Postdoc Academic Chat #3

Perspectives of Assistant Professors on Course Development with Interactive Learning

Thursday, December 8 , 2016

Questions/Discussion Items to Consider

*** What do you personally see as some of the barriers to your experimenting with active learning?**

*** What steps could you take to address the above concerns?**

*** What experiences can you share about other postdocs you know who have experiments with active learning?**

READINGS

1. **Active Learning - You Got Questions, We Got Answers (2014)**
2. **Common Active Learning Mistakes**
3. **What Do You Mean Active Learning Doesn't Work ?**

1. Active Learning - You Got Questions, We Got Answers (2014)

The article below offers some valuable answers to questions often asked about active learning. It is by Richard M. Felder, Hoechst Celanese professor emeritus of Chemical Engineering, North Carolina State University and is from Chemical Engineering Education, 47(2), 97-98 (2013) and is reprinted with permission. Check out Felder's website at: [www.ncsu.edu/effective_teaching].

[Note: This column contains responses to the second set of questions raised by a higher education learning community at New Mexico State University following a workshop that Rebecca Brent and I gave there. The first set can be found in Reference 1, and this one was prompted by the group's reading References 2-4.]

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 Reference 2; 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 that traditional lectures usually 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.

- **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 in-class 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.

- **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 cost.

- **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 when you stop an activity (sometimes call on individuals or groups instead); (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 Skype, instant messaging, and email; 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), 25-26, (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*>.
3. R.M. Felder, Sermons for Grumpy Campers. *Chem. Engr. Education*, 41(3), 183-184 (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), 131-132 (2011), <*www.ncsu.edu/felder-public/Columns/HangInThere.pdf*>.
5. R.M. Felder, FAQs. III. Groupwork in distance learning.. *Chem. Engr. Education*, 35(2), 102-103 (2001), <*www.ncsu.edu/felder-public/Columns/FAQs-3.pd*f>.

2. Common Active Learning Mistakes

The article below, as the title suggests, looks at several common active learning mistakes that teachers make. It is from Chapter 6, Active Learning in the book *Teaching and Learning STEM: A Practical Guide*, by Richard M. Felder and Rebecca Brent. Published by Jossey-Bass, A Wiley Brand. One Montgomery Street, Suite 1000, San Francisco, CA 94104-4594 www.josseybass.com

Active learning is an easy and remarkably robust teaching method that functions well in every conceivable academic setting – a claim supported by a mountain of literature. Instructors who start using it often limit its effectiveness by making certain mistakes, however, and many drop the method when the results disappoint them or they experience vigorous student resistance. Table 6.5-1 lists six mistakes to avoid when you use active

learning and strategies to avoid making them, and the paragraphs that follow elaborate on the strategies.

Table 6.5-1. Six Common Active Learning Mistakes

Mistake
Plunge into active learning with no explanation.

How to Avoid Mistake
First explain what you're going to do and why it is in the students' best interests.

Mistake
Expect all students to eagerly get into groups the first time you ask them to.

How to Avoid Mistake
Be proactive with reluctant students in the first few group activities you conduct.

Mistake
Make activities trivial.

How to Avoid Mistake
Make active learning tasks challenging enough to justify the time it takes to do them.

Mistake
Make activities too long, such as assigning an entire problem in a single activity.

How to Avoid Mistake
Keep activities short and focused (five seconds to three minutes). Break large problems in to small chunks.

Mistake
Call for volunteers after every activity.

How to Avoid Mistake
After some activities, call randomly on individuals or groups to report their results.

Mistake
Fall into a predictable routine.

How to Avoid Mistake

Vary the formats and lengths of activities and the intervals between them.

Set the stage before you start using active learning.
Many of your students may have experienced only traditional lecturing before they show up in your class. If you suddenly plunge them into active learning with no preparation, their assumption may be that you're either playing some kind of game with them or conducting an experiment with them as the guinea pigs, neither of which they appreciate, and you may experience some vigorous pushback.

You can minimize and possibly even eliminate student resistance to active learning by taking a little time on the first day of class to explain what you'll be doing, why you'll be doing it, and what's in it for the students. An illustrative explanation in the interlude "Sermons for Grumpy Campers" preceding Chapter 11 may be helpful. Felder and Brent (1996), Felder (2011a), and Seidel and Tanner (2013) discuss student resistance to learner-centered teaching methods – why it occurs, what forms it may take, and how instructors can deal with it when it arises.

Be proactive in the first few group activities.
When you first ask students to get into small groups in class and do something, if they are active learners (see preceding interlude) or accustomed to group work they are likely to jump right into it. However, if they are reflective learners or novices or veterans of bad experiences with groups, they may ignore your request and start to work alone. Instructors who encounter that behavior tend to be discouraged by it, and when they encounter it they may be tempted to give up on active learning.

If you find yourself in that situation, don't give up. When you assign your first activity, give the instructions calmly and confidently, as though fully expecting all of the students to do what you ask. If some start working individually, casually move toward them and tell them to work with each other. With rare exceptions, they will. The second time you call for an activity, most of the class will engage immediately, and by the third time you should see at most one or two students remaining isolated. Don't worry about them – it's their loss. (We'll explain that statement later in the chapter.)

Make group activities challenging.
Students expect to be treated like adults and are likely to resent being asked to do anything they consider trivial. A common active learning mistake is to put students in groups to address questions with obvious answers. You are wasting their time, and they don't appreciate it. Make the questions and problems hard enough to justify the time it takes to get

into groups and figure out the answers.

Keep activities short.
Two problems commonly arise when students are given, say, ten minutes to solve a problem. Some finish in two minutes and spend the next eight on their smartphones or talking to their neighbors about the football game, which is a waste of valuable class time. Other students struggle for the full ten minutes and fail to complete the task, which is intensely frustrating and also generally a waste of time after the first few minutes. If you keep the activities short and focused – anywhere between five seconds and three minutes – you avoid both problems. Most technical problems take more than three minutes to solve, so rather than allowing enough time for most students to get complete solutions, break the problems into chunks. The students may struggle with something but only for a short time before they get feedback and clarification, and they can then proceed to the next step.

Sometimes call on individuals after activities.
Probably the most common active learning mistake is to call on volunteers for responses after every activity. When you do that, many students won't even bother to think about what they were asked to do, knowing that someone else will eventually provide the answer. The benefits of active learning will then be realized by only a small fraction of the class. However, most students don't want to be in the embarrassing position of having had time to work on something, individually or with others, and then being called on and having nothing to say. If they know that after any given activity you might call on them, most or all of them will make a serious effort to do whatever you asked them to do. You don't have to call on individuals after every activity – as long as you do it often enough for students to be aware that it could happen, it will have the desired effect.

Don't be predictable.
Active learning has the potential to create a lively and instructive classroom environment. If you conduct it with the monotonous regularity of a cuckoo clock, however (lecture ten minutes, one-minute pair activity, lecture ten minute, one-minute pair activity, etc.), it can quickly become as monotonous as straight lecturing. The key is to mix things up. Vary the type of activity (answering questions, beginning problem solutions, taking the next step in a problem solution or derivation, brainstorming, etc.); the activity duration (five seconds to three minutes); the interval between activities (one to fifteen minutes); and the size of the groups (one to four students). If your students can never be sure what you're going to do next, you have a good chance of holding their attention for the entire class session.

Thought Question
If you are not experienced in active learning and you are like most instructors, you probably still have worries about it that could discourage you from trying it. What are they? Make a

list before reading the next section, which reviews and addresses the concerns we hear most often. See how many of your worries show up on our list, and then see if you find our reassurances convincing.

References

Felder, R. M. (2011a). Hang in there: Dealing with student resistance to learner-centered teaching. *Chemical Engineering Education*, 45(2), 131-132. Retrieved from www.ncsu.edu/felder-public/Columns/HangInThere.pdf

Felder, R.M., & Bret, R. (1996). Navigating the bumpy road to student-centered instruction. *College Teaching*, 44, 43-47. Retrieved from www.ncsu.edu/felder-public/Papers/Resist.html

Seidel, S.B., & Tanner, K.D. (2013). "What if students revolt?" – Considering student resistance: Origins, options, and opportunities for investigation. *CBE Life Sciences Education*, 12, 586-595. Retrieved from www.lifescied.org/content/12/4/586.full

3. What Do You Mean Active Learning Doesn't Work ?

The article below raises some questions about the general assumption regarding the effectiveness of active learning compared to more traditional methods. It is prepared by the Research and Evaluation Team, Office of Information Technology, University of Minnesota - Twin Cities. http://z.umn.edu/research. In an effort to make research in the educational technology field more accessible, OIT\\'s Research & Evaluation team produces frequent brief synopses of important recent studies. These synopses may be freely shared and used for non-profit academic purposes. http://z.umn.edu/briefs. For further information contact Dr. J.D. Walker (jdwalker@umn.edu).

Andrews, T.M., Leonard, M.J., Colgrove, C.A., & Kalinowski, S.T. (2011). Active learning not associated with student learning in a random sample of college biology courses, CBE-Life Sciences Education, 10, 394-405. Retrieved 11 April 2012. DOI:10.1187/cbe.11-07-0061

Active Learning

Although "active learning" as an approach to classroom instruction has been around for decades, its widespread acceptance and deployment has been hastened by the publication of numerous studies demonstrating that active learning techniques have a positive and significant impact on student learning. As an "instructional method that engages students

in the learning process" (Prince, 2004, p. 223), active learning is comprised of a host of classroom activities such as class discussion, group-work, structured student debates, simulations, games, and collaborative problem-solving. Along with its corollaries - constructivism, collaborative learning, team-based learning (Michaelsen, Bauman-Knight, & Fink, 2003), & problem-based learning - active learning often is contrasted with passive learning, a modality most frequently associated with lecture-based pedagogies.

Among the most important studies that have secured active learning's place of prominence in the scholarship of teaching and learning is a seminal meta-analysis conducted by Michael Prince, who concludes that, "Although the results vary in strength, this study has found support for all forms of active learning examined" (2004, p. 7). However, the authors of the study considered here note that there is the potential for significant bias in existing scientific literature on the impact of active learning techniques. Andrews, Leonard, Colgrove, and Kalinowski contend that given that most studies are authored by instructors who 1) are deeply interested in science education, and 2) are engaged in the scholarship of teaching and learning, it is possible that this interest and engagement might enhance their ability to deploy active learning effectively resulting in the gains observed and reported. The authors, therefore, hypothesize that the results produced by instructors with extensive experience using and researching active learning teaching techniques are not comparable to the larger population of science instructors who may not be engaged in educational research.

Data & Methods

The authors randomly selected 77 colleges and universities from a list of 144 institutions (comprised of the 2 largest in each state + top 50 according to the U.S. News & Report rankings). From these randomly selected schools, the authors identified introductory biology courses that included a unit on natural selection and invited 88 instructors to participate in the three-semester study. Of these, 33 (38%) instructors accepted the invitation resulting in a sample that included 29 courses at 28 institutions in 22 states; controls for self-selection bias were employed using comparative data collected from non-participants.

For student data, the authors employed the Conceptual Inventory of Natural Selection (CINS) - Abbreviated version, a 10-question multiple-choice test on the topic of natural selection that has been subjected to validity tests by instrument developers and inter-rater reliability testing by the authors. Additionally, students completed an open-ended question in which they applied knowledge of natural selection to a question regarding the adaptive ability of cheetahs to run quickly; responses to these questions were graded

using an established rubric, the results of which were subjected to inter-rater reliability testing (Pearson's r = 0.93). Data regarding student experiences, instructor teaching methods, frequency of classroom activities, and the like were collected via instructor and student surveys.

For the analysis, the authors primarily used the Cohen's d for repeated measures statistic to measure learning gains, but compared the Cohen's d results with other established learning gains measures (e.g. normalized gains, % change, raw change) to confirm their findings. To establish the relationship with the theoretical variables of interest, the authors employed a generalized linear regression model that included a host of controls for instructor and student variation.

Findings

There are four main findings reported in this article. First, instructors reported using active learning techniques frequently (8.03 instances/week). Second, learning gains were modest for both the CINS test (Cohen's d = -0.11 to 1.26; mean effect size = 0.49; normalized gain = 0.26) and the open-ended question (Cohen's d = -0.16 to 0.58; mean effect size = 0.15; normalized gain = 0.06). Third, no association between the frequency of active learning activities and how much students learned about natural selection was found. That is, student learning was not positively associated with the amount of active learning used. Fourth, other factors, such as overcoming misconceptions, course difficulty, and how interesting a course was, were positively associated with student learning.

Discussion and Implications

The implications of the finding that active learning is not associated with student learning has implications for two important groups in the academy: 1) researchers and faculty development professionals, and 2) instructors. For the former, the authors recommend that researchers need to identify what it is about active learning that makes it effective. Those findings, in turn, need to inform the development of a broad set of active learning strategies and exercises that are fungible [i.e.,interchangeable], useful, and easily distributed to a broad population. Faculty development programs can be built around these strategies and exercises to train and support the general population of instructors in using active learning more effectively. For the latter, instructors cannot assume that they are effective teachers just because they are using active learning exercises; they need empirical evidence that is garnered through a carefully planned assessment protocol to help them understand what is and what is not working. Furthermore, given that it is highly unlikely that students will not alter their a priori beliefs about a particular topic

(e.g. natural selection) without targeted instruction, instructors need to identify what preexisting beliefs students possess and plan their approach to the topic accordingly.

Four methodological issues may limit the effectiveness and accuracy of this study. First, the selection process does not really appear as random as the authors purport with an a priori winnowing of possible participants and participants' self-selection into the study. Second, self-reported frequencies of events and activities is a highly individuated task that can introduce biased or incorrect responses due to a host of factors, not the least of which is individual memory. Third, the number of courses included in the analysis is relatively small, limiting the statistical power to detect with a great deal of accuracy the impact of active learning techniques. Fourth, although the CINS is both a valid and reliable instrument, it might not be the appropriate instrument given the amount of instructor, course, and institutional variation inherent to the study.

While the article's title is jarring and certainly grabs one's attention, the general thrust of this research is not that active learning is inherently ineffective, but active learning can be executed poorly, just like any other teaching technique. Most instructors need coaching, examples of good practice, and faculty development programs that encourage a fundamental shift in pedagogical approach if it is to be effective.

References

Michaelsen, L., Bauman-Knight, Arletta, & Fink, D. (2003) Team-based Learning: A Transformative Use of Small Groups in College Teaching, Sterling, VA: Stylus Publishing.
Prince, M. (2004). Does active learning work? A review of the research. Journal of Engineering Edu
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The authors used multiple calculations for learning gains, each of which were highly intercorrelated, to demonstrate general consistency in results regardless the methodology used.