Chemical Engineering Education, 33(1), 32–33 (1999)

FAQs

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At the teaching workshops we give, we propose a variety of instructional methods that deviate from traditional teaching practice. We recommend, for example, that instructors break up their lectures at frequent intervals with brief individual or small group exercises. We suggest using formal cooperative learning, in which students work on assignments in instructor-formed teams under conditions structured to assure individual accountability for all of the assigned material. We caution against giving tests that only the best students in the class have time to finish, and we argue strongly against curving grades.

Predictably, critical questions are raised about these recommendations and others we offer. In a series of columns beginning with this one, we review some of the most frequently asked questions (FAQs) and our responses. We have two reasons for doing this. First, the suggestions we offer at the workshops are far from unique with us: they are being made with increasing frequency by educational researchers, national study commissions, employers of engineering graduates, and accrediting bodies like ABET. If you have not already been exposed to them, you almost certainly will be before long, and some of our responses may be helpful as you consider the ideas being advanced. Our second objective is to offer those of you who are already using the new methods some answers to give your colleagues, administrators, and students, who are certain to raise the same questions with you.

Here, then, is our top ten list of questions frequently asked at teaching workshops.

1. *Is there any real evidence that these methods work?*

2. I have a lot of material to get through in a semester. *Can I use these methods and still have time to cover my syllabus?*
3. I teach a class of 175 students in a fixed-seat auditorium. *Will these methods work in large classes?*
4. I'm teaching a course by distance education. *How can I get students active when I'm not in the same room with them?*
5. I tried putting students to work in groups, but some of them hated it and one complained to my department head. *Why are some students so hostile to cooperative learning and what am I supposed to do about the hostility?*
6. Many of my students are (a) unmotivated, (b) self-centered, (c) apathetic, (d) lazy, (e) materialistic, (f) unprepared, (g) unable to do high school math, (h) unable to write, (i) unable to read, (j) spoiled rotten. (Pick any subset.) *How can you teach people who don't have the right background or the willingness to work or even the desire to learn?*
7. Engineers constantly have to face deadlines. *What's wrong with giving tests that only the best students have time to finish?*
8. *What difference does it make if my test averages are in the 50's, since I'm going to curve in the end?*
9. My department head says that we can't count teaching too much in promotion and tenure decisions because we don't know how to evaluate teaching. *Is there a meaningful way to evaluate teaching?*
10. The people who go to teaching workshops are mostly excellent teachers—the ones who most need to change wouldn't go to a teaching workshop at gunpoint. *How can I persuade my traditional colleagues to do some of the nontraditional things you're recommending?*

The workshop participants who ask these questions are doing what they have been trained to do as scientists and engineers and educated people, which is to ask for hard evidence before changing the way they've always done things. We applaud them for asking. In this column we'll offer an answer to the first question, and subsequent columns will deal with the others.

Q: *Is there any REAL evidence that these nontraditional methods work?*

A: *Tons of it*.

Cognitive and educational scientists have learned a great deal about learning in recent years. The near-unanimous consensus is that we learn mainly by doing things and reflecting on the outcomes, taking in relatively little of what we just see and hear (e.g., in lectures) and retaining even less. Countless studies have compared the academic performance and attitudes of students taught using active and cooperative methods with the performance and attitudes of students taught more traditionally. The evidence for the effectiveness of the nontraditional methods is overwhelming. (Specific references will be cited shortly.)

Unfortunately, most professors have never seen a monograph, paper, or seminar on research into teaching and learning and would be hard pressed to name a journal or conference where such research might show up. When the "Prove it!" card is played at our workshops (and even if it isn't), we therefore urge our questioners not to take our word for anything we say but to approach the matter scientifically and check the literature. We point them to a series of three papers in *Chemical Engineering Education* written by Jim Haile,[1] which collectively provide the best summary we've ever seen of what cognitive science has discovered about the learning process and the implications of this knowledge for teaching. We introduce them to the classic *Teaching Tips,*[2] in which Wilbert McKeachie offers an abundance of practical suggestions about

every aspect of college teaching along with citations of the research that backs up the suggestions. We tell them about *What Matters in College,*[3,4] Alexander Astin's monumental study of nearly 25,000 students at over 300 institutions that powerfully demonstrates the deficiencies of the traditional instructional model. We cite references on cooperative learning (e.g., Johnson, Johnson, and Smith[5]) that in turn cite hundreds of research studies attesting to the effectiveness of this approach, and we discuss the results of a longitudinal study one of us carried out of the effectiveness of cooperative learning in chemical engineering education.[6,7] "Browse these references," we urge. "*Then* decide whether the research and the methods we're advocating are worthy of serious consideration."

More to come.

References

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5. D.W. Johnson, R.T. Johnson, and K.A. Smith, *Active Learning: Cooperation in the College Classroom*, 2nd Edition. Edina, MN, Interaction Book Co., 1998.
6. R.M. Felder, "A Longitudinal Study of Engineering Student Performance and Retention. IV. Instructional Methods and Student Responses to Them," *J. Engr. Education, 84* (4), 361–367 (1995). (View at < *http://www2.ncsu.edu/unity/lockers/users/f/felder/public/Papers/long4.html* >.)
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