AC 2010-116: CONTINUOUS QUALITY IMPROVEMENT PROCESS FOR APPLIED ENGINEERING TECHNOLOGY PROGRAM AT DREXEL UNIVERSITY

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Continuous Quality Improvement Process for Applied Engineering Technology Program at Drexel University

Abstract

The Applied Engineering Technology (AET) Program at Drexel University recognizes the need for periodic assessment and evaluation to ensure that AET is achieving its mission. This paper describes how the assessment and evaluation of Program Educational Objectives and Program Outcomes leads to an annual "Continuous Quality Improvement (CQI) Report" for the AET Program. The presented methodology demonstrates how assessment data is compiled, how the data is analyzed, and how the analysis is translated into an understanding of the program, including required actions to improve the program. The recommended actions are incorporated into the program's future assessment and evaluation procedures to validate the program's improvement. Useful templates for collecting and storing assessment data are described and examples of histograms are presented that demonstrate the assessment results. The information is summarized in a series of standard "Student Learning Outcomes at the Program Level" that present the evaluated results with any needed actions that were taken. This information is also tied to the next cycle of the evaluation process.

Introduction

The undergraduate Applied Engineering Technology (AET) Program started at Drexel University in 2002. The program prepares students for high-level employment in an industrial environment. The program is comprised of three concentrations: Electrical Engineering Technology, Mechanical Engineering Technology, and Industrial Engineering Technology. The students learn in a hands-on environment by using state-of-the art laboratories that replicate real-life industrial processes and techniques. Students learn to work on multidisciplinary teams and solve technical problems by applying principles and theories of science, engineering, and mathematics.

This paper describes how the assessment and evaluation of Program Outcomes are conducted to validate that students are achieving the Program Educational Objectives (PEO)[1]. In the first section, an internal process is presented in detail, which leads to an understanding of how program outcomes are translated into measurable performance criteria with assessment rubrics. Students and facilities are assessed to validate the program educational practices and strategies based on the collected assessment evidence accumulated for analysis[2]. This evidence is interpreted to gain an understanding of the program and results in a continuous quality improvement of the program through specific implemented actions[3,4]. In the second section, the process for establishing and maintaining Program Educational Objectives is presented. The major constituents' role in this process is to assess and evaluate these PEOs and approve any changes.

Continuous Quality Improvement Process

The CQI process is based on Program Outcomes that are consistent with the AET Mission and the Program Educational Objectives. A list of outcomes from a through k is designated by the Accreditation Board of Engineering and Technology (ABET). The Drexel's AET program is relatively new, so the ABET list of outcomes was adopted unchanged. In general, the CQI process requires collection of assessment information from all aspects of the program that are scored to measure performance criteria[5,6,7]. The assessment information is evaluated and a CQI of the program report is produced annually, which implements program improvements through recommended actions[8]. The program's goal is to score an overall average of 3.0 or better (in scale from zero to five) which indicates that students meet all Program Outcomes (See Figure 2). A flow chart titled Continuous Improvement of the Program (Figure 1) depicts the details of this process.

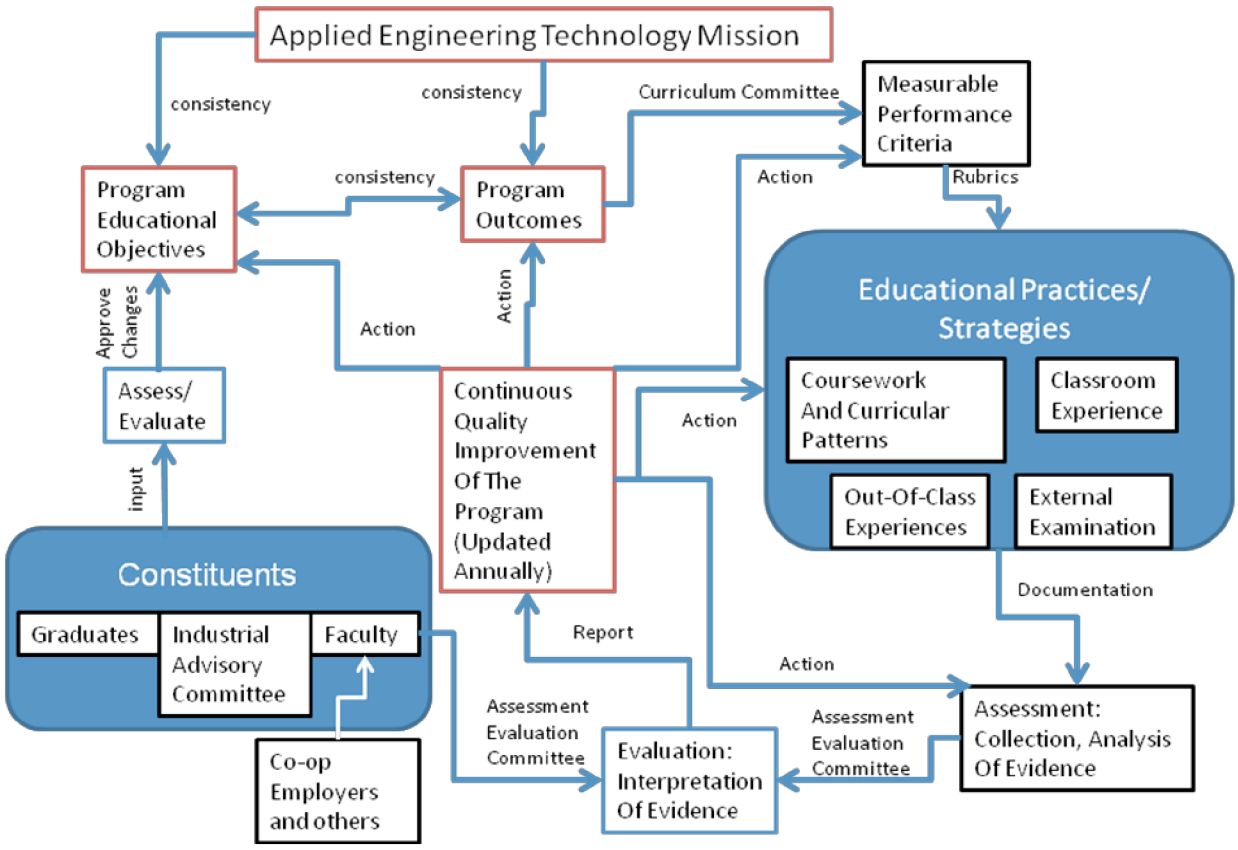


Figure 1. Continuous Improvement of the AET Program.

The CQI report may recommend changes to the Program Outcomes[9] consistent with ABET requirements. As recommended by this report, the AET Curriculum Committee may change the

Performance Criteria and the corresponding assessment rubrics[5, 6, 7, 10]. In a like manner, changes can be made to each successive block in the CQI flow chart (Figure 1).

At the end of each term, the assessment information in the form of scored documents relating to individual student performance is collected from course instructors and CO-OP employers. A typical Assessment Sheet for a course is presented in Figure 2. This information is summarized in Course Assessment Summary Sheets and Survey Assessment Summary Sheets. Samples of these summary sheets are presented in Figure 3 and Figure 4.

MET 209 - Fluid Power – Goodwin College - Drexel University

Performance Criteria Assessment

Student Name: Joe Student

Instructor: Dr. Robert Instructor **Term: Winter 200825** **Campus: Drexel**

Instructions: Circle one description that best represents your evaluation of each Outcome/Performance Criterion. Descriptions are found in either the **Exceeds, Meets, Minimally Meets, or Fails to Meet** columns.

Outcome/Performance Criteria	Exceeds (5)	Meets (3)	Minimally Meets (1)	Fails to Meet (0)	Score
Outcome k. /Performance Criterion 2. Manages time and specifically plans for general review of work to improve results.	Manages time effectively and specifically plans for general review of work to improve results. Implements an improvement plan.	Manages time well and specifically plans for general review of work to improve results.	Sometimes fails to manage time well or sometimes does not set time for general review.	Manages time poorly and often does not set time for general review of work to improve results.	**5**

Figure 2. Course Assessment Sheet

Outcome Letter: a

Course Type: EET | Course Number: 202

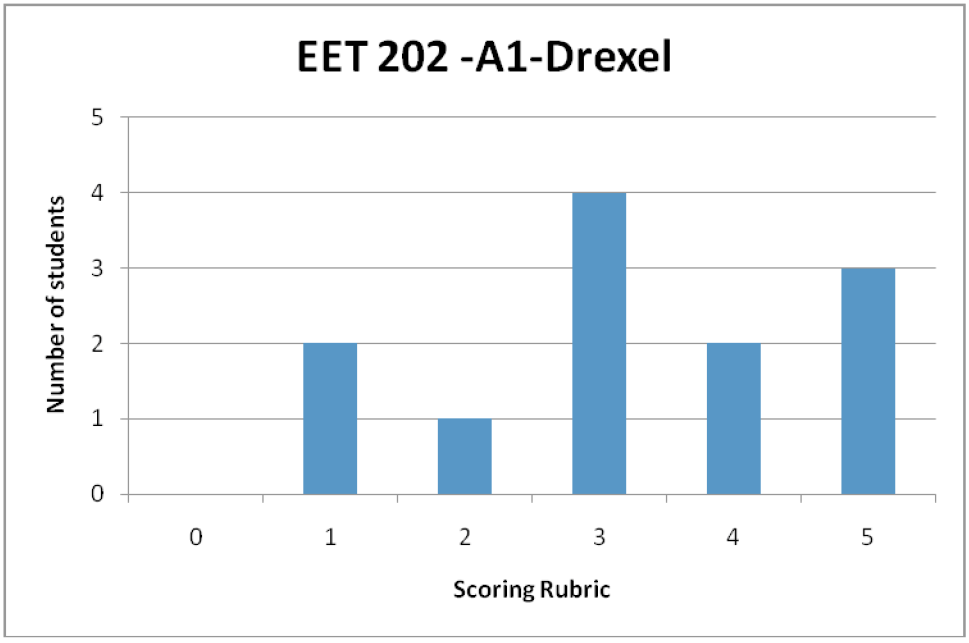
Section Number: 701 | Campus Taught: Drexel University

Term: Fall | Academic Year: 07-08

Performance Criterion Assessed: Demonstrates mastery of the skills of their discipline.

Assessment Method: Locally developed examination (Locally developed examinations may include quizzes, mid-term examinations and final examinations)

Educational Practices / Strategies: Coursework and Curricular Patterns



Average Score = 3.25 | One Standard Deviation = 1.42

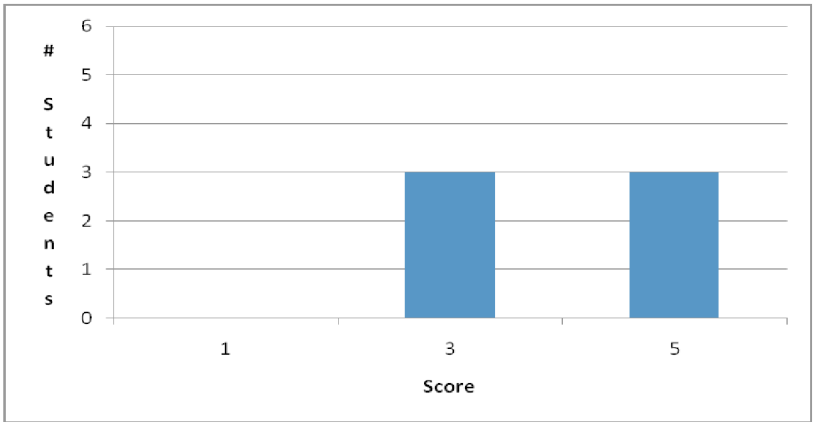
Figure 3. Sample of the Course Assessment Summary Sheet (These assessments are scored by each faculty member for a particular Scoring Rubric for all students).

Outcome Letter: a

Academic Year: 07-08

Survey type: 2. Example CO-OP Employer Survey

Performance Criterion Assessed: Demonstrates mastery of the skills of their discipline.



Average Score = 4.00 One Standard Deviation = 1.10

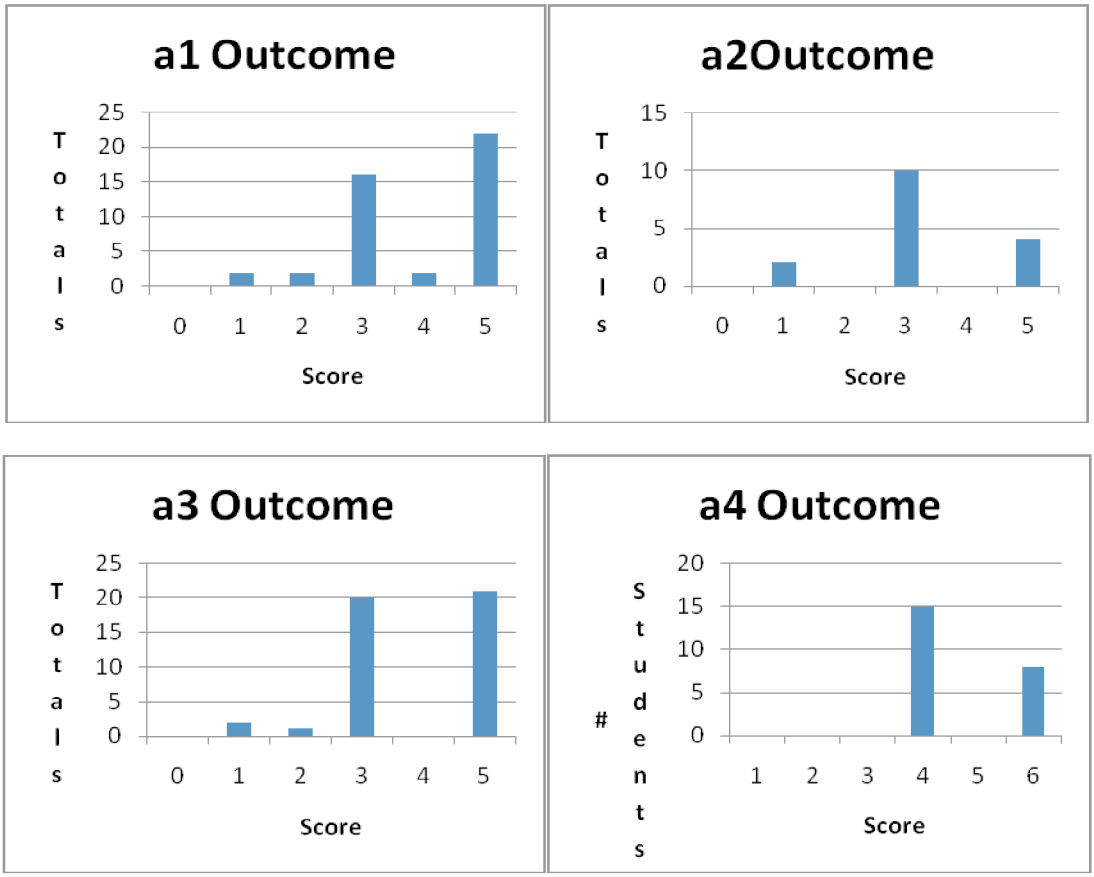
Figure 4. Sample of the Survey Assessment Summary Sheet.

Figure 3 and Figure 4 have pull down menu features that allow selection of all items ending in a colon so the basic information is easily entered. Student's scores are used to produce histograms for each assessed performance criterion to visualize the distribution of results. The average and one standard deviation are also posted. The histograms and averages identify areas where improvement needs to be made. During the 2007-2008 and 2008-2009 academic years, 206 Assessment Summary Sheets were collected representing 170 students. All Program Outcomes were assessed in this period and presented to the ABET evaluators during their visit in October 2009. In the future, all Program Outcomes will be evaluated on a three-year cycle as described in our program's Self-Study report. This information forms the basis for evaluation of each Program Outcome and is documented using the format "Student Learning Outcomes at the Program Level[1]". Figure 5 and Figure 6 show the Program Outcome a, "An appropriate mastery of the knowledge, techniques, skills and modern tools of their discipline", displayed with all relevant information required by ABET and in a form useful for AET Program improvement and follow up. The format for these figures is patterned to the example suggested in the "Faculty Workshop on Assessment and Program Outcomes" conducted in 2006[1]. The information presented in this format summarizes what was reviewed, the assessment methods used, and general information about the evaluator and evaluation time period. Further, the results of the evaluation are discussed with included histograms to summarize the findings and recommended actions. All assessment components are compiled and used to produce an annual CQI report.

Performance Criteria	Strategies	Assessment Method(s)	Context for Assessment	Time of data collection	Assessment Coordinator	Evaluation of Results
Demonstrates mastery of the skills of their discipline.	EET202, MHT222, MET421, MET422, MET423, EET404, MHT224, MHT405	Locally developed exams, external examiner, oral examinations, scoring rubrics	EET 202 MET 423	Start of academic year 07-08 on a three year cycle	William Danley	Department Assessment and Evaluation Committee
Applies techniques used in their discipline.	MHT205, MHT402, MET422, MET423, EET402	Locally developed exams, behavioral observations, scoring rubrics	MHT 205 MET 422	Start of academic year 07-08 on a three year cycle	William Danley	Department Assessment and Evaluation Committee
Demonstrates mastery of knowledge in their discipline.	EET206, MET421, MET422, MET423, EET407, MET380	Locally developed exams, external examiner, scoring rubrics	EET 206 MET 423	Start of academic year 07-08 on a three year cycle	William Danley	Department Assessment and Evaluation Committee
Employs modern tools used in their discipline.	MET100, MET310, EET324, MET422, MET423, MHT314	Locally developed exams, performance appraisal, scoring rubrics	MHT 314 MET 422	Start of academic year 07-08 on a three year cycle	William Danley	Department Assessment and Evaluation Committee

Figure 5. Learning Outcome *a.* An appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines.

Results ___Summer 2008__ (date): It was observed that students achieved an appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines. The presented results demonstrate that 91%, 88%, 93% and 100% of scores from the Context for Assessment for courses and surveys met the Applied Engineering Technology goal. The included histograms show the results graphically. These results and some other capstone results from courses and surveys are presented. All performance criteria for this Program Outcome were assessed using triangulation from a variety of Assessment Methods. They encompass the Educational Practices/Strategies as detailed in program's CQI. The assessment summaries inducate agreement that the outcome was met through third party assessment.



Actions ___Summer 2008__ (date): Based on the analysis of these results, no action is recommended at this time.

Second-Cycle Results _____(date): Since no actions were recommended, the evaluation process as outlined in Continuous Improvement – Process Timetable for Assessment and Evaluation of Applied Engineering Technology Program of our self-study will be reviewed as indicated in the schedule.

Figure 6. Description of Results and Actions with Histograms for Outcome a.

Program Educational Objectives

The information collected and documented in Survey Assessment Summary Sheets from recent graduates and their employers indicates how well AET meets the Program Educational Objectives (PEO). Program objectives are broad statements, which describe the career and professional accomplishments that our program is preparing our graduates to achieve. Program Educational Objectives are listed and discussed in self-study reports provided to ABET prior to evaluation visits. It is important to note that PEOs are consistent with the program mission and with the program outcomes as indicated in Figure 1. This information is included in the CQI report and is made available to AET Industrial Advisory Committee. These results are reviewed during the biannual meetings and may be used to improve or update Program Educational Objectives.

Summary

The AET Program at Drexel University has developed an effective methodology for assuring that the program is meeting the program mission. The students' data are collected and used for preparing an understandable CQI report that accurately portrays how well the program is meeting the Program Outcomes and Program Educational Objectives. The format is consistent with the methodology suggested by ABET, so the program is assured to meet ABET requirements and the needs of industry. The collected information is useful to the program constituents and to the public, so that they can form opinions about the program and understand the value of the program to the students. Examples of the documents used during the CQI process to help in the extensive task of accumulating and storing data are discussed. Visual tools, such as histograms and performance statistics are presented. The recommended actions are incorporated into the program and evaluated in future assessments to validate program improvement.

Bibliography:

1. 2008 – 2009 Criteria for Accrediting Engineering Technology Programs, ABET Inc., 2008.
2. Robert Lingard. A Process for the Direct Assessment of Program Learning Outcomes Based. on the Principles and Practices of Software Engineering. Proceedings of the ASEE Annual Conference, pp. 1-9, 2007.
3. Assessment 101 – Part I, Gloria Rogers, Community Matters, ABET Publication, Page 3, May 2007.
4. Assessment 101 – Part I, Gloria Rogers, Community Matters, ABET Publication, Page 3, October 2007.
5. Assessment 101 – Part I, Gloria Rogers, Community Matters, ABET Publication, Page 3, Sept 2006.
6. Assessment 101 – Part II, Gloria Rogers, Community Matters, ABET Publication, Page 3, Oct 2006.

7. Assessment 101 – Part III, Gloria Rogers, Community Matters, ABET Publication, Page 3, Nov 2006.
8. Aaron Hill. A Direct Assessment Technique That Works. Proceedings of the ASEE Annual Conference, pp. 1-10, 2007.
9. Robert Lingard. A Process for the Direct Assessment of Program Learning Outcomes Based on the Principles and Practices of Software Engineering. Proceedings of the ASEE Annual Conference, pp. 1-14, 2007.
10. Heidi Goodrich Andrade. Understanding Rubrics. Educational Leadership, 54 (4), pp.14 – 17, 1996.