We extend our appreciation to Joseph Shaeiwitz (West Virginia University) for acting as Guest Editor in compiling, reviewing, and editing the following papers that comprise a special-feature section on outcomes assessment in this issue.

Commentary . . .

OUTCOMES ASSESSMENT

Its Time Has Come

Teaching is no longer sufficient; student learning must be demonstrated.

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When faced with the necessity of developing an assessment plan for regional accreditation about seven years ago, my initial response was directly from the "textbook of faculty responses when confronted with doing something new." I was not enthusiastic about having another task to fit into an already-full schedule.

If you have the same attitude, or if you are faced with a colleague reciting all of the "textbook responses" as excuses for not doing outcomes assessment, consider this: all faculty members reading this article have been doing outcomes assessment for their entire careers. When mentoring graduate students, the goal is to develop a set of skills to permit the MS or PhD to do research on any topic; the mentor (consciously or unconsciously) constantly compares the student's acquired skills to the desired skills and focuses on making certain that all of the desired skills are acquired before a degree is granted. Assessing undergraduates involves the same process—plus the additional challenge of dealing with a larger number of students.

The concept of outcomes assessment has been around for about thirty years. It is becoming more prevalent in higher education because of its acceptance by regional accreditation agencies and by professional accreditation agencies such as ABET, and because of the demand for more accountability by boards of trustees and state legislatures.

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With the adoption of EC 2000, engineering programs are struggling with how to develop meaningful assessment plans. The following collection of papers is designed to assist with the development of those plans. The papers contain opinions and observations from those involved on both sides of the first few EC 2000 pilot visits in chemical engineering, those involved in educating engineers on outcomes assessment, and those who have experience in developing and implementing assessment strategies for courses and curricula that can serve as models for other assessment plans.

Some may wonder why we should be doing outcomes assessment. After all, if our students graduate and get good jobs or attend graduate or professional school, we are doing fine. Right? But are employers really satisfied with the skills of the graduates they hire? Are students really satisfied with the education they received? Do graduates really possess the knowledge and skills faculty believe they possess?

How do we know the answers to these questions?

Outcomes assessment allows faculty to begin to answer them. With outcomes assessment, teaching is no longer just the act of showing up in class and simply giving lectures, assignments, and exams. Teaching now includes setting goals for student learning in a course and/or curriculum, and taking responsibility for students achieving those goals. Teaching now involves determining those goals in consultation with constituencies such as employers and students. The curriculum being taught should now have opportunities for development of desired skills over time. Teaching now involves evaluating whether students have achieved the desired skills and knowledge and modifying courses and curricula to ensure that the goals are achieved (continuous quality improvement). Teaching is now based on an output model, *i.e.,* measuring the knowledge and skills of the graduate and the student moving through the curriculum, not on an input model where the output is assumed based solely on curriculum content. Teaching is no longer sufficient; student learning must be demonstrated.

Among the results of implementation of an assessment plan are faculty who know their students—who know their students' individual strengths and weaknesses and who are in a position to help individual students exploit those strengths and overcome those weaknesses. In recent years, we have heard several of the most prestigious research universities proclaim publicly that they plan to devote more time to undergraduate education. Outcomes assessment provides them with the perfect opportunity to make good on their promise.

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If we agree that the skills and knowledge that students obtain in the curriculum are what is being assessed, the next question is how to do such an assessment. This requires an assessment plan with three main elements. First, goals must be set, preferably in consultation with external constituencies. A subset of enumerating goals is to determine performance, *i.e.,* what a student must do to achieve a goal. Second, multiple measures of achievement of these goals are necessary. Among the most common measures are interviews with students, alumni and employer questionnaires, portfolios, and capstone projects. Finally, the results obtained from these measures must be used to improve the educational process.

The papers that follow describe assessment plans that all use the methodology described above, but each illustrates a different set of measures. A valid assessment plan need not and should not contain all of the elements of all of the plans described in these papers. Over-assessing is as bad as under-assessing.

Another key question is: When should assessment be done in the curriculum? The answer is: At multiple points within and beyond the curriculum. Graduates should be tracked to obtain a self-evaluation of their education. Employers should be surveyed to obtain an evaluation of their employees' education. Students about to graduate should be assessed (self-evaluation and faculty evaluation) to determine whether they have achieved the desired outcomes.

Students in the curriculum should also be assessed to determine if mid-course corrections are needed. Assessment can be done in a single course, as described in one of the papers that follows, or classroom assessment can be done to determine the outcomes of a single class.[1]

Finally, who should do the assessment? It is tempting to say "all faculty." While that would be an ideal situation, it may be unrealistic—although all faculty teaching undergraduate classes really should be involved with the undergraduate assessment plan. It is important, however, to avoid the opposite extreme! Assessment cannot be the job of one faculty member, or even worse, solely the job of an external consultant. There must be a critical mass of faculty involved in the assessment process to ensure its continuity and to ensure that all parts of the curriculum are covered.

So, now you are enthusiastic about assessment! And, after reading the following papers, you will want to learn even more about it. Where do you go? One place is to the Best Assessment Processes in Engineering Education conference held at Rose-Hulman Institute of Technology. Another is to a web page that I have created (found at http://www.cemr.wvu.edu/~wwwche/outcome/index.html) that includes the assessment references I have found most enlightening.

It should be noted that many faculty are uncomfortable with outcomes assessment, especially using it for accreditation purposes. We have become comfortable with the much-maligned "bean counting" process. As noted in several of the following papers, creating and implementing an assessment plan involves finding one good solution to an ill-defined problem. At the design level, that is what we as engineers are trained to do. So, by implementing an assessment plan, we are simply demonstrating to our students that we can solve the type of problem we expect them to solve in the capstone course.

REFERENCES

1. Angelo, T.A., and K.P. Cross, *Classroom Assessment Techniques: A Handbook for College Teachers,* 2nd ed., Jossey-Bass, San Francisco, CA (1993) ❒