

Random Thoughts . . .

YOU GOT QUESTIONS, WE GOT ANSWERS 2. Active Learning*

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Sometimes at the end of a workshop, a participant suffering from information overload asks, “If I want to try just one thing you told us about, what should it be?” My answer is always active learning. For those who came in late, that means engaging students in course-related activities in class other than watching and listening to the instructor. They may be asked to answer a question, begin a problem solution or derivation or figure out the next step, explain a concept, interpret an observation, brainstorm a list, predict the outcome of an experiment, or any of a hundred other things.

Reference 2 offers suggestions for implementing active learning and answers to frequently asked questions about it, including:

Can I use active learning and still cover my syllabus? (Short answer: Yes.) *Won't it take me a huge amount of time to plan all those activities?* (Short answer: No.) *What should I do about students who complain bitterly if I do anything but lecture? What should I do if some students refuse to participate?*

If you're not experienced with active learning, reading that short paper first will make this one—which answers different questions—more meaningful. The web address for it is in the bibliography; if you want to check it out I'll wait here for you. Otherwise, forge on.

- ***What are the most persuasive arguments for instructors to try active learning?***

Active learning fully engages most students in a class instead of just the two or three who normally do all the talking; the class atmosphere is much livelier than the wax museum most traditional lectures resemble; and cognitive science and tons of classroom research have established that people learn far more through active practice and feedback than from simply watching and listening to lectures.^[2]

* Second set of questions raised by a reading group at New Mexico State University. The first set can be found in Reference 1, and these were prompted by the group's reading References 2–4.

- ***But don't they get practice and feedback in assignments?***

Sure, but preliminary in-class activities make assignments far more effective. For instance, in a traditional lecture you might outline a problem-solving method and give one or two examples. If you're a decent lecturer it might all seem clear to the students, and only later when they spend hour after frustrating hour on assignments do they discover that they didn't understand critical parts of it. In active learning, they are taught the method in small steps that they can practice and get immediate feedback on. Their chances of being able to integrate what they learned to solve entire problems are then much greater than if they have to do both the initial learning and the integration simultaneously.

- ***How can I prove to others that active learning works? (My department head, for instance, who occasionally hears complaints from students that I'm making them work in class instead of just telling them everything they need to know.)***

You can cite solid research that demonstrates the effectiveness of active learning^[2] and compare your class's performance with the performance of previous classes you taught traditionally (no activities). If you teach one of two parallel sections of a course and the other instructor teaches traditionally, you might also compare the average grades of the two classes on common exams or exam questions.

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- **What proportion of the class period do you, yourself, lecture?**

Anywhere from 90% (rarely that much) to 20% (rarely that little); usually around 60%. I haven't used a "flipped classroom," in which the basic material is presented to students before class in online videos or tutorials and most or all of the class period is devoted to activities. If I were still teaching regularly I would be inclined to move to that approach, but I would need *really* good online materials before I made the switch.

- **What process do you go through to try to connect activities to what you're discussing?**

Every activity I've ever done flowed directly from what I was discussing. I don't know how else you would do active learning.

- **Some students are terrified of being called on to speak in class, such as to report on the outcome of an activity. What should I do about them?**

That's an important issue. Many students—either for cultural or psychological reasons—are strongly averse to speaking up in class, either to ask or answer questions. They generally have no trouble speaking to one or two classmates in a small group, however, and so active learning is no problem for them. Even if they are called on to report out following an activity, the threat level is low because they are speaking for their group and not themselves, and they are not being asked to think on their feet but merely to share what has already been worked out.

The method doesn't work for everyone, however. Once in my career, a student came up to me after class and begged me never to call on her. I simply said "OK" and honored the request. I can't think of any possible benefit of forcing the issue that would compensate for the severe emotional distress it might cause.

- **When using active learning, are there any things I shouldn't do?**

Don't (a) make the activities trivial; (b) make them longer than about three minutes; (c) always call for volunteers to summarize their group's responses (sometimes call on individuals or groups); (d) grill or ridicule students who respond incorrectly. Reference 2 discusses the drawbacks of mistakes (a), (b), and (c), and the problems with (d) should be obvious.

- **Problems in my course take much longer than three minutes to solve. Can't I use active learning for them?**

You can have students work through long problems or derivations, but they should be chunked into small activities with reporting out and feedback interspersed. If you give students five minutes or more to solve a problem, some groups may finish early and waste valuable class time on irrelevant conversation; other groups may flounder for the entire interval, become intensely frustrated, and also waste class time. Chunking avoids both problems, gets students who are lost back on track fairly quickly, and illustrates the steps of whatever method you are trying to teach them.

- **Can I use active learning in an online environment?**

Absolutely! The key to active learning is engagement, and with the right software you can engage students online in ways you can't use in a live class. You can have them work through interactive multimedia tutorials that provide information, pose questions and problems, and affirm or correct student responses; perform experiments and optimize processes using virtual laboratories and simulations; complete activities and projects in virtual groups using e-mail, instant messaging, and Skype; and incorporate activities into synchronous and even asynchronous online lectures.^[5]

- **Do you ever advocate "non-active" learning?**

Mixing lecturing (non-active learning) with activity? Always. Straight lecturing with no activity for 50- or 75-minute stretches? Never!

REFERENCES

1. R.M. Felder & R. Brent. You got questions, we got answers. 1. Miscellaneous issues. *Chem. Engr. Education*, **47**(1), 25 (2013), <www.ncsu.edu/felder-public/Columns/QandA-1.pdf>
2. R.M. Felder & R. Brent, Active learning: An introduction. *ASQ Higher Education Brief*, **2**(4), August 2009, <[www.ncsu.edu/felder-public/Papers/ALpaper\(ASQ\).pdf](http://www.ncsu.edu/felder-public/Papers/ALpaper(ASQ).pdf)>
3. R.M. Felder, Sermons for Grumpy Campers. *Chem. Engr. Education*, **41**(3), 183 (2007), <www.ncsu.edu/felder-public/Columns/Sermons.pdf>
4. R.M. Felder. Hang in there: Dealing with student resistance to learner-centered teaching. *Chem. Engr. Education*, **45**(2), 131 (2011), <www.ncsu.edu/felder-public/Columns/HangInThere.pdf>
5. R.M. Felder, FAQs. III. Groupwork in distance learning. *Chem. Engr. Education*, **35**(2), 102 (2001), <www.ncsu.edu/felder-public/Columns/FAQs-3.pdf> □

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