Work in Progress – Assessing the Un-assessable

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Abstract – ABET requires direct assessment of student outcomes. For some outcomes this can be relatively simple; for others it can be a significant challenge. The authors have been developing and implementing direct assessment instruments for several of the “un-assessable” outcomes. This includes outcomes related to life-long learning, adapting to a continuously changing work environment, and teaming. The instruments address various competencies related to each outcome at different levels according to Bloom’s taxonomy, and include instruments from non-engineering courses. Preliminary results show that the instruments produce assessment results that are consistent with ad-hoc faculty observation and appear to be reliable indicators of achievement of the outcomes.

Index Terms – outcomes assessment, life-long learning, professional skills, multidisciplinary teaming.

INTRODUCTION

During ABET accreditation visits programs are expected to show evidence of direct assessment of student outcomes; that is, work performed by the students and evaluated by the faculty that demonstrates achievement of the outcomes. For some outcomes this is relatively simple. For example, it is easy to show whether or not students have the ability to apply knowledge of mathematics, or the ability to solve engineering problems. Other outcomes, however, present a challenge for assessment. For example, how does one show that students have the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context?

There are three distinct challenges with these more difficult-to-assess outcomes. The first is that they are vague and open to interpretation. What exactly does one mean by “a knowledge of contemporary issues”? The second difficulty is that the outcomes frequently address “soft skills” that have historically not been a major focus of engineering education, and thus most engineering faculty are not well prepared to evaluate them. For example, how do you determine whether someone is able to function on a multidisciplinary team? The third difficulty in assessing these outcomes is that they are frequently future-oriented; that is, the true test of whether the outcome has been met does not come until long after graduation (for example, an ability to engage in life-long learning).

The first of these three difficulties can be addressed through the use of rubrics [1]. Rubrics have been addressed sufficiently in the literature and do not need further elaboration here. The other two difficulties – assessing soft skills and future-oriented skills – is the focus of this paper.

Over the past year the authors have been developing and implementing assessment instruments that have been useful in assessing some of the more challenging outcomes. These instruments have two significant features – they measure the outcome at various levels of Bloom’s taxonomy [2] and they are based on competencies that can be measured with current students. In addition, the instruments address specific actions or products that can be observed directly by the faculty. Our goal is to develop measures that are more objective than ad-hoc impression. The following section will provide examples of these instruments along with some preliminary results.

EXAMPLE ASSESSMENT INSTRUMENTS

I. Assessing Future-Oriented Outcomes

One of the more challenging outcomes in our program from an assessment viewpoint is the following four-part outcome:

Students should be able to (a) recognize the need for life-long learning, (b) be prepared to continue their education through formal or informal study, (c) be open-minded with regard to different opinions and cultures, and (d) be able to adapt to a continuously changing work environment.

Assessment data have already been collected for parts (c) and (d) and will be discussed first. Part (c) was assessed in the freshman Introduction to Engineering Design course where students were given an assignment to identify three cultural customs in a foreign country that are different than in the U.S. and would affect a proposed expansion of a business. In Bloom’s taxonomy this would be considered a mid-level activity (comprehension). It does not directly measure whether the students are open-minded, but knowledge about the different cultures is a prerequisite to being open-minded. In general the students did a good job on this assignment. Typical responses addressed topics such as the use of alcohol and the way people greet each other. Lower-quality responses focused on logistical rather than cultural issues (for example, customs declaration), or issues that would most likely not affect business expansion.

A higher-level (evaluation) assessment for part (c) is under discussion with faculty in the School of Humanities and Social Sciences. Faculty in courses such as History and Political Science frequently assign essays that address the question of respecting different opinions and cultures, and have agreed to collect these assignments as part of our assessment process. This is an example that shows how we
can use non-engineering courses to help with assessment of the more challenging outcomes.

Assessment of part (d) was accomplished through an assignment in the Senior Design project-based course. Students were asked to read two articles on adapting to change [3,4], identify 4 things that they expected would be different about their professional life once they graduate, and explain what they plan to do to adapt their habits and attitudes to be successful in their anticipated environment. The students did a very good job of identifying differences between their current and future professional lives (lower-level skill), but did not do a very good job of developing a plan to adapt (higher-level skill). For example, many students pointed out that they currently turn in work that they know is not correct because the only consequence is a lower grade, whereas when they are working full-time this could result in getting fired. However, their plan for correcting this situation typically was something like “I’ll change my attitude” — not exactly what we would call a plan. Higher quality submitted work tended to have plans that were specific and actionable; the weaker work had plans that were vague. It should be noted that the results of this assessment are consistent with comments that faculty advisors have made regarding project plans for Senior Design projects, and in fact show that we need to do a better job of teaching the students how to develop a quality plan.

Direct assessment of parts (a) and (b) has not been completed but is under way. A project will be assigned in the System Dynamics course where students will have to learn something they did not know and were not taught in class. Four specific competencies have been identified that relate to parts (a) and (b) of the outcome and that span Bloom’s taxonomy from lower to higher-level skills: identify what you know and don’t know about the problem; prepare a plan for learning something about the problem; describe the process you used to learn about the problem; and assess how well you learned what you needed to learn. Students will be asked to address each of these competencies and their responses will be evaluated by the faculty.

II. Measuring Performance in a Team Environment

All engineering programs must assess the ability of their students to function on a multi-disciplinary team. A common way of assessing teaming is to look at the product of the team — that is, if students do a good job on a project, then the team must have functioned effectively. While this is sometimes true, the final product of a team is not necessarily a good measure of how a team functions. Two instruments are used at Behrend to assess teaming directly: team contracts [5], and faculty advisor evaluation of team. Team contracts are widely discussed in the literature and will not be detailed here; the focus will be on assessment.

Team contracts are used in the Senior Design course as well as a required senior-level course in manufacturing. In the manufacturing course students are paired with Finance majors, thus providing a multi-disciplinary team experience. The teams prepare a contract which defines expectations for behavior and consequences. The contracts are evaluated by faculty according to a rubric, which addresses issues such as: whether meeting attendance policies are clearly stated and consequences for not following the policies are well established; procedures for conflict resolution; definition of team roles; consequences for late, incomplete or incorrect work, etc. The grades on the team contracts correlate well with ad-hoc faculty observation of overall team performance, and appear to be a reliable measure of team function.

The second form of team evaluation is a short rubric used by Senior Design project faculty advisors. The advisors meet bi-weekly with each team throughout the fall semester, and weekly throughout the spring semester, so they have adequate opportunity to observe team performance. The five items on which each team member is evaluated are: on time for all meetings; well prepared for all meetings, including an agenda; actively participates during all meetings; interacts will with other team members; and produces quality work. As with the team contract evaluation, the results of this assessment seem to correlate well with ad-hoc faculty observation of team function.

OBSERVATIONS AND CONCLUSIONS

The authors have developed instruments that they believe effectively assess some of the more difficult-to-assess outcomes. Three observations have been made about how to develop these instruments:

1. Focus on identifying competencies that are both measurable for current students and are important to the outcome. One does not have to necessarily show that a student recognizes the need for life-long learning, as long as it can be shown that they have several of the critical skills needed for life-long learning.
2. Don’t get hung up on high-level assessment. While it would be ideal to assess every outcome at the “evaluation” level, it is ok to look for “knowledge”.
3. Use non-engineering courses for assessment where applicable. At Behrend, half of the program credits are offered outside the School of Engineering. We cannot afford to neglect this important resource, and we have found that faculty in other schools are very willing to participate in the process.

REFERENCES