

FAQs. II. ACTIVE LEARNING, COVERING THE SYLLABUS, AND DEALING WITH LARGE CLASSES

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In a earlier column,¹ we listed the top ten questions we get at teaching workshops and responded to the first one (“Is there any hard evidence that the instructional methods we recommend actually work?”) In this column we consider two more questions.

Early in our workshops—usually within the first 15 minutes—we suggest that instructors include brief active exercises in their lectures. Some participants invariably express concern that they have to present a lot of material in their courses, and one of them poses Question #2: *How can I take the time for those exercises and still cover the syllabus?* Another follows up by observing that he or she teaches a lecture class to 175 students and raises Question #3: *Can you use these methods in large classes?*

Can you use active learning and still cover the syllabus?

A huge volume of material can be “covered” in a short period of time. If you put all of your lecture notes in PowerPoint or on transparencies and flash through them in class, you can get through several hundred pages of text in a month. The question is, what is your objective? If it is simply to present all of the prescribed course material, regardless of how much or little of it the students actually absorb, then you should not use active learning exercises—they do indeed slow things down. However, if the objective relates to what the students learn as opposed to what you present, then the goal should not be to cover the syllabus but to uncover the most important parts of it.

People acquire knowledge and develop skills only through repeated practice and feedback, not by watching and listening to someone else showing and telling them what to do.* In lecture classes, most students are neither practicing nor receiving feedback on anything. They are just sitting there—sometimes watching and listening to the lecture, sometimes thinking of other things, sometimes daydreaming or sleeping. Most of them would learn just as much if the

* For theoretical and empirical support of this claim, see any text on cognitive psychology written in the last 20 years, e.g. Pressley and McCormick.²

classes were cancelled and they were simply given the lecture notes and homework assignments and perhaps review sessions before the tests.

It's a much different story if lectures are punctuated with brief active exercises that call on students—working individually or in small teams—to answer questions, begin problem solutions, fill in missing steps in derivations, brainstorm, formulate questions about material just presented, summarize, or do anything else that they may subsequently be asked to do in homework and on tests.³ The exercises energize the students (sometimes literally waking them up), direct their focus to the most important points in the lecture, and increase their subsequent concentration when the lecture continues. They give the students practice in the methods and skills the course is intended to teach them and immediate feedback on their efforts, thus meeting the criteria for learning to occur. Even if some material were dropped from the course syllabus to make way for the exercises, the increased learning would more than compensate for the loss.

But there is no need to shorten the syllabus. Suppose that instead of saying every word and writing every statement and drawing every diagram and deriving every equation in class, you were to put a lot of the material in class handouts that include gaps—skipped steps in derivations, axes with no curves showing—and exercises with spaces left for responses. “*Estimate the solution of this problem.*” “*If you increase the temperature, how would you expect the product yield to vary? Why?*” “*Draw the free-body diagram.*” “*Fill in the missing steps between Eqs. (4) and (5).*” “*List three reasons why an experimentally determined value of this variable might differ from the one predicted by the formula just derived.*” Further suppose you announce that you will not go over most of the details in the handouts in class but any of it—especially the gaps and questions—could show up on the test. Most of the students will then actually *read* the handouts—at least after the first test, when they discover that you meant it.

This strategy accomplishes several things. By eliminating the need to say and write and draw everything in class, you buy yourself many classroom hours that can be devoted to the things that make learning happen— spending more time on conceptually difficult material, giving more examples, asking and answering questions, and implementing active learning. You can fill in some of the gaps in the handouts in class; get the students to fill in others in active learning exercises; and leave some for them to work out for themselves before the test. The students learn more (we learn by doing, not by watching and listening), the classes are more lively, daily attendance increases, and the syllabus is safe.

Do active learning methods work in large classes?

Large classes (75 students or more) are a fact of life in the first year of engineering at most universities, and they are also common at higher levels at some institutions. Several references present ideas for making such classes effective.⁴⁻⁷

The larger the class, the more essential it is to use active learning. In a traditional lecture class with 15 students, it is not too difficult to get almost everyone actively involved in asking and answering questions and participating in discussions of course material. In a class with 40 students it is extremely difficult to do so, and in a class of 75 or more it is virtually impossible. Few students have the self-confidence to risk looking foolish by asking or answering questions in front of a large number of classmates, and the traditional pep talks proclaiming that there are no dumb questions and that wrong answers are also valuable generally have little effect. On the other hand, when a class is periodically given something to do in groups of two or three, the risk of embarrassment is minimal—the only real difference between a class of 20 and a class of 200 is that the latter class is noisier during activities.

A key to making active learning work in large classes is to stop the activity after the prescribed time interval and call on individual students or teams to state their results.* If you only call for volunteers to provide responses after a group exercise, many students will not participate in the activity, knowing that sooner or later another student or the instructor will supply the answer. If they know that any of them could be called on, the same fear of embarrassment that keeps them from volunteering responses in the whole class will prompt most of them to work with the small group so that they will be ready with something if they are picked.

Instructors who have never used active learning in a large class usually envision two problems. They worry that some students will refuse to participate under any circumstances and that the noise level during the activity will make it difficult to regain control of the class.

In our experience, more than 90% of the students in a class routinely participate in active learning exercises after the first few, in which they feel awkward and unsure about what they are supposed to do, and the usual involvement is closer to 100%. Nevertheless, it disturbs instructors to see even one student sitting with arms crossed, pointedly refusing to participate, and the instructors often take such observations as evidence that the method is failing.

That's the wrong way to look at it. Suppose a full 10% of your students sit on their hands during an active learning exercise. This means that 90% of your students are engaged in thinking about what you want them to think about and trying to apply the concepts you have been teaching, so that the odds are 9 to 1 in your favor. In a typical traditional lecture, the percentage of the class actively engaged in thinking about the lecture content at any given time, let alone trying to apply it, is generally very low. Even if it is as high as 10%, which is unlikely, the odds are 9 to 1 against you. No instructional method—lecturing, active learning, multimedia tutorials, or anything else—is guaranteed to reach every student. As an instructor, the best you can do is go with the odds.

It is true that in a large class the noise level can make it more difficult to bring the students' attention back to you, which makes it important to establish a signal (e.g. a buzzer, whistle, or handclap) for them to finish their sentence and stop the discussion. After the first few exercises, we have never had to wait for more than 10 seconds for the room to quiet down, even with 400 people there. Besides, if you are teaching a class in which the students are so involved in answering your questions or working out your problems that you have trouble getting them to stop, there are far worse problems you could have.

References

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5. Felder, R.M. "Beating the Numbers Game: Effective Teaching in Large Classes," *Proceedings, 1997 Annual ASEE Conference*, American Society for Engineering Education, 1997. <<http://www2.ncsu.edu/unity/lockers/users/f/felder/public/Papers/Largeclasses.htm>>.
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* When we do this we tend to overload on the back of the classroom, where many students go to avoid the instructor's attention. In our classes the students quickly learn that they can run but they can't hide.