focus on.”

Another common strand in the comments was the request for supporting materials to aid in preparation for the exam. One comment stated the request for a study guide... “comes from my belief that an exam of this type should not be just a hurdle approached blindly with a reliance on self-directed study.” Another comment was, “I think that a proper study guide would include a set of problems on each topic which comprise the most essential aspects of that subject.”

A few other comments were also revealing. One comment of interest was: “The topics covered, and the depth in which they were explored, was almost exclusively the domain of two-year EET programs. It is my belief that I would have performed better had I taken this exam after my last semester in a community college's EET program (and I scored highest in the group). It is a

proper examination of our discipline's "first principles", then, but worthless in gauging our performance in Control Systems, Power Systems, etc."

This last comment reveals the need for an additional assessment exam dealing with specialized topics in upper division of EET programs. What is even more important, this call comes from a student.

Student recruitment

For each of the last two years, all graduating seniors in the Electrical Engineering Technology (EET) program at Buffalo State and RIT were encouraged to take the EET assessment exam (RIT participated in a pilot exam as well as in the first production run). The exam is not an academic requirement, and is offered close to graduation when students are very busy. Because of this, it is expected that a relatively small number of students will actually participate in the exam. The EET program realizes the importance of this opportunity to collect meaningful data, and has fully funded the cost of student participation in the exam. Additionally, in order to incentivize students each year, the department has offered two prizes, one for the highest score, and one to be drawn randomly from all participants in the exam. This approach was chosen in order to attract a wide range of students; not only the highest achievers. Additionally, students were encouraged to take the exam seriously, but not too seriously. They were told that studying was not necessary, but they should be well rested and prepared to take an examination.

Approximately 43% of graduating seniors in the Electrical Engineering Technology program at RIT have taken the exam over the last two years. 15 students took it as a pilot test in 2009 and 11 students in 2010. This level of participation seems reasonable given the incentives provided by the institution.

At Buffalo State seniors were encouraged to participate in the exam and as an incentive were offered an independent study course targeted towards preparation for the exam. The program did not provide any funding, and students paid the exam fee individually. Seven students participated, and this number is also reasonable considering the size of the program.

Unintended outcomes and additional benefits

While the EET assessment examination clearly provides a mechanism to assist in the assessment and evaluation of technical competencies, there may be secondary opportunities to evaluate non-technical or employability skills.

The fact that the exam was not required by the programs and students volunteered to take it, suggested significant level of commitment from students. This commitment could be mapped to Criterion 3h, *recognition of the need for, and an ability to engage in lifelong learning* and may include the following performance indicators^{2,3}:

- Recognition of the value and participation in professional societies
- Recognition of the value of periodic examinations
- Recognition of the value of professional licensing
- Recognition of the value of certification exams

In addition, Criterion 3k, *a commitment to quality, timeliness, and continuous improvement* can be represented by the following performance indicators:

- Practicum, internship, field experience, co-op experience
- Work on a research project with a faculty member outside of course or program requirement
- Culminating senior experience (capstone course, senior project, comprehensive exam, etc.)

Strict time constraints of the exam also suggested including timeliness as a factor.

Program outcomes 3h and 3k were chosen to illustrate relevance of the EET test as an indirect tool because the above mentioned performance indicators identify the value of examinations (periodic, professional, certification, comprehensive, etc.) in student's academic and professional learning experience.

These important non-technical outcomes, also known as employability skills, are difficult to measure directly. Therefore, several indirect tools to assess achievement of these outcomes are desirable. The EET assessment exam may well provide an additional benefit to satisfy such demand. It is not designed to provide direct assessment of employability skills but may be used as evidence in indirect assessment if the programs will choose to do so.

Conclusions and recommendations

As mentioned before, the exam met program administrators' expectations from the overall program perspective. It does what it promised and does it well. Programs receive comprehensive reports, although supplementary information with national averages in each area of the exam in addition to a total national average score may be very useful.

A nationally normed exam of this type was the first real experience for EET students with the test similar in format to professional certification exam that many of them will encounter in their careers. Students' comments indicate that they were not psychologically ready for an exam of this type and expected more of a regular class-setting examination with sufficient time to solve problems and achieve relatively high numeric grade. Some students were disappointed with results although there were no failures and both programs achieved group results higher than the national average. Perhaps, an explanation document could be prepared and posted on the SME web site explaining the rigors of standardized exams of this caliber and expectations associated with them. Otherwise, bruised confidence may result unnecessarily.

Besides successful attainment of the exam original intent (to provide direct assessment of program outcomes 3a and 3b and to serve in programs continuous improvement processes) more opportunities may exist for programs to utilize this exam as evidence of achieving performance indicators associated with employability skills. It may make administering such an exam even more attractive for programs that otherwise have difficulty in collecting sufficient and credible evidence of achieving desired outcomes.

For four-year programs development of assessment exam of similar rigor and professionalism covering specialty areas will be very beneficial. It will close the gap in direct assessment of technical competencies in discipline-specific areas.

Bibliography

1. Ronald Land, First Use Of A Prototype Nationally-Normed Assessment Exam for EET Programs, *Proceedings of the American Society for Engineering Education*, Louisville, KY, June 20 – 23, 2010
2. Gloria Rogers. Assessment Planning Matrix.
<http://www.abet.org/assessment.shtml#Tools%20to%20help%20you%20work%20through%20the%20assessment%20process> (accessed January 19, 2011).
3. ABET Criteria for Accrediting Engineering Technology Programs Mapped to 2008 NSSE Survey Questions. National Survey of Student Engagement.
http://nsse.iub.edu/institute/documents/accred/special2008/ABET_ENGTECH_final.pdf (accessed January 19, 2011)