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Student Outcomes Assessment and Evaluation for ETAC/ABET

Dr. Mohammed Abdallah, State University of New York,Polytechnic Inst.

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M. Abdallah, D. Jones, I. Gherasoiu

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Abstract

ETAC/ABET-accredited programs have demonstrated their excellence during rigorous, objective, periodic reviews conducted by external evaluators. One main part of the accreditation process concerns the student outcomes. It all starts with ETAC/ABET student learning criteria.

An Engineering Technology program must use these learning criteria to develop its own student outcomes. It must document student outcomes that will serve as a reference in judging how the students attain the program educational objectives. A documented and effective process for the periodic review and revision of student outcomes must be available. One challenge is how to present the student outcomes in the self-study report. Each student outcome has to be assessed via a well-developed rubric. Another challenge is to how to summarize all statistics from all different rubrics and report it in a well-written presentation.

This paper proposes a simple presentation method to document and present the student outcomes in the self-study report. Data from the Electrical and Computer Engineering Technology programs is used in this paper to illustrate the presentation method.

For each course taught, the instructor evaluates each student on a specific Performance Criteria. These Performance Criteria are derived from the course syllabus and are chosen to capture a specific skill or attribute for a particular student outcome. The faculty member must indicate which course evaluation tools were used (e.g. a specific exam problem, lab exercise, etc), how the data was collected, the threshold used, and the expected level of attainment for that particular Performance Criteria. This information is then captured and summarized on a Course-Level Assessment Form.

For each ETAC/ABET criteria a-k, one or more student outcomes are developed and mapped to the criteria. In this paper, criteria "C" is considered for exemplification purpose. It is the ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.

A student outcome can be proposed to reflect these criteria. In this paper, a student outcome is proposed to assess criteria "C" in the Electrical/Computer Engineering Technology program. A new rubric to assess this student outcome is presented along with data collected. Ideas for improvement are reported as well, in order to close the loop followed by effective changes of the evaluation process.

1. Introduction

The Electrical Engineering Technology Program has adopted the student learning outcomes listed below. These outcomes were developed in consultation with the faculty and the Industrial Advisory Board. Students that graduate from this program will:

1. Apply modern technology tools, such as software and test equipment, to analyze, simulate, design and improve electrical systems.
2. Apply digital and analog electronics to existing and new components, subsystems, and systems.
3. Apply microprocessors/microcontrollers to existing and new components, subsystems, and systems.
4. Apply programming concepts and application software to general purpose and specific purpose systems.
5. Apply mathematics, physics and sciences to solve technical problems.
6. Communicate effectively, both orally and in writing.
7. Function effectively as part of a project team.
8. Recognize the need for professionalism, excellence, and continuous improvement.

The student outcomes are published on the website, on-line catalog, in front of the department office and on bulletin boards throughout the buildings. These outcomes are assessed at the course level. Both levels of assessment include direct and indirect measures. Table 1 presents the program specific outcomes as they map to the ETAC/ABET [1] student learning criteria [2]. In this paper, criterion "C" is considered and student outcome #1 is mapped to Criterion "C" as shown in the table.

Table 1: Mapping of Student Outcomes to the Criteria (a) – (k)

Electrical ET

Program Specific Student Outcomes	a. an ability to select and apply the knowledge, techniques, skills, and modern tools of the	b. an ability to select and apply a knowledge of mathematics, science, engineering, and	c. an ability to conduct standard tests and measurements; to conduct, analyze, and	d. an ability to design systems, components, or processes for broadly-defined engineering	e. an ability to function effectively as a member or leader on a technical team	f. an ability to identify, analyze, and solve broadly-defined engineering technology	g. an ability to apply written, oral, and graphical communication in both technical and non-	h. an understanding of the need for and an ability to engage in self-directed continuing	i. an understanding of and a commitment to address professional and ethical	j. a knowledge of the impact of engineering technology solutions in a societal and global	k. a commitment to quality, timeliness, and continuous improvement
1. Apply modern technology tools, such as software and test equipment, to analyze, simulate, design and improve electrical systems.	X		X								
2. Apply digital and analog electronics to existing and new components, subsystems, and systems.	X			X							
3. Apply microprocessors/microcontrollers to existing and new components, subsystems, and systems.	X					X					
4. Apply programming concepts and application	X					X					

software to general purpose and specific purpose systems.											
5. Apply mathematics, physics and sciences to solve technical problems.		X									
6. Provide an effective and timely communicate, both orally and in writing.							X				X
7. Function effectively as part of a diverse project team.					X				X		X
8. Recognize the need for professionalism, excellence, and continuous improvement.								X	X	X	

2. Student Outcomes

In this section, the student outcome assessment process will be discussed. In addition, the proposed table to present and summarize the collected data will be introduced. Moreover, two important quantities an instructor should determine will be introduced.

2.1 Student Outcome Assessment Process

As shown in Figure 1, it is required to assess the knowledge a student gains. Lectures, labs, test, or projects can be used to assess this knowledge. Data will be collected. A certain target should be placed. Then, a comparison should be done between the real percentage and the target percentage. If the real percentage of students who met the standards is above the target, no urgent changes should be made. Otherwise, a feedback action should be done to close the loop and enhance the performance.

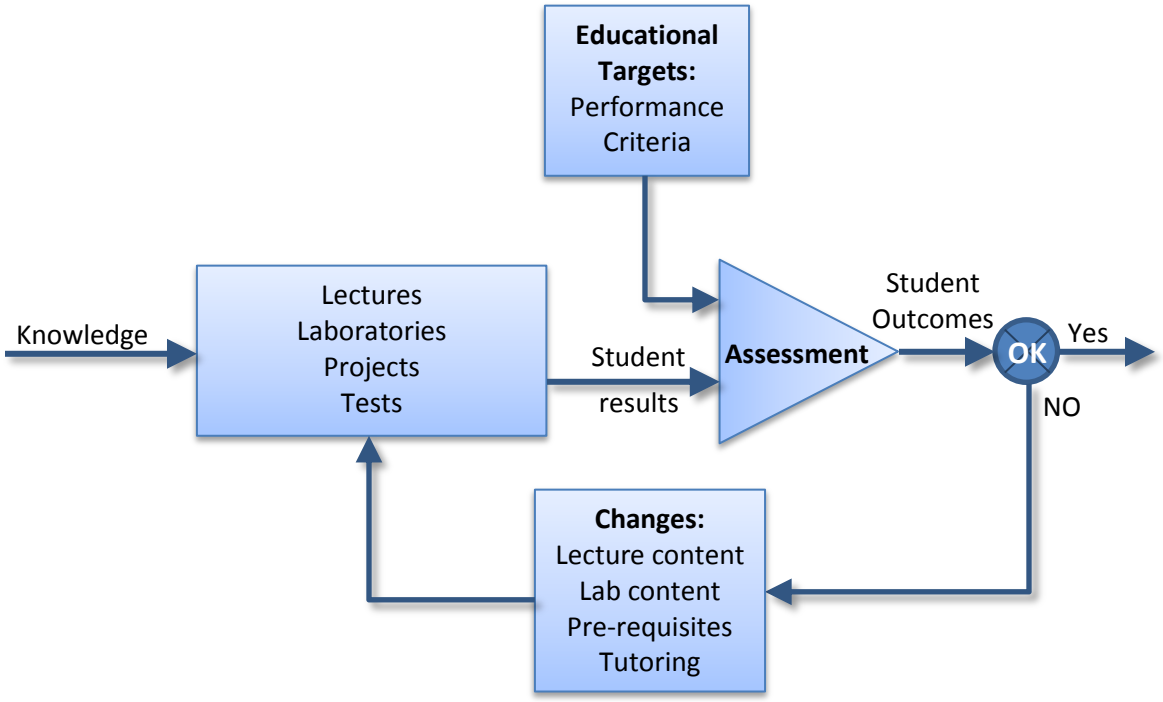

Figure 1. The Student Outcome Assessment Process

2.2 Proposed Tables

Provided below is a description of the assessment process used to gather the data upon which the evaluation of each student outcome is derived.

For each course taught, the instructor evaluates each student on a specific Performance Criteria [3]. The Performance Criteria for Student Outcome 1 is provided in Table 2. Table 2 is considered as the rubric for student outcome #1. Each performance criterion will be assessed to fall into one of three levels as will be discussed in the next subsection.

These Performance Criteria are derived from the course syllabus and are chosen to capture a specific skill or attribute for a particular student outcome. The faculty member must indicate which course evaluation tools were used (e.g. a specific exam problem, lab exercise, etc), how the data was collected, the threshold used, and the expected level of attainment for that particular Performance Criteria. This information is then captured and summarized on a Course-Level Assessment Form as shown in Table 3.

Table 2: Student Outcome 1 and its Performance Criteria in Electrical Engineering Tech

Student Outcome	1. Apply modern technology tools, such as software and test equipment, to analyze, simulate, design and improve electrical systems.
Performance Criteria	Students will have successfully achieved this student outcome by demonstrating one or more of the following: EET 1.1 ETC 210: Design a combinational logic circuit from a problem description using logic components such as adders, comparators, (dc) multiplexers, encoders, decoders EET 1.2 ETC 103/203: Design circuits containing diodes, transistors, and op amps, to meet specified requirements EET 1.3 ETC 203: Analyze, design and construct a system, component, or process to meet requirements and/or desired outcome

Table 3: Course Level Assessment Form

ABET Criteria	Student Outcome	Information					Results	
		Performance Criteria	Assessment	Date of Assessment (Semester/Year)	Students Assessed		Target for Performance	% Meeting Expectations
					N	%		
(a), (c)	(1) Apply modern technology tools, such as software and test equipment, to analyze, simulate, design and improve electrical systems.	EET 1.1 Design a combinational logic circuit from a problem description using logic components such as adders, comparators, (dc) multiplexers, encoders, decoders	ETC 210 (Final Exam Question 3)				70% of students should meet expectations	
		EET 1.2 Design circuits containing diodes, transistors, and op amps, to meet specified requirements	ETC 103 (Final Exam Questions 1 and 2)				70% of students should meet expectations	
		EET 1.3 Analyze, design and construct a system, component, or process to meet requirements and/or desired outcome	ETC 216 (Lab 5)				70% of students should meet expectations	

Table 3 is proposed to summarize and represent the data collected to assess student outcome number 1 which is mapped to criteria 'A' and 'C'. As shown in Table 3, there are different Performance Criteria (EET 1.1, EET 1.2, and EET1.3). Each performance criteria is used to assess a certain aspect of the student outcome. Different materials are collected and assessed. For example, in the first performance criteria (EET 1.1), the question 3 in the final exam is used to assess students' capability to design a combinational logic circuit from a problem description using logic components such as adders, comparators, (dc) multiplexers, encoders, decoders. The instructor uses a proposed rubric to grade this question and reports the following information results: the number of students in this course and the percentage of students taking this exam.

2.3 Rubrics

The instructor needs to determine two important items:

A. The instructor should determine the threshold of the score that is considered acceptable in this question.

Based on performance a student demonstrates on the evaluation tool (this would be an assignment, exam question, report, presentation, or whatever the instructor decides to use to measure the level of attainment on the performance criteria), the instructor determines the percentage of students that fall in each of the following categories:

- Level #1: *Did not show minimum acceptable level of achieving objective*
- Level #2: *Demonstrated minimum acceptable level of achieving objective*
- Level #3: *Demonstrated better than minimum acceptable level*

Therefore, students in both levels (2 and 3) are considered above the threshold the instructor determines. Students in level 1 are considered below this threshold.

B. The instructor needs to determine another quantity which is the target performance of each course/student outcome. An instructor needs to decide the percentage of students who are in levels (2 and 3). In other words, he/she needs to determine the acceptable percentage of students who are above the performance threshold. As shown in Table 3, a 70% is chosen as the acceptable percentage in these student outcome performance criteria.

Finally, as data analysis results, an instructor will report the actual percentage of students who are above the threshold. If this actual percentage is above the target percentage, so, there is no need to immediately improve this aspect of the student outcome. Otherwise, immediate attention should be paid to this aspect and new improvement actions need to be devised and implemented

3. Data Analysis and Representation

It is a challenge to represent all the data and discuss the results in a smooth and easy to read way. For this purpose, Table 3 is introduced. Moreover, Table 4 is prosed to represent the discussion of the data collected and presented in Table 3.

Table 4. Discussion Representation

Performance Criteria	How assessment was performed	Major Findings of this Assessment	Action to be taken in addressing these assessment findings	Observation (Close the loop)
EET 1.1	Students in ETC 210 had to solve the Question 3 in final exam. They had to demonstrate their understanding of combinational logic circuits. This exam was graded from 0-10. Students with a grade of 0-6 were labeled as Level #1, grade 7-9 was Level #2 and grade 9-10 was Level #3.	Depending only on the final exam to assess the performance is not accurate because the final is not accumulative and it only focuses on the last part which is normally much difficult than the previous topics	Use another assessment measurement such as the final grade	
EET 1.2	Students in ETC 103/203 had to solve the final exam. They had to demonstrate their understanding of diodes, transistors, and op-amps. This exam question was graded from 0-10. Students with a grade of 0-6 were labeled as Level #1, grade 7-9 was Level #2 and grade 9-10 was Level #3.	No significant findings have been found at this time.	Approach seems to be effective, no significant findings drawn.	
EET 1.3	Students in ETC 216 had to show their understanding of Electronics Communications and test analog modulation techniques. This final exam question1 was graded from 0-10. Students with a grade of 0-7 were labeled as Level #1, grade 8-9 was Level #2 and grade 10 was Level #3	In spring 2012, the lab had limited number of equipment. The lab did not have different domain equipment.	Buy new lab equipment. The merits of the different domain equipment is analyzed providing the student with practical cockpit time and in-depth l knowledge of advanced equipment including test and measurement	In spring 2013, the performance is improved as should be shown above in Table 3.

Finally, after analyzing all the student outcomes, one should be able to present two tables per student outcome such as Tables 3 and 4. Table 5 is proposed to present a summary of all student outcomes in one place. As shown in Table 5, the eight student outcomes can be presented with final results.

Table 5: Summary of Results (EET)

ABET Criteria	Student Outcome	Information			Results	
		Date of Assessment (Semester/Year)	Students Assessed		Target Goal	Meeting Standard
			N	%	%	%

Each student outcome is evaluated via more than one course and performance indicator. This evaluation is done along different semesters. In Table 5, the summary of the evaluation is presented. The last column, is the result column, and represents the average result of the different performance indicators per student outcome. In the cases that we closed the loop by assessing the same performance indicator a second time (i.e. after one semester or two) to check the improvement, the second performance result is considered in the calculations (i.e. the result after the improvement is taken into account). The number of students that are assessed is determined by the total number of students assessed toward a student outcome.

4. Documentation and Maintenance of Results

These results are documented by each faculty member responsible for their respective performance criteria. This information is collected, analyzed at the conclusion of each semester and then maintained by the department chair and program coordinator.

Conclusion

In general, this paper can be considered as a guideline for any faculty member who is interested in student outcomes assessment. It helps to show how to create a rubric for a given student outcome. Moreover, it proposes a new presentation layout to present all collected data from different courses and semesters in one place. In addition, it shows how to present the summary of all student outcomes and more importantly, how to close the loop and provide ideas of improvement.

References

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