ONBOARDING INSTRUCTORS INTO AN ACTIVE LEARNING CLASS

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I'm a course coordinator for a large linear algebra course (about 1300 students/semester spread among about eight sections), and every year I face a challenge:

> How do I ensure quality and uniformity across sections while not stifling an instructor's individual voice and development?

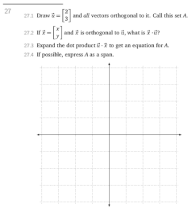
To understand my specific approach to this question, I need to give some context.

A few years ago, I was tasked with redesigning Linear Algebra I. After interviewing faculty to pin down the content goals, I added the additional goal of having every section taught in an *active learning* style (more on this later). The trouble is, most instructors are postdocs and graduate students who have never experienced an "active learning" classroom; my other instructors are researched-focused professors who are open-minded, but have limited "active learning" teaching experience.

Active Learning

Active learning is a broad term, but for my linear algebra course what I hope for in my classroom is that about 50% of class time is spent with students thinking about and discussing math problems and concepts.

For example, the fourth week of class starts with the following question displayed.



Before coming to class, students have already done pre-reading on dot products and normal forms of lines; however, they haven't yet done homework problems on these topics. Given that students should have familiarity with the terms *orthogonal* and *dot product*, they are asked straight away to start working on #27. After some time, I ask them to share and discuss their drawings for #27.1 with their neighbor. This is followed up by a full-class discussion where I root out misconceptions (for the curious, the big misconception for 27.1 is whether one should draw vectors rooted at the origin or not). When clarity is reached, I ask students to return to working on the rest of #27, and the process repeats.

Finally, after the class has understood each part of the question, we have a "wrap up" where we discuss what we've learned, how the problem relates to earlier problems, and what new questions we can answer that we couldn't before. (For example, this question gives yet another way to describe a line; the problems that follow formally introduce the *normal form* of a line.)

Onboarding Instructors

The obvious onboarding challenge is how to convince instructors to teach in a way they're unfamiliar with. And, after that, how to get them to be *good* at this unfamiliar teaching style. (I've observed several dozen instructors and have yet to see one that was good the first time they tried.)

I approach this challenge in three ways:

1. Salesmanship.
2. Training and support, including providing instructors with well-crafted in-class exercises and an instructor's guide.
3. De facto classroom expectations, i.e. "active learning is just the way it is."

Before the Semester

It starts before the semester with an **email to all instructors** containing short readings. I normally ask them to read the Freeman *et al.* metastudy on active learning, which is a five-page paper outlining the benefits of active learning and how the evidence points towards "more active learning during class equals more learning period." I also include my Linear Algebra I design document, which explains the curricular changes and their motivations. Further, I **supply the instructor guide to in-class exercises**, which breaks the entire semester into 50 minute blocks with explicit learning objectives.

Next, I have a pre-meeting with my instructors where we discuss the class format. Through that meeting, it is made explicit that **active learning is just the way this course works**. At this point, many instructors are skeptical, but they are willing to try it out. They're curious whether the results of the Freeman et al. paper will apply to *their* classroom.

I request **all instructors visit my classroom** to see what the class format looks like in action. Schedule permitting, this happens before the semester (e.g., Winter instructors come to my Fall class), otherwise instructors visit my class on the first day of the semester. They usually find the visit inspiring, and it leaves them with a lot of questions!

Next, I run a **pre-semester coaching session**. For this coaching session, I have instructors prepare the first two lessons of the semester (i.e., the first two hours of class). Since there are seven or eight of us, we take turns role playing with one person as the instructor and the others playing students. This coaching session provides a good opportunity to root out some instructor misconceptions. For example, instructors usually prepare a 20 minute lecture to give before a problem. However, the goal of an introduction is for instructors to give context for the forthcoming question, not explain the math (the explanation comes after students have struggled!). An introduction takes between 30 seconds to two minutes, which is much shorter than the mini-lecture most instructors prepare.

During the Semester

I hold weekly meetings. These meetings serve partly to cover class content, but more importantly, they **provide emotional support**. Compared to a carefully orchestrated lecture, an active learning class may feel ineffective—I mean, *I gave the students a really easy question and they didn't get it, even after twenty minutes of prodding!* Compared to the "trusty lecture" where you could explain something once and students nod their heads as a show of understanding, an active learning classroom can be frustrating. Instructors need a space to discuss these feelings.

At least once per semester (I aim for twice) I **observe each instructor in the classroom**. The observation is mandatory, though the debrief and feedback is optional. Almost everyone asks for feedback and they report that the observation is the most valuable training that I provide.

Finally, I provide TA support. **Every section has a lecture TA assigned**. Not only does the lecture TA help facilitate group work, etc., but they also provide emotional support as the instructor tries something new. It's nice to have a non-student in the classroom that you can rely on if things go wrong (this is doubly true when teaching online)! It should be noted that, since the instructors are new to active learning, they often don't know how to use a lecture TA. So, all lecture TAs are provided training on different ways they can help their instructor then the lecture TAs discuss with their instructor how best they can help.

What Is The Effect?

In my experience, I get very little pushback from instructors on teaching style. And, most instructors report that they moved from skeptics to believers in active learning. Further, despite having a daily schedule of problems and pre-written learning objectives, instructors feel like their voice comes across in the classroom. This was a huge relief to me, because when I started this process I was worried the instructors would feel like bus drivers for *my* class instead of instructors for *their* class.

Of course, this doesn't mean things work perfectly! Instructional quality varies, and even with training and support, teachers new to active learning take *a lot* of time to become proficient. Don't get discouraged as a course coordinator! I recall one instructor who was thoughtful and wanted to improve. He asked me to come for a third teaching observation. I was disappointed when I saw little improvement during the semester. He figured out things like properly controlling the blackboard lights, but good full-class discussions weren't happening. Fast forward a year, and I had the same instructor again. He had become one of my star instructors! In retrospect, this isn't surprising. We don't expect students to become excellent proof writers or master problem modelers in one semester; we shouldn't expect instructors to become master teachers in one semester either.

Another challenge is that setting up a class for this style of onboarding takes a ton of work! It took me several years to construct and refine the in-class exercises and instructor guide. I was also fortunate enough to build off the work of the Inquiry Oriented Linear Algebra project's exercises. All this effort resulted in a linear algebra textbook that integrates with the in-class exercises (please, feel free to use my book, or parts of my book in your class; shoot me an email if you have questions). I think providing instructors with pre-made resources goes a long way, especially for postdocs and graduate students who are desperately focused on their research.

I look forward to continuing to refine my onboarding process and to the institutional change that's coming as a result of me and my colleagues' work. I hope by outlining my process there might be something you can take away and apply at your institution!

References

Freeman et al., *Active learning increases student performance in science, engineering, and mathematics*, https://www.pnas.org/content/111/23/8410

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