The Assessment of Teaching

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Introduction

The role of the teacher in the classroom carries tremendous responsibility. A group of students that can range from a half-dozen to several hundred depend on their professor to provide structure to a body of knowledge, to guide the learning process, to convey difficult subjects in a clear manner, to lead the classroom and out-of-class activities so that student time is used efficiently, and to provide a course of instruction in which the students can successfully complete the learning objectives. And somehow, the teacher is expected to establish some rapport with these students along the way. How does the teacher know when he or she is doing well? And how does someone who oversees a program know that the program's faculty members are teaching at an appropriate standard? This Teaching Lessons Learned installment attempts to answer these questions, using tools and techniques currently in use at the U.S. Military Academy as illustrations.

What Constitutes Good Teaching?

Before teaching can be assessed, we must first answer the question, *what constitutes good teaching?* In a previous Teaching Lessons Learned paper, we discussed the ExCEEd Teaching Model (Estes et al. 2005), shown in Fig. 1. This model is used in the ASCE ExCEEd Teaching Workshops to define the elements of good teaching. The ExCEEd model recognizes the need for structure and organization, rapport with students, and an enthusiastic, engaging presentation. Learning objectives must be clearly stated, and students should receive frequent and timely feedback against which they can measure progress and make adjustments. Different students learn in different ways, and instructors need to appeal to these different learning styles. Technology in the form of computer simulations, software demonstrations, PowerPoint slides, video clips, overhead slides, and even chalk can enhance instruction as long as it is used appropriately. The ExCEEd model represents one of many attempts to define the elements of good teaching. If the model is valid, we can then assume that a teacher who is doing everything on the list is probably teaching well.

Assessment of Teaching for the Individual

The civil engineering program at the U.S. Military Academy uses several tools to assess the teaching performance of an individual faculty member. They include student ratings, student performance, peer/mentor assessment, self-assessment, and classroom assessment techniques.

Student Ratings

Student ratings are obtained through Web-based surveys administered at the end of each course. In our Web-based survey system, the actual student ratings are anonymous; however, the instructor can track whether a student has completed the course-end survey at any given time. This feature allows instructors to reward students who have completed the survey and provide additional encouragement to those who have not. As a result, we are able to attain very high response rates.

The Web-based survey system uses a standardized set of questions that every student answers for every course at the institution (A1 to A6 and B1 to B3 on Table 1). Each department can add its own department-specific questions (C1 to C12 on Table 1), and each individual course can also add questions. Typically these course-level questions pertain to how well the respondent believed that she or he met the course objectives. The Department of Civil and Mechanical Engineering questions, which relate to instructor enthusiasm, organization, communication, depth of knowledge, concern for learning, and timeliness of feedback de-

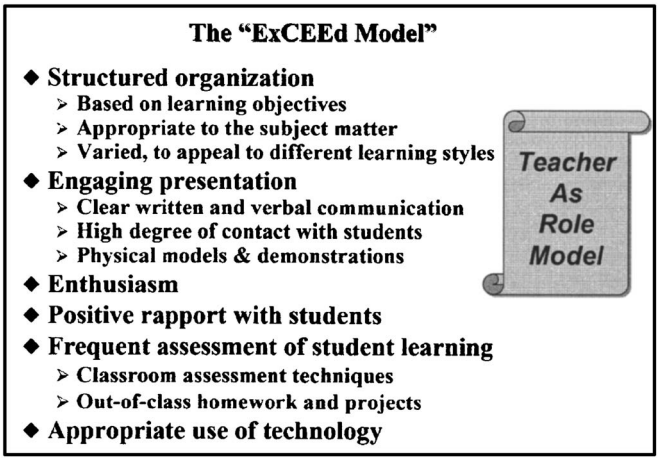

Fig. 1. ExCEEd Teaching Model (Estes et al. 2005)

Table 1. Institution and Department-Level Questions Used on Course-End Surveys in Civil and Mechanical Engineering Programs at U.S. Military Academy

USMA-level questions:

A1. This instructor encouraged students to be responsible for their own learning.

A2. This instructor used effective techniques for learning, both in class and for out-of-class assignments.

A3. My instructor cared about my learning in this course.

A4. My instructor demonstrated respect for cadets as individuals.

A5. My fellow students contributed to my learning in this course.

A6. My motivation to learn and to continue learning has increased because of this course.

B1. This instructor stimulated my thinking.

B2. In this course, my critical-thinking ability increased.

B3. The homework assignments, papers, and projects in this course could be completed within the USMA time guideline of two hours preparation for each class attendance.

Department-level questions:

C1. In this course, my instructor served as a professional role model for cadets.

C2. My instructor demonstrated depth of knowledge in the subject matter.

C3. My instructor demonstrated enthusiasm for teaching and for the subject matter.

C4. My instructor had a structure or plan for every lesson's learning activities.

C5. My instructor helped me understand the importance and practical significance of this course.

C6. My instructor used well-articulated learning objectives to guide my learning.

C7. My instructor communicated effectively.

C8. My instructor demonstrated that he or she cares about my learning.

C9. My instructor demonstrated positive expectations of the cadets in the class.

C10. My instructor used visual images (pictures, demonstrations, models, diagrams, simulations, etc.) to enhance my learning.

C11. My instructor gave me timely and accurate feedback on my learning progress.

C12. In this course, the exams were fair and relevant.

rive directly from the ExCEEd Model. For a given course, if the students react positively to all these questions, then one can rightly assume that the students believe that the quality of teaching in that course is high.

The questions are answered on a scale of 1 to 5, where 1 represents "strongly disagree," 5 represents "strongly agree," and 3 is neutral. The numbers for an individual instructor offer a nice snapshot in time, but their value is greatly enhanced when they are placed into context by comparing them with the corresponding departmental and institutional ratings. Fig. 2 shows the results from the institution-level questions for an individual instructor relative to the results of other instructors in his course, in the CE division, in the rest of the department (C&ME), and in the institution (USMA) as a whole. In addition, the surveys are repeated each semester (Fig. 3), so an instructor can track his or her performance over time to establish trends of improvement and identify areas where more effort may be needed. All the surveys also solicit freeform comments from students, so that feedback not specifically requested in the structured questions can be obtained.

Some may question the validity of student ratings as a measure of teaching ability, but extensive research (Cashin 1988) reveals that a very high correlation exists between student ratings and teacher performance. The internal consistency and stability over time of student ratings are excellent, and both measures continue to improve as the number of students participating increases (Wankat and Oreovicz 1993). Felder (1992) notes, "research shows that student evaluations of an instructor provide a reliable, valid assessment of that individual instructor's teaching effectiveness…next time someone says that there's no good way to evaluate teaching, quietly mention that one or two thousand research studies suggest otherwise."

Student Performance

A second vehicle for assessment of teaching is student performance. Certainly grades and the results of homework, projects, and exams provide an effective measure of teaching. Students can also be surveyed about their perceived ability to achieve each of the objectives in a particular course. The student data are obtained through the previously described course-end survey. In our program, the instructor in charge of each course also makes his or her own independent judgment about how well the students met the objectives. These results are presented as part of an annual course assessment process that is done for each course in the civil engineering program. Fig. 4 shows partial assessment results for our civil engineering professional practice course. The student data over several years are compared with the instructor's assessment of student performance. Note that the students believe that they have a much greater understanding of the difference between bidding and quality-based selection than the instructor believe that they have. The most recent students (Term 04-2) believe that they have a greater understanding of the characteristics of a profession and a lesser understanding of the challenges facing civil engineers in practice than students in previous years, but the difference is not large in either case. Large changes over time and significant discrepancies between the students' and instructors' assessments are areas that merit the instructor's attention.

Students' grades over time can also be an indicator of student performance. Fig. 5 shows student grade-point averages for a given course over time. After having used this measure for a few years, we realized that the final course average tends to reflect both students' performance in the course and students' overall academic capabilities. To separate these two influences, we began tracking the students' incoming grade-point average in 2002, as indicated in the graph.

Many variables can affect grades. Final course grades are probably useful as an assessment tool only if there is a large change from the previous year's performance. In the USMA civil engineering program, term-end examinations are never returned to the student and are carefully safeguarded. As a result, only minor changes (typically less than 20%) are made from year to year on the final exam. This practice ensures that the final exam provides a reasonably consistent measure of students' performance from year to year. Fig. 6 shows the student averages on a similar final exam over time. In this course, adjustments made in the second semester of Academic Year 2001 made the final exam less challenging than desired. The instructor overcompensated a bit during the following semester, and the results returned to steady state in the next iteration.

Angelo (1993), Chickering and Gamson (1991), and Wankat and Oreovicz (1993) all suggest that student learning increases with the amount of high-quality time that the students spend on course activities outside the classroom. The Department of Civil and Mechanical Engineering conducts time surveys during each

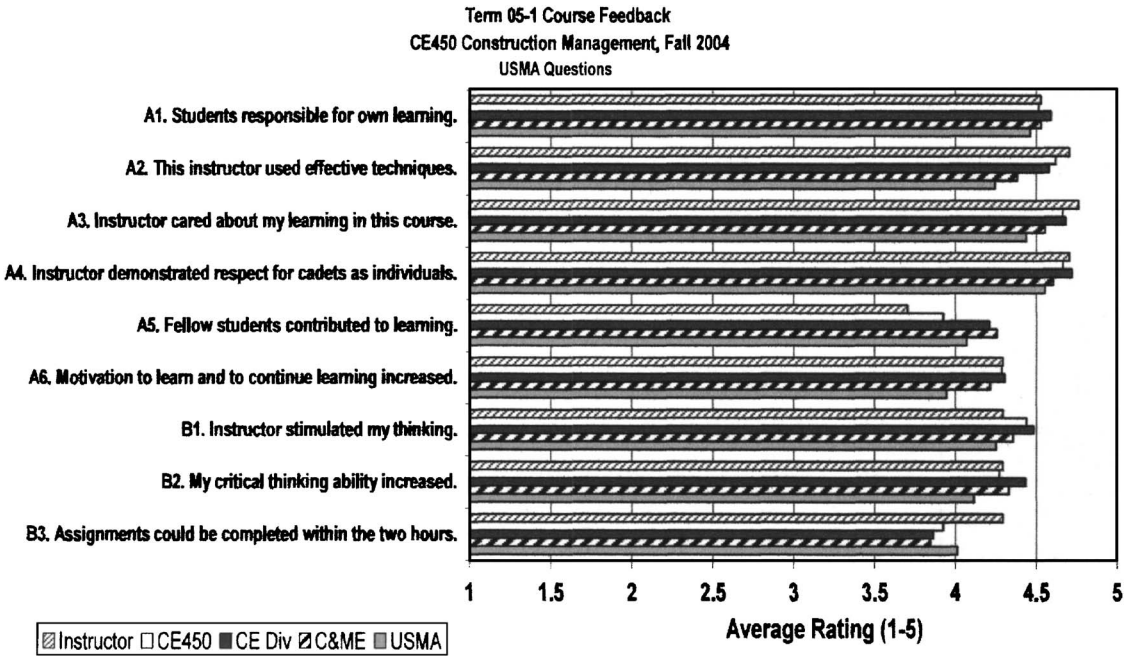

Fig. 2. Individual instructor ratings compared against corresponding ratings for course, program, department, and institution

lesson to measure the amount of time spent on out-of-classroom activities for the course. These data provide an assessment about whether the instructor is assigning too much or too little out-of-class work. The data are obtained anonymously by passing a survey sheet around the class during every lesson. The student records the amount of time in minutes that he or she has spent working on a given course since the previous class meeting. Fig. 7 shows the average time spent for each lesson and the cumulative time over a 40-lesson semester for an individual course. The cumulative time came to approximately 51 minutes per student per lesson over the semester. For our situation and student load, we have found that a range of 50 to 80 minutes per lesson in each course is a desirable target. Fig. 8 shows the average time spent by students in a course over time. An appreciable rise or drop in time is cause to examine what may be done differently in a course, and unreasonably large spikes of time (Fig. 7) might in-

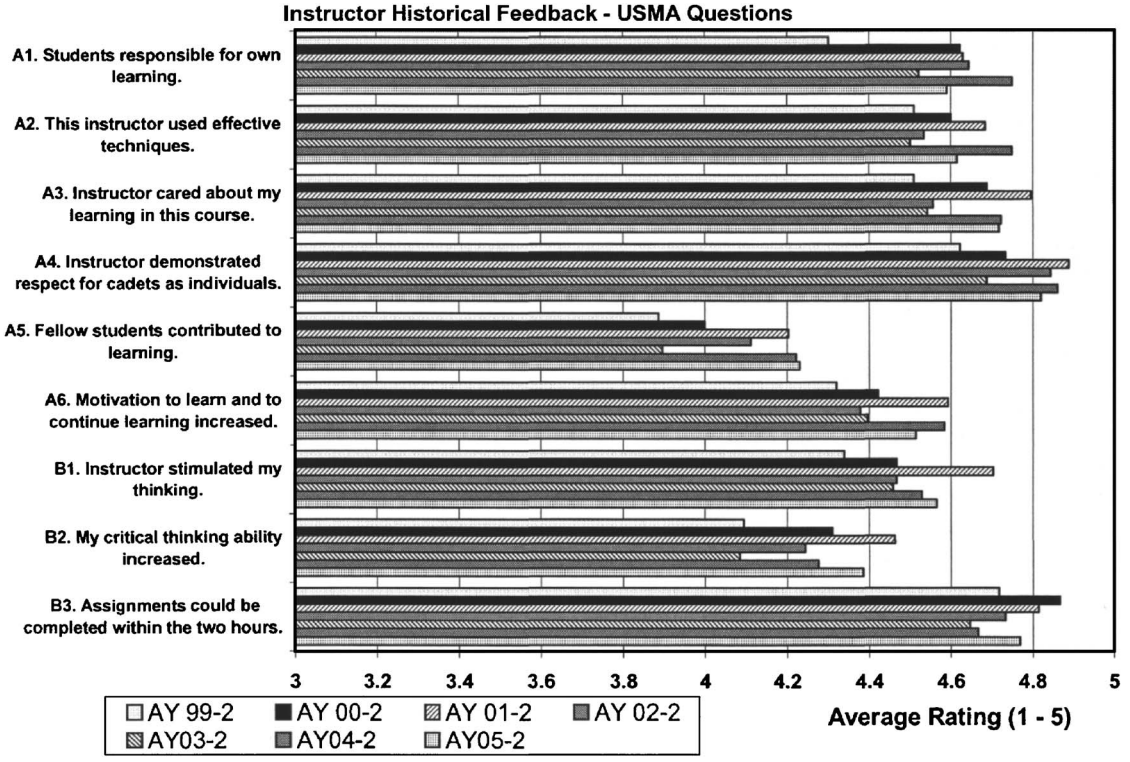

Fig. 3. Instructor ratings over time for institution-level questions

Table of Course Objectives	Cadet Assess.			CD
	02-2	03-2	04-2	Score
Describe the characteristics of a profession.	4.33	4.21	4.52	4
Describe the roles and responsibilities of the principal members of the Project Team.	4.24	4.11	4.10	5
Analyze how the quality of a constructed facility is affected by the interactions between the members of the Project Team.	4.29	4.33	4.59	5
Explain the advantages and disadvantages of bidding vs. quality-based selection processes for acquiring engineering and construction services.	---	4.57	4.21	3
Apply the ASCE Code of Ethics to the solution of an ethical problem confronting a practicing engineer.	4.27	4.52	4.47	4
Demonstrate an appreciation of the multi-faceted challenges facing CEs in professional practice.	4.22	4.28	4.12	4
Describe the professional registration process.	4.07	3.96	4.11	3.5

Fig. 4. Assessments of achievement of course objectives from civil engineering professional practice course, showing student self-assessments over three semesters and course director's assessment

dicate that a particular assignment was too demanding. In this course, problem sets 1 and 3 (Fig. 7) might need some revision, and the overall out-of-class requirements could be increased.

Peer/Mentor Assessment

Another means of teaching assessment is the personal observation of one faculty member by another. West Point has a large annual turnover of instructors, since many of our military faculty teach for three years and return to the field army. We therefore conduct a rigorous six-week teacher training program each year. In this program, new instructors observe demonstration classes taught by veteran faculty members, attend seminars on how to teach, and then teach seven practice classes to an audience of their peers and senior faculty members. The instructor is videotaped and receives a detailed assessment after each class. A standardized teaching assessment worksheet is used to guide the assessment (Fig. 9). The front side of the worksheet includes space to write the instructor's strengths and areas of improvement as they occur throughout the class. The observer specifically gives a rating of "needs work," "good," or "excellent" in specific areas relating to technical expertise, lesson organization, conduct of the class, and the classroom environment. These areas, as shown in Fig. 10, relate directly back to the ExCEEd model. The numbers in the remarks section refer to specific strengths and areas for improvement cited previously. As a final conclusion, the observer makes a judgment about whether the students could complete the lesson objectives on the basis of the completed class and suggests the top three areas on which the instructor should focus for the next class.

As the school year progresses, these personal observations continue. The program director visits each instructor at least once per year, and the group director visits at least once per semester. Additionally, each instructor is required to observe three lessons from different instructors each semester. A teaching assessment worksheet is completed and given to the instructor after each of these class observations, and the instructor and observer together discuss the elements of each class.

Wankat and Oreovicz (1993) note that peer ratings can be internally inconsistent. They can be adversely affected by profes-

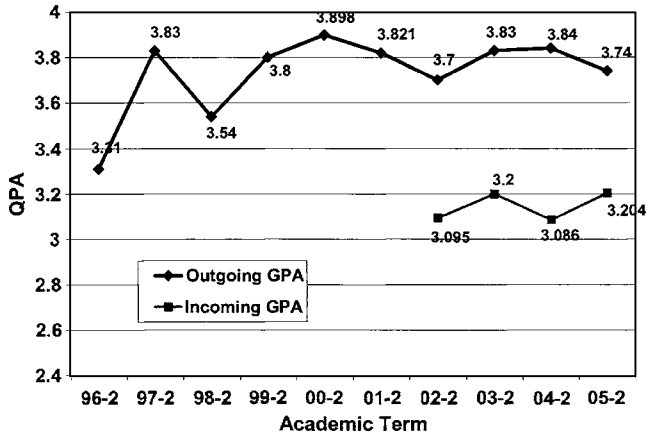

Fig. 5. Graph of course grade-point average over time, compared with incoming grade-point average of enrolled students

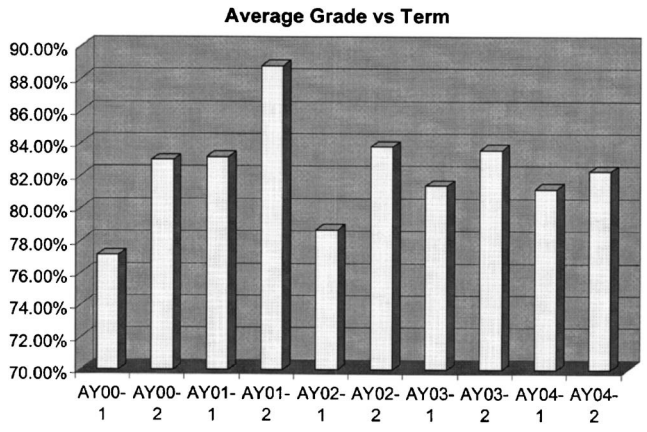

Fig. 6. Graph of final exam performance over time

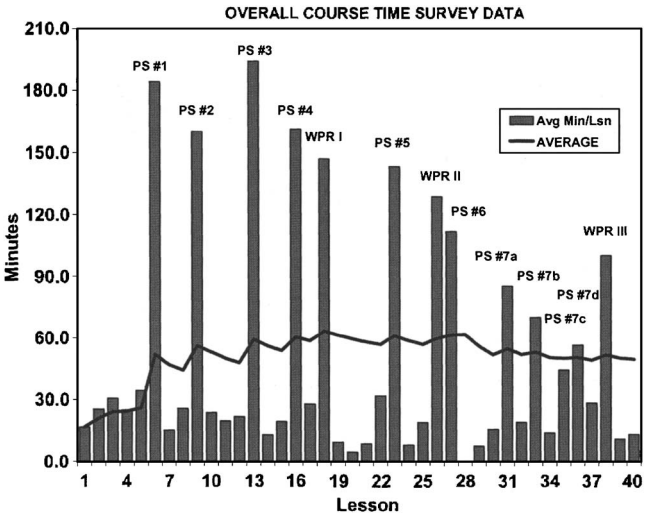

Fig. 7. Time survey data for course over 40-lesson semester, showing minutes of out-of-class preparation per lesson and cumulative average

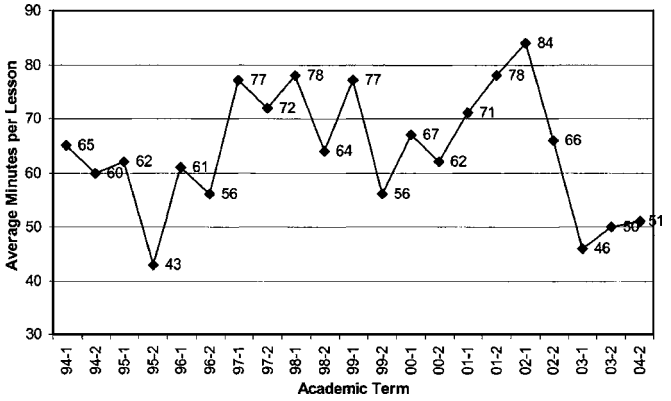

Fig. 8. Average out-of-class preparation time per lesson for course over time

sor reputation, personal agenda, ego, deference, and teaching style preference (Lowman 1995). The validity of peer ratings improves considerably if the rating faculty member has some training in assessment and if the evaluation is conducted in a structured manner. The teaching assessment worksheet (Fig. 9) attempts to provide such structure.

Self-Assessment

During the instructor summer training program, our new instructors are asked to complete a self-assessment to enable them to continue to improve their teaching throughout the semester. Once the academic year begins, these instructors will not have an observer in most of their classes, and so they will need to be able to recognize areas that require improvement on their own. ExCEEd teaching workshop participants perform similar teaching self-assessments during the workshop.

Educational research suggests that the correlation between instructor self-ratings and student ratings is low (Wankat and Oreovicz 1993). Instructors tend to rate their own performance significantly higher than do their students. Validity is improved when the instructor discusses the self-assessment with a mentor. Self-assessment also tends to be more reliable when an instructor focuses on a specific course and seeks feedback through a well-structured and comprehensive questionnaire.

Classroom Assessment Techniques

Angelo and Cross (1993) proposed a number of classroom assessment techniques that assess student learning and that can provide the professor with some quick and early feedback. A few examples include the minute paper, the muddiest point paper, and the approximate analogy. The minute paper asks student to summarize the main learning point at the end of a lesson. As the name suggests, the exercise is completed in about 60 seconds, and the instructor can rapidly assess whether students grasp the major importance of a topic. The muddiest point paper provides more targeted feedback, as since students are asked to identify the topic that needs the most clarification. The instructor can work to improve a specific explanation or illustration of a concept. The approximate analogy asks the student to make a connection between the new material and something that they have seen before. Good performance on the approximate analogy is a sign that the students have begun to internalize a concept and are progressing beyond rote memory. Effective and frequent questioning of students (Estes et al. 2004) can also provide valuable feedback on student understanding, teacher rapport, and general morale in the classroom.

Program Level Teaching Assessment

A department head or program director may wish to assess the quality of teaching in his or her area of responsibility. The same student survey tools can be used to compare the ratings of various courses in the program, as shown in Fig. 11. The results help indicate where more attention is needed. Of course, a disparity may exist between upper-division design courses and lower-level engineering science courses because of the relevance of the material, the size of the class, and the relationship between the instructor and the student. Data over time may better indicate whether there is a problem with a particular course.

A department leader can also observe classes personally. Class observations take a lot of time, but if spaced over the period of an entire semester or academic year, visiting every faculty member at least once is possible.

A very positive way to assess teaching is to implement a teaching awards program, in which the best teachers are visibly and prominently honored. A financial reward or genuine credit toward tenure would attract everyone's interest. The West Point civil and mechanical engineering programs have implemented an annual teaching award for instructors with less than two years of teaching experience and another for veteran instructors. Peers and department leadership make the nominations. The winner is decided on the basis of student ratings, classroom visits (by a committee that represents the entire faculty), and teaching portfolios.

Conclusion

Classroom teaching is a critically important factor in student learning and motivation. Teaching is an art, and everyone does it

TEACHING ASSESSMENT WORKSHEET

INSTRUCTOR: _____ **ASSESSED BY:** _____

LESSON TOPIC: _____ **DATE:** _____

STRENGTHS:

1	
2	
3	
4	
5	
6	
7	
8	
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AREAS FOR IMPROVEMENT:

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Fig. 9. Teaching assessment worksheet

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	Needs Work	Good	Excellent	Remarks
TECHNICAL EXPERTISE				
Command of the Subject Matter				
LESSON ORGANIZATION				
Lesson Objectives				
Organization of Boards & Classroom Activities				
CONDUCT OF THE CLASS				
Enthusiasm, Energy, and Confidence				
Orientation to the Subject Matter				
Clarity of Presentation *(boards, viewgraphs, etc.)*				
Clarity & Precision of Explanations				
Voice *(volume, speed, variation)*				
Questioning & Answering Questions				
Contact with Students				
Visual Aids and Demonstrations				
Time Management				
Appropriate Use of Textbook				
THE CLASSROOM ENVIRONMENT				
Classroom Appearance				

OVERALL ASSESSMENT:

Are the students who attended this class adequately prepared to accomplish the Lesson Objectives? ☐ **No** ☐ **Not sure** ☐ **Yes**

Specific areas on which to focus during your next class:

1. _____

2. _____

3. _____

Fig. 9. (*Continued*).

	Needs Work	Good	Excellent	Remarks
TECHNICAL EXPERTISE				
Command of the Subject Matter		✓		
LESSON ORGANIZATION				
Lesson Objectives			✓	11
Organization of Boards & Classroom Activities			✓	Nice flow!
CONDUCT OF THE CLASS				
Enthusiasm, Energy, and Confidence			✓	
Orientation to the Subject Matter			✓	
Clarity of Presentation *(boards, viewgraphs, etc.)*		✓		
Clarity & Precision of Explanations		✓		16, 19
Voice *(volume, speed, variation)*			✓	
Questioning & Answering Questions		✓		6, 21
Contact with Students			✓	very engaging.
Visual Aids and Demonstrations			✓	8, 10, 22
Time Management		✓		16
Appropriate Use of Textbook			✓	2
THE CLASSROOM ENVIRONMENT				
Classroom Appearance				

OVERALL ASSESSMENT:
Are the students who attended this class adequately prepared to accomplish the Lesson Objectives? ☐ No ☐ Not sure ☑ Yes

Specific areas on which to focus during your next class:

1. Work on precision in use of terminology
2. Use more directed questions; fewer "jump balls"
3. Find an alternative to "guys" in referring to students

Fig. 10. Portion of teaching assessment worksheet, completed by observer

somewhat differently. Good teachers must use their own personality traits and natural abilities to their best advantage. Some would contend that standardized assessment is therefore impossible. This article has attempted to demonstrate otherwise. Even though personalities and specific techniques will vary considerably, certain elements are universal to good teaching. They include knowledge, enthusiasm, rapport, and organization. The ExCEEd model is just one attempt to capture these elements. Once these elements have been identified, they can be assessed by using a number of indicators. An amalgam of colleagues' feedback, students' performance, personal observation, students' time on task, and student ratings can be used in combination to perform an assessment. When these data are compared over time and against other courses and instructors, they constitute a valuable

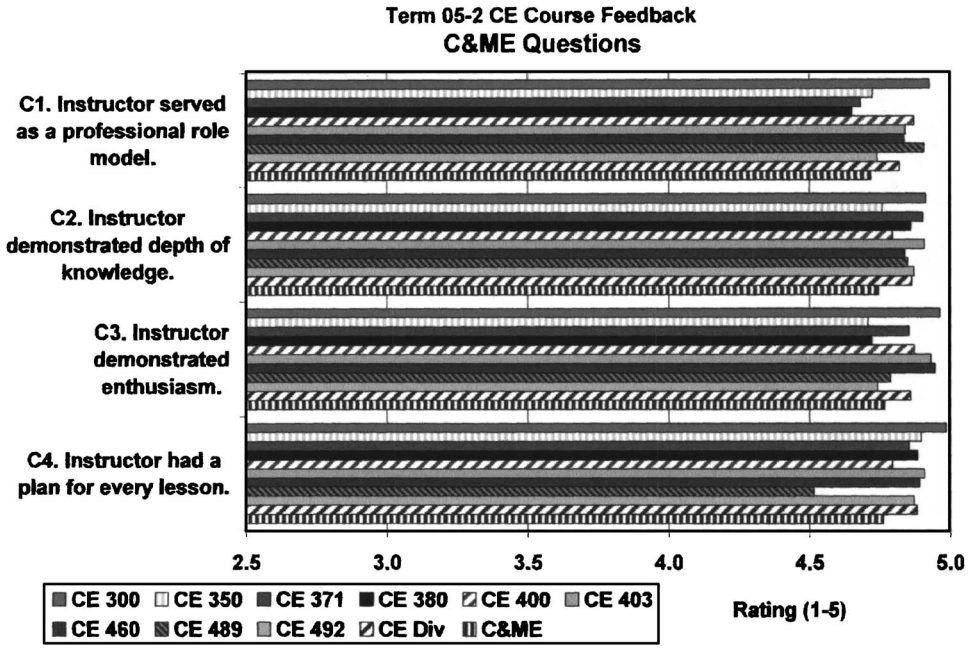

Fig. 11. Comparison of student ratings for various courses in civil engineering program

and valid tool for assessing teaching by an individual and within an entire program.

When Seymour and Hewitt (1997) conducted their landmark study about why students leave math, science, and engineering programs in such high numbers, the clear and compelling reason cited by the 335 students from seven different institutions was poor teaching. The students were asked how to improve this situation. Their collective response was to call for effective teacher training, more senior faculty mentoring, and a system in which good teaching is recognized and rewarded. This eight-part series of Teaching Lessons Learned articles has attempted to provide theories, tools, and techniques that will help civil engineering educators fulfill these students' insightful recommendations.

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