Metrics and Methodology for Assessing Engineering Instruction

By C. Judson King, Susan A. Ambrose, Raoul A. Arreola, Karan Watson, Richard M. Taber, Norman L. Fortenberry and Elizabeth T. Cady

One of the challenges in balancing how faculty allocate their time among the three canonical tasks of research, teaching and service is that the only well-established assessment methods are in research—even though they're imperfect.

In recent years, increased attention has been devoted to the assessment of teaching. For example, the Association of American Medical Colleges (AAMC) issued a 2007 report that offered a conceptual framework (quantity, quality and engagement) and specific categories of educator activity (such as teaching, curriculum, advising and mentoring, educational leadership and learner assessment).[1]

We can define assessment-of-the-educator activities specified in the AAMC report as an assessment of teaching effectiveness. Based on their review of practices, Shaefer and Utschig[2] indicated that the context of such assessments is provided by the answers to the following questions:

- What is the organizational context of the assessment?
- Is participation in the assessment voluntary or mandatory?
- Whose instructional performance is being assessed?
- What professional development activities support or operate in parallel with the assessment?

The *sine qua non*—meaning, "without which there is nothing"—of academic research evaluation is peer review. Since the early 1990s, faculty at U.S. institutions have been exploring various models for implementing peer review of teaching, seeking to maximize the familiar and collaborative nature of peer review while addressing the political and methodological challenges of applying peer review to teaching.[3] Specific interest in peer review of teaching in engineering disciplines is implied in calls for greater recognition and reward of instructional innovation within a 1995 report[4] by the Board on Engineering Education of the National Research Council (NRC) and is explicitly indicated by a 2003 NRC report.[5]

In 2007, with support from the National Science Foundation, the National Academy of Engineering convened a committee of engineering educators, leaders in faculty professional development and experts in teaching assessment. They were

charged with organizing a fact-finding workshop and preparing a succinct consensus report that addressed the development and implementation of a system to measure the instructional effectiveness of engineering faculty members.

The charge to the committee was to identify and assess options for evaluating scholarly teaching, which includes a variety of actions and knowledge related to faculty members' content expertise, instructional design skills, delivery skills, understanding of outcomes assessment and course management skills. The intent of this project was to provide a concise description of a process to develop and institute a valid and acceptable means of measuring teaching effectiveness. This, in turn, would foster greater acceptance and rewards for faculty efforts to improve their performance of the teaching role that makes up a part of their faculty responsibility. Although the focus was in the area of engineering, the concepts and approaches are applicable to all fields of higher education.

The study process included a fact-finding workshop that brought together 25 experts in the areas of engineering education, institutional administration, and teaching and learning assessment. Three commissioned papers were presented relating to research in assessing instructional effectiveness, currently available metrics and what constitutes effective teaching.

Drawing on the commissioned papers, workshop discussions and additional background research, the committee (article authors C. Judson King, Susan A. Ambrose, Raoul A. Arreola and Karan Watson), with support of NAE professional staff, prepared a report[6] (www.nap.edu/catalog.php?record_id=12636) that addressed the following topics:

- Background, framing and concepts.
- Governing principles of good metrics.
- The committee's key assumptions in approaching the task.
- Attributes that should be measured and sources of data.
- How to measure and compute teaching performance.

Some stipulations

The committee reached the following stipulations and recommendations for action by institutional leaders and external stakeholders of the engineering educational system:

- Faculty instructional enrichment programs on campus often have high enrollments and are sometimes oversubscribed (relative to the resources available to faculty development programs). The optional nature of such programs and their limited resources, however, lead to low and uneven overall participation.
- The development of a thoughtfully designed and agreed upon method of evaluating teaching effectiveness—based on research of effective teaching and learning—would provide administrators and faculty members the ability to use quantitative metrics in the promotion and tenure process.
- Quantitative and broad metrics would provide faculty members with an incentive to invest time and effort to enhance their instructional skills.
- All faculty and administrators should have significant input into the design of an evaluation/assessment system and should provide feedback based upon the results stemming from the evaluation system that is developed.
- The assumptions, principles and expected outcomes of assessing teaching effectiveness should be explicit (and repeated frequently) to those subject to the evaluations, as well as to those who will conduct the evaluations.
- Information gathered for tenure and promotion evaluations will likely overlap with information gathered for professional development. These two functions, however, should remain separate, because identifying weaknesses for professional development efforts (collecting formative assessment data) is not seen as having potentially negative impacts on tenure and promotion evaluation (summative assessment data). This is a necessary safeguard that maintains faculty members' confidence that sincere effort to improve their teaching through honest evaluations of strengths and weaknesses will not result in downgraded tenure and promotion evaluations.

Recommendations

Our recommendations are that institutions, engineering deans and department heads should:

- Use multidimensional metrics that draw upon different constituencies to evaluate the content, organization and delivery of course material and the assessment of student learning.
- Take the lead in gaining widespread acceptance of metrics for evaluating teaching effectiveness in engineering. Their links to faculty and institutional administrators give them the authority to engage in meaningful dialogue in the college of engineering and throughout the larger institution.
- Seek to develop an appropriate number of evaluators who have the knowledge, skills and experience to provide rigorous, meaningful assessments of instructional effectiveness (in much the same way that those institutions seek to ensure the development of the skills and knowledge required for excellent disciplinary research).
- Seek out and take advantage of external resources, such as associations, societies or programs focused on teaching excellence—for example, Carnegie Academy for the Scholarship of Teaching and Learning, the U.K.'s Higher Education Academy and Professional and Organizational Development Network—as well as on-campus teaching and learning resource centers and organizations focused on engineering education. This includes the International Society for Engineering Education and the Foundation Engineering Education Coalition's website devoted to Active/Cooperative Learning: Best Practices in Engineering Education.[7]

Leaders of the engineering profession (including the National Academy of Engineering, American Society for Engineering Education, ABET Inc., American Association of Engineering Societies, the Engineering Deans' Council and the various engineering disciplinary societies) should:

- Continue to promote programs and provide support for individuals and institutions pursuing efforts to accelerate the development and implementation of metrics for evaluating instructional effectiveness.

- Create and nurture models of metrics for evaluating instructional effectiveness. Although each institution will have particular needs and demands, nationally known examples of well-informed, well-supported and carefully developed instructional evaluation programs will benefit the entire field.

ABET engineering accreditation criterion 6 requires that engineering faculty "must be of sufficient number and must have the competencies to cover all of the curricular areas of the program" and explicitly indicates that among the factors to be examined in judging faculty competence is "teaching effectiveness."[8] This seems to imply the accreditation regime already provides an incentive for engineering programs to adapt the scheme presented in the committee's report.

References

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