Alternatives to Traditional Lecturing

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The Traditional Large Lecture Session

As a student of the profession of teaching, I have watched many teachers give classroom lectures. Mostly they talk and write at the board or overhead projector. Although most lecturers would disagree, there are actually only occasional times when they ask or answer a question.

Class size is often an issue when teaching is discussed. While we can image one-on-one teaching, or teaching in small groups, much chemistry teaching is done in large groups. The classrooms that I have most recently worked in hold over 200 students, and they are not the largest of lecture halls. What is it like to be one among the group in a very large lecture hall? I think students are easily lost. Some say the large universities attract students whose style favors the anonymity of large classes. Most of the students, I suspect, have little idea of what they face in college, and few really appreciate these large classes.

This paper concerns activities we can use as alternatives to traditional, large-class lecturing. Lecturing is fun. When you are good at it, lecturing is fun for both the lecturer and the lecturee. Popular lecturers are clear, tell good jokes, respect the class, and provide structure. By respect the class, I mean that they take the students to be serious about learning.

At best, providing structure by a lecturer usually involves indicating to students the parts of the text to be skipped. At worst, it is telling students exactly what is on the exams so that recall without processing can lead them to success. The reality of the human condition is that all learning demands structure. When you give lots of structure for a problem, performance on the problem improves. The term often used by critics to describe providing structure is spoonfeeding.

Among my alternatives to traditional lecturing I find no alternatives to texts. Obviously texts alone do not lead to learning. If they did we would not have schools—just examinations and examiners. Remember, many lecturers' main contribution in class may be to tell students which parts of the book will be covered on exams.

Canned Lectures

In my course we add structure to the text using canned lectures (1). This includes lap-dissolve slide programs, classnotes, detailed assignments, and help coordinated between assignments and available resources. About 50% of the available lecture time is devoted to presenting "canned" materials. Two, three, or four modules lasting an average of 8 min each are shown each period.

All canned lectures are transferred from slides to videotape, and are available for very detailed review of the content presented. There are student notes for every lecture. The notes contain assigned problems, worked-out answers, and references to help. The notes provide support for in-class experiments. Almost everything is in the notes, and few student additions are needed.

Studies show that students can either mentally process what you say or write notes; they cannot do both simultaneously (2). The processing is potentially more efficient for learning. If there is a drawback, it is that students using these notes seem to read less in their texts. Again, with these notes everything presented can be subjected to careful review.

Few other schools use canned lectures. Rod O'Connor used to give canned lectures by TV at Arizona (3). At Illinois, a system credited to Gil Haight has used TV for a decade (4,5). This latter system incorporates prerecorded demonstrations and experiments into the TV lectures, including having students take dry-lab data. Live demonstrations are now coordinated into class; carts are prepared with materials for TA's to use in the classroom. There are daily lecture notes for TA's. For each day there is a lecture outline, and there are objectives in a syllabus that students buy for the course.

When details are put aside, the Illinois and Nebraska courses have nearly identical features. The biggest difference is that Nebraska uses senior faculty in large classes while Illinois uses TA's in small classes. Unless you known who the teacher is, there is no a priori basis for claiming one approach to be superior to the other. When you measure student attitudes, and when the course is run at its best, the canned methods get just as good evaluations as do conventional lectures. The canned methods, however, always cover more ground.

Other Alternatives to the Traditional Lecture

Demonstrations and Lecture Experiments

Suppose you do not want to become immersed in media, but you do want alternatives to lecturing. You can start by doing demonstrations and lecture experiments. Because we store visual and auditory memories differently (6), the likelihood that we will recall material is increased via lecture experiments. Also, doing demonstrations gives students a chance to reason out loud and to hear you reason out loud, which are among the best ways to get them to think. In a large room you may need a TV system for image magnification.

Suppose you wish to do a demonstration where students have a chance of predicting in advance what will happen—say, boiling hot water using ice, or pouring liquid nitrogen and liquid oxygen over a magnet. Here is a protocol for questioning. First, tell them what you will do. Have them predict the outcome out loud. Then do it. Observe the outcome. Finally, have them rationalize the outcome and confront any inappropriate predictions. Demonstrations can be fun for you, but they are also lots of work. (No matter how you do it, good teaching means a lot of work.)

Computer Simulations

You can also use computer simulations in the lecture, as was illustrated by Tom Lippincott's simulation of a viscosity experiment in the first talk in this symposium. In this area any institution may have an individual that can develop a "super" simulation for lecture. We keep a computer in the lecture room, and use it every day to present a student newsletter of class announcements.

Teaching Problem Solving

Solving problems in large groups can also be helpful. About 10 or 20 min of each regular lecture at Nebraska are devoted to solving problems brought by the students; student participation is expected. The lecture before each hour exam in our course is devoted entirely to the solving of student-selected problems. When solving these problems I simply reason out loud and write.

When we scientists solve problems, we first interpret words (7). Then we try to represent the problem in our minds. We
might substitute some scientific terms such as force or area or pressure in our representation. Finally, we might write down several possible quantitative relationships that apply. When you do problems in lecture, reason out loud. Beginners often jump to equations. Experts do not. Instead, experts say to themselves things like "Ah, the pressure is changing at constant temperature. Therefore the volume will change. Therefore this is a PV problem." Do not just say, "this is a PV problem," because that is not how you actually reason the problem for yourself.

Breaks in Lecture

Mary Budd Rowe argues that you get improved performance by having students spend 2 min discussing among themselves what has transpired after every 10 min of lecture (9). She attributes this to allowing sensory buffers to unload. Whatever the underlying reason, breaks seem to help performance. Dean Osterman at Oregon State advocates a structured lecture in which there are 20 min of lecture followed by 10 min in which students work in teams on a particular problem (9). This is followed by another 20 min of lecture. He advocates providing detailed lecture notes for this experience. Formally breaking the class into groups of two or three and having them work on problems, even (especially) in the large class setting, seems to work effectively. Two years of total experience are typical. TA lifetimes of two semesters in a course and three semesters in a given course are able to unload. Never underestimate giving exams as an alternative to lecturing. Multiple tries at exams coupled with rapid feedback is what the Keller Plan is all about (15). Judging from the crowds around our microfiche readers at exam time, it is clear that this activity as much as any other engages students' attention. Our exams are hand-graded, open-format exams with short problems, fill-in-the-blanks, sentences, paragraphs, and, every now and again, a long problem. Copies of answer keys are provided to students as they emerge from the exam room. Another reality of the human condition is that more learning takes place per unit time in those few moments after the exam than during any other time period.

Conclusion

One final comment—essentially all of the in-class alternatives to traditional lecturing that really work, including problem-solving out loud, require more teacher effort than does traditional lecturing. Good teaching always requires work!

Literature Cited