

Classroom Assessment in Engineering Technology (Two Examples)

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Abstract

Accountability has become a national concern in higher education. In response, accrediting agencies require the development and implementation of academic assessment models designed to assure and enhance institutional improvement. Assessment is what faculty members can do in order to demonstrate to themselves how well their students are learning. It is the source of in-process feedback. Furthermore, assessment satisfies the demands for accountability by external agencies.

This paper introduces two examples of classroom assessment in engineering technology. These two examples provide engineering technology programs with quantitative and qualitative measures that may be incorporated as one component of a plan for assessment of student academic achievement.

1. Introduction

The purpose of assessment of undergraduate education is to help the particular institution determine the extent to which it is fulfilling its mission of educating undergraduate students. Assessment allows an institution to make improvements in program structure, course content, and pedagogy. It also assists in advisement and placement and provides students with indicators of their performance. Finally, assessment monitors the competence of graduating students, not just in terms of disciplinary expertise but also with respect to the attainment of a general education. Much of assessment is embedded within the teaching function of the university and, ideally, occurs alongside each student's regular academic effort^{1,2,3}.

According to the new criteria for accrediting engineering technology programs for the 2001-2002 accreditation cycle by TAC of ABET, the importance of outcomes assessment is emphasized as follows:

Criterion 6. Assessment. Programs must have written goals that, as a minimum, focus on the student body served, employer expectations, resource allocation, and other factors affecting the program. Programs are required to have plans for continuous improvement and evidence that the results are applied to further development and improvement of the program.

2. Classroom Assessment

Classroom assessment is a simple method faculty can use to collect feedback, on how well students are learning. The purpose of classroom assessment is to provide faculty and students with information and insights needed to improve teaching effectiveness and learning quality. College instructors use feedback gained through classroom assessment to make adjustments in their teaching. Faculty also share feedback, using it to help students improve learning strategies and study habits in order to become more independent and successful learners. Faculty may use the data collected as a means of measurement for evaluation of students' technical preparation

The idea is to implement a process by which a teacher assesses student learning through classroom tests and assignments, the context in which an instructor establishes that process, and the dialogue that surrounds grades and defines meaning to various audiences. Grading cannot be separated from planning, teaching, and interacting in classroom. Grading, then, includes tailoring the test or assignments to the learning goals of the course, establishing criteria and standards, helping students acquire the skills and knowledge they need, assessing student learning over time, shaping student motivation, feeding back results so students can learn from their mistakes, communicating about students learning to the students and to other audiences and using results to plan future teaching methods. Grading is a tool for evaluating student learning, and, is a basis of a college or a university's decision about who graduates. It is the most universal form of communication to employers or graduate schools about the quality of a student's learning. Grading systems implemented in classrooms powerfully shape students' expectations and experiences.

Establishing clear criteria and standards ¹ for grading can:

- Save time in the grading process
- Allow an instructor to make that process consistent and fair
- Help the instructor to explain to students what the instructor expects
- Show an instructor what to teach
- Identify essential relationships between discipline information and processes
- Help students participate in their own and each other's work

In the following examples, performance assessment is used to measure student outcomes based on a specific assessment problem or task.

3. Examples of Classroom Assessment in Engineering Technology

RUBRIC and MATRIX, EET Logic Circuits Course

The main objective of this course is to provide students with the fundamentals of digital electronics. Students gain the necessary skills to design and implement projects in the digital systems. This course also allows students to have hands-on experience with various combinational circuits, as well as sequential circuits. Finally, the ultimate objective of this course is to broaden students' understanding and appreciation of computer hardware.

The following information will be used to evaluate homework, laboratory assignments, and exams for the Logic Circuits course. The given information describes not only the grading criteria but also provides guidelines about what should be avoided. Students should become

familiar with descriptive phrases in each category ranging from “unacceptable” to “excellent.” Students are encouraged to accept evaluators’ constructive criticisms in the spirit intended.

Laboratory Assignment Requirements:

1. PRELAB

Each student will plan, design, and produce a design for the given experiment. Each student must provide a written report 2-3 pages in length and present the information to the lab instructor at the beginning of the laboratory session. The instructor will provide feedback for revision and approval.

2. LAB

Each student must demonstrate his/her design to the lab instructor. If the logic circuit does not function properly, the design and/or wiring errors must be corrected prior to leaving the laboratory.

3. POSTLAB

Complete laboratory report to contain:

1. Introduction
2. Procedure
 - a. Truth Table and K-map
 - b. Logic Equations
 - c. Labeled Circuit(s)
3. Conclusion and Applications(s)

In the introduction section, students should describe the purpose of the lab. Students must provide rationale for the conducting of the given experiment. In the conclusion section students should describe educational value and application for the given experiment.

Laboratory, Homework, and Exams Requirements:

- **Truth Table and K-Map**

A truth table is a means for describing how a logic circuit’s output depends on the logic levels present at the circuit’s inputs. Note that there are 4 table entries for a two-input truth table, 8 entries for a three-input truth table, and 16 entries for a four-input truth table. The number of input combinations will equal 2^N for an N-input truth table. Also note that the list of all possible input combinations follows the binary counting sequence, and so it is an easy matter to write down all the combinations without missing any. The Karnaugh map (henceforth abbreviated K-map) is a graphical tool used to simplify a logic equation or to convert a truth table to its corresponding logic circuit in a simple, orderly process.
- **State Table and State Diagram**

The first step in designing a sequential circuit is to determine how many states and which transitions are possible from one state to another. State diagram provides a description of the behavior of a sequential circuit that is easy to understand and helpful for implementing of the circuit. The state table indicates all transitions from each present state to the next state for different values of the input signal.

- **Logic Equations**
Digital (logic) circuits operate in the binary mode where each input and output voltage is either a 0 or a 1; the 0 and 1 designations represent predefined voltage ranges. This characteristic of logic circuits allows us to use Boolean algebra as a tool for the analysis and design of digital systems. Boolean algebra is a relatively simple mathematical tool that allows us to describe the relationship between a logic circuit's output(s) and its inputs as an algebraic equation (a Boolean expression). Boolean algebra is also a valuable tool for coming up with a logic circuit that will produce a desired input/output relationship.
- **Labeled Circuits and Neatness**
Every circuit that is drawn in this course must be drawn neatly using a template. For the laboratory assignments every circuit must be labeled appropriately by assigning the actual pin-number of the used chip from the TTL data book.
- **Problem Solving Skills**
Students are encouraged to use the prior knowledge gained in this course to solve problems related to their design.

Primary Trait Analysis and Matrix Assessment Logic Circuits Course				
	<i>Unacceptable to Below Average D-F (Below 70%)</i>	<i>Average C (70% to 79%)</i>	<i>Good B (80% to 89%)</i>	<i>Excellent A (90% or Better)</i>
<i>Format (Laboratory Assignments)</i>	Format is not followed	Incomplete information in all three areas	Incorrect information in one of the criteria	The report contains correct information, correct format.
<i>Truth Table (or State Table) and K-Map (or State Diagram)</i>	More than one incorrect entry in the truth table and K-map; K-map and truth table do not match	One incorrect entry in the truth table; one incorrect entry in the K-map	One incorrect entry in the truth table; correct K-map	Complete and correct truth table; correct use of K-map
<i>Boolean Expressions and Circuits</i>	Partially correct expressions; circuit does not match the expressions	Partially correct expressions; circuit matches the expressions	Correct expressions; circuit matches the expressions	Correct and minimized expressions; circuit matches the expressions
<i>Complete Design</i>	Design is incomplete; needs more than minor changes.	Design is incomplete; needs minor changes.	Design is complete and labeled.	Design is complete, minimized; and labeled.

R U B R I C and M A T R I X
EET Special Project Course

The Special Project course generally addresses job importance and student preparedness in written and oral communication skills. The course is designed to provide students and faculty with a means for assessment of technical competence of students as well as written, oral, and presentation communication skills that are critically important for success in their professional careers. A major component of this course requires learners to plan, develop, and present a semester-long project in their field of engineering technology on a subject of their choice which demonstrates knowledge and skills in project handling, technical writing, problem-solving and evaluation processes, and oral presentation techniques. The course enables students to: (1) complete a semester project based on their field of interest, (2) prepare an effective written technical report, (3) plan and produce presentation materials which most effectively communicate the intended message for their technical oral presentation, and (4) apply concepts and practices of their field of experience to develop and effectively present their semester project to colleagues and faculty.

Oral Presentation Evaluation

What follows (Assessment Matrix) will be used to evaluate oral presentations for the Special Project course. This form is used not only to rate students, but to provide examples of what should be avoided in presentations and examples of what constitutes a professional briefing. Students should become familiar with descriptive phrases in each category ranging from “unacceptable” to “excellent.” The graduation from poor to excellent simply allows the instructor to assess the quality of presentations in a general overall manner in each category.

Students are required to give several presentations throughout one's career for job related issues. Not only can a successful effort enhance one's own career, but may very well have a positive impact on co-workers and place of employment.

Appearance

Presenters should be appropriately dressed. The suggested attire is coat and tie for men, suits for women. Such dress is not mandatory, but all presenters should remember that initial impressions of the audience are critical.

Unacceptable (2 points)	Fair (3 points)	Average (4 points)	Good (5 points)	Excellent (6 points)
Denim; shoes, disheveled in appearance. Generally appearance is a negative factor instead of a positive asset.	Some attire less than desirable; colors clash, shoes unpolished, faddish cloths that distract from message.	Nondescript, sport clothes, golf shirt; denim skirt for women; sandals, casual dress.	Sport coat, tie, slacks, appropriate shoes for men; dress for women. Generally attire is acceptable.	Conservative color for suits, closed-toe shoes for women, generally professional attire adds to presentation.

Narrative

Presenters should be at ease with the audience, not frivolous, but relaxed and personable. Eye contact is essential; turning one's back on the audience and reading from slides is insulting to the audience and will be graded accordingly. Good presentations have clear, sharp beginnings and endings. Students should avoid "Uhs," "you know;" and beginning sentences with "OK," etc.

Unacceptable (6 points)	Fair (7 points)	Average (8 points)	Good (9 points)	Excellent (10 points)
No definable beginning, no introduction; reads most of script, little if any eye contact; nervous; silly, attempts at humor unsuccessful; jumps from one topic another; reads presentation from script; back to audience; not audible.	Generally poor, with some positive points; eye contact occasionally; poor beginning or ending. Frequent "uhs," etc. Reads from script; turns back to audience; frequently puts hands in pockets; voice level low.	Some positive points; eye contact OK. Difficult to follow at times; fairly relaxed; some improvement needed, some distraction.	Good job overall; sharp, clear, good beginning and ending, articulate; only a few areas need improvement; few distracting mannerisms.	In top 5% of all presentations; at ease, enjoyable, informative; needs no improvement; spoke loudly enough.

Visual Aids

Any appropriate visual aid may be used. Transparencies, slides, charts, and Power Point are permissible. All material must be legible and neat. Scrawled handwritten transparencies are unacceptable. Charts must be printed neatly. Lines should be drawn with straight edge. Students should avoid too much information on each slide. Visual aids should not supplant the presentation, but improve the quality, directing attention to significant points.

Unacceptable (4 points)	Fair (5 points)	Average (6 points)	Good (7 points)	Excellent (8 points)
Illegible; no care taken in printing or thought about content; too dark or too light; excessive information. Distracted from presentation; blocked view of slide.	Some slides adequate, others poor quality. Crooked lines, careless preparation, no color; some slides have too much information; hard to read. Slides didn't add to message presented.	Generally acceptable but minimally satisfactory; simple block letters, easily seen, readable, not excessive information, and no creativity.	Legible, interesting, neatly printed, color added to presentation. Visually entertaining, good art.	Superb; color, neat, different in a very positive way; in top 5% of all slides shown in class.

Organization

Student presentation should be logical and in progressive sequence. There should be an introduction followed by a brief description of what is to follow. Both narrative (verbal portion) and slides should work in union to provide understandable information regardless of the complexity of the topic. Students should be conscious of audience and their level of understanding. Acronyms unfamiliar to the listeners should be explained early in the presentation. Points should be explained sufficiently; repetition or restatement should be avoided. The ending should consist of summary and a closing statement. “That is my presentation” or “That is all I have” is an unacceptable ending for any presentation and will be graded accordingly.

Unacceptable (6 points)	Fair (7 points)	Average (8 points)	Good (9 points)	Excellent (10 points)
Episodic; disjointed; listeners and evaluators lost and confused throughout; no introduction; no summary; logical sequence poor.	Barely adequate; no overview of what’s to come; lacks summary; poor ending, sometimes lost audience. Too many restatements; did not convince audience topic worthwhile.	Adequate; not as professional and informative as some but about as good as most. Most of the time audience could follow. Some improvement needed but generally acceptable.	Good performance; introduction; attention getting; points listed in order; summary noted; only a few areas of improvement needed.	Very professional introduction; excellent points clearly made; summary well executed; ending well done; good performance.

Content

The quality of the topic should be at an acceptable level for graduates of an electronics engineering technology program. This is not to suggest that over complexity and excessive detail are desirable. Rather, the topic should be of sufficient depth and usefulness for graduating senior-level students.

Unacceptable (7 points)	Fair (9 points)	Average (11 points)	Good (13 points)	Excellent (16 points)
Topic too simplistic; not sufficient area for research; time requirement not met; topic is unacceptable.	Fairly simple; barely acceptable; difficult to understand; points not clearly made	Acceptable; lacks depth to some degree, but can become adequate research material; room for improvement.	Sound proposal; clear, concise, well presented; appropriate design; little room for improvement; informative to all listeners; well done.	Top 5% of all proposals; excellent design, clearly presented; can be accomplished and will benefit all listeners; no significant weaknesses.

4. Primary Trait Analysis

Primary Trait Analysis (PTA) is a way to take what faculty already do --record grades-- and translate that process into an assessment device. Advantages of PTA [1] assessment include (1) using information that is already available, (2) bringing to consciousness the mostly subconscious processes that goes into recording grades, and (3) looking at performance strengths and weaknesses in individual segments of an assignment, course, or curriculum. PTA is a particularly powerful device because one can apply it at the levels of the institution, department, curriculum, course, single class, or classroom assignment.

To construct a PTA scale one may use examples of past students' performances, grading checklists, descriptions of criteria, comments on assignments or tests--anything that has helped in the past to articulate criteria for students' performances^{1,2}.

1. The instructor may choose a test or assignment that tests what the instructor wants to evaluate. Objectives for the assignment must be made clear.
2. Traits could be identified that will count in the evaluation.
3. Two to five-point scale could be constructed for each trait. These are descriptive statements.
4. Ideally, the scale with a sample of student work or review could be tried with colleagues for potential revision.

Primary trait analysis may be used as a good tool to review students learning for a specific course by reviewing students' understanding of various features that make up the given course.

Matrix Assessment, Primary Trait Analysis
Special Project Oral Presentation

	<i>Unacceptable</i>	<i>Fair</i>	<i>Average</i>	<i>Good</i>	<i>Excellent</i>
<i>Appearance</i>	2	3	4	5	6
<i>Narrative</i>	6	7	8	9	10
<i>Visual Aids</i>	4	5	6	7	8
<i>Organization</i>	6	7	8	9	10
<i>Content</i>	7	9	11	13	16

5. Conclusion

The purpose of assessment of undergraduate education is to help the university determine the extent to which it is fulfilling its mission of educating undergraduate students. Assessment allows the university to make improvements in program structure, course content, and pedagogy. It also assists in advisement and placement and provides students with indicators of their performance. Finally, assessment monitors the competence of graduating students, not just in terms of disciplinary expertise but also with respect to the attainment of a general education. Much of assessment is embedded within the teaching function of the University and, ideally, occurs alongside each student's regular academic effort.

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