TEACHING LESSONS LEARNED

This is a continuing series of quarterly articles on lessons learned and best practices in civil engineering education. The intent of the series is to reinforce good practices, describe new or developing practices, and provide a forum for what works well and what does not. It is hoped that this series will be an important quarterly read for all civil engineering educators and all those interested in what's going on in civil engineering education today. Authors and topics will vary from issue to issue. Contact the Associate Editor, Mark Evans (im8670@usma.edu), if you wish to contribute to an upcoming issue.

I AM A GOOD TEACHER—OR AM I?

I am a good teacher—or am I? This Shakespeareanlike question is one I recently asked myself and one that all instructors should consider in their teaching careers. Occasional self-reflection regarding the type of teacher you are, in consultation with evidence of teaching effectiveness, is necessary for growth as a teacher.

So, what makes a good teacher? If a teacher receives high marks on their end-of-term student evaluations, does that make them a good teacher? We all enjoy receiving good marks and take pride in the fact that students enjoy our courses, but can we use student evaluations to determine our worth as teachers? Pessimists will argue that student evaluations are deceiving and good marks go to ''popular'' or ''easy'' teachers. In some respects, this is true. Popular teachers are frequently good teachers who pique their students' interest in subject matter. Significant research has been performed that indicates that student evaluations can provide a reliable assessment of an instructor's teaching effectiveness (Felder 1992). However, receiving good evaluations should not be the final determination that someone is a good teacher.

Another feature of a good teacher is one who cares whether or not the students succeed and makes that fact very obvious to them. Concern for students is very important and frequently neglected. Here, lack of concern does not refer to teachers who run ''unsafe'' laboratories. Rather, it refers to teachers who have an apathetic attitude to a student's overall well-being. When we were students, our favorite teachers were frequently those who expressed interest in our achievements and cared whether or not we were successful. Why would our students not feel the same way? In fact, a recent study at North Dakota State University (Mehta and Danielson 2000) interviewed students, graduates, and teachers to determine what each thought were the most important factors for improving their learning. The survey showed that concern for students and their ability to learn the material was the second most important characteristic behind the ability to explain subject matter clearly. Therefore, a good teacher cares about their students and has the ability to express this concern. Unfortunately, concern for students is something many engineering teachers do not express. For most of us, it is probably a matter of stoicism and not a true lack of concern. Most teachers probably don't realize the impact expression can have. Try to develop a good rapport with your students by learning their names and showing an interest in them as students and individuals. This creates a more open learning environment in which students are more likely to excel (Marsh 1984; Wankat and Oreovicz 1993; McKeachie 1999).

Encouraging student feedback is another sign of a good teacher. Some students will gladly and openly share with you their concerns for a course, however, just as many won't feel comfortable talking to you. A solution to that problem is to solicit anonymous feedback. For example, have your students voluntarily submit comments on 3 by 5 note cards once a week. On those cards they can candidly address issues such as course speed and content, the most interesting subject of the week, or the most confusing subject of the week. The distinct advantage to this method is you will get a sense of how the whole class feels and not be swayed by a vocal minority. This concept is very similar to ''Minute Papers'' advocated by Angelo and Cross (1993) in which students take the last two minutes of class to write about the clearest and muddiest points of the days lecture. The next lecture then begins by addressing students' evaluations of the previous lecture. A more formal feedback structure can also be useful. In fact, one study shows that students of teachers who received midterm student feedback were more motivated to learn and scored higher on achievement tests than students of teachers who did not utilize midterm feedback (Felder 1992). Midterm feedback is also important because students believe they are having an effect on the course, as they should. End of the term evaluations are frequently viewed as nontimely, since whatever a student writes won't affect them.

A good teacher is one whose presentation style successfully maintains students' interest. This seems obvious, yet many teachers do not adequately capture and keep a classroom's attention. One example would be to utilize the whole room. Students will pay more attention to you if you leave the podium and blackboard and interact with them directly. Imagine their surprise the first time you venture up the aisle during a discussion on the current material. Another good example is to express enthusiasm for subject matter. By inflecting your voice, changing your facial expressions, and getting excited about the material students will see how important and fascinating you find the material. This enthusiasm for the subject matter will hopefully transfer to them. Another good example is to inject a little humor into the course. Students will relate better to an instructor who they perceive as human. The key here is to not become a stand-up comedian or someone they do not respect. The humor should be anecdotal and relevant, not offensive and deprecating.

Studies have shown that students respond favorably to

this type of open and entertaining classroom environment (Marsh 1984; Wankat and Oreovicz 1993). It is always rewarding to receive student evaluations in which they cited teacher enthusiasm for the subject matter as the primary reason they enjoyed the course and learned so much. Enthusiasm for subject matter can be especially important in courses that the students perceive as boring. For example, students who dreaded my *Probability and Statistics* or *Numerical Methods* courses before the term started ended up having a ''positive experience.'' Overall, the most important thing is to create an atmosphere in which they feel comfortable and are willing to participate and learn. A student should attend class because they enjoy and benefit from it, not because attendance is mandatory.

An extremely important consideration for all of us is the concept of learning styles and how people typically learn (Wankat and Oreovicz 1993; Felder 1993; Felder and Brent 2000). Realizing how our students process knowledge should play a key role in our self-evaluation and what we might do to improve.

A majority of our classes are typically taught deductively, or ''top-down.'' For example, we start with the assumptions, then derive the formula, and finally write an example or two on the board. In actuality, induction, or ''bottom-up,'' is a more natural human learning style. In inductive learning, observations or experiments come first and then progress is made toward a solution. It has been shown that induction is better for long-term retention and the transfer of logic, yet it's commonly neglected in the classroom. Deduction tends to be the more common teaching style because it's how we were instructed, and once someone has a grasp on the material it is easier to present. It is important to realize that the two are not dichotomous and people learn both ways, they just have a preference for one over the other.

Many teachers also have the tendency to neglect visual learners, which compose a majority of the population. When we lecture, we write formulas and examples on the board and then describe what we have done. This method really only caters to the verbal learner. Since science and engineering problems frequently lend themselves to visual aids, there really is no excuse not to incorporate them into the classroom. Incorporate more multimedia outlets during presentations including slides, colored overheads, PowerPoint presentations, and CD-Rom demonstrations. Bring laboratory style demonstrations into the classroom to help pique student curiosity and maintain interest levels. Also, bringing ''real-world'' problems and examples into the classroom is very well received by the students and often is cited as an important part of their learning experience.

Finally, and perhaps most importantly, a good teacher should incorporate active learning into their classroom. Signs of a poorly managed classroom are when students sit passively listening to the instructor. In such classrooms, students may occasionally ask questions and provide answers to questions asked of them, but rarely are they actively engaged. Experiments have shown that humans tend to lose focus after 20 minutes or so and that student retention of material is greatly increased when the class is broken into segments (McKeachie 1999; Felder and Brent 2000). However, most teachers will lecture for an hour or more without a real break. In an active learning environment, the instructor employs a variety of teaching techniques, students are engaged in the material and are interacting with each other as well as the instructor. In doing so not only will their learning be enhanced, but they too become ''teacher.''

If we do not employ a variety of teaching methods or address more than one learning style, we are doing a disservice to students. In fact, we may be unintentionally ''weeding out'' good students who just process information differently than we present it. Frequently we do not hear any complaints because our students are largely unaware of alternative learning styles and teaching methodologies. Instructors who address more than one learning style in their lectures will not only accommodate a larger audience but will help students grow as ''learners,'' because they will see examples in more than one style. Overall, there are numerous ways to implement active learning (Johnson et al. 1998; Felder and Brent 2000; Budny 2000); the important thing is to implement techniques that are productive and comfortable for both you and your students.

Another technique employed by good teachers is the use of instructional objectives (Stice 1976). Many instructors include a few course goals or objectives on the syllabus, but they tend to be very general. An instructional objective should be formulated like ''at the end of this [course, chapter, section, lecture], you should be able to [calculate, solve, derive, compare, explain, identify, etc.] (Felder and Brent 1997).'' By specifically writing instructional objectives for each section of a course, you can better communicate your expectations to the students. Instructional objectives can also benefit an instructor since they can also assist in the design of the course. By stating what you feel your students should be able to accomplish, you can better plan lectures, assignments, and exams so that those objectives are met. When using instructional objectives to write exams, exams may get more difficult while scores still improve. Why? Because students have a clear picture of what is expected of them and complain less if they do poorly. After all, they knew what to expect. One important point when writing instructional objectives is to avoid the verbs: know, learn, appreciate, and understand. While these are important, they are not directly measurable so it will be hard to determine whether students are meeting your expectations (Felder and Brent 1997).

Another advantage of using instructional objectives is they can help you address higher level learning skills. According to Bloom's Taxonomy (Bloom and Krathwohl 1984), there are six levels of learning skills: knowledge,

comprehension, application, analysis, synthesis, and evaluation. The first three are considered lower level learning skills and are at the level many undergraduates tend to plateau. They have the ability to solve and understand but not to analyze, formulate, and evaluate. Writing objectives for your courses can assist you in determining whether your students are operating only in the lower levels and help them expand into higher level skills. After all, it should be a goal of all teachers to expand our students' abilities.

As we start a new century, it is time for all educators, especially those in engineering, to reflect upon their teaching styles and abilities. Views toward education and what makes successful teachers are changing, and it is important for us to keep ahead of, or at least keep pace with, educational trends. Traditionally, as engineering educators, we receive no formal training on how to teach, so our professional development is largely our responsibility. The resources to improve are available in a variety of forms. For example, there are many books available that offer great advice to improve teaching, including Wankat and Oreovicz (1993), Angelo and Cross (1993), Lowman (1995), Johnson et al. (1998), and McKeachie (1999).

Another great source for teacher improvement are the many workshops held in conjunction with conferences, such as Frontiers in Education or the American Society of Engineering Education National and Regional Conferences. Some workshops, like ExCEEd (Excellence in Civil Engineering Education), are separate events held on campuses. Many individuals as well as the Educational Research and Methods Division of ASEE will make special arrangements to give workshops on your campus.

There are also numerous websites devoted to teaching and engineering education, such as:

- Resources in Engineering and Science Education: *http://www2.ncsu.edu/effective_teaching/*
- American Society for Engineering Education: *http://www.asee.org/*
- National Science Foundation Engineering Education Coalition: *http://www.needs.org/coalitions*
- Engineering Education: Assessment Methodologies and Curricula Innovation: *http://www.engrng.pitt.edu/~ec2000*
- University of Michigan Center for Research on Learning and Teaching: *http://www.umich.edu/~crltmich/*
- Stanford Learning Lab: *http://sll.stanford.edu/*

In conclusion, am I a good teacher? This question should be considered regularly by all of us. Hopefully we are doing well, but recognition that there is always room for improvement will help us develop into better teachers.

The opinions expressed here are entirely the writer's and are intended to promote meaningful discussion.

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