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Teaching Philosophy Statement

Active Learning and Flipped Classrooms

From my personal experiences learning physics as an undergraduate, as well as what I have observed while working as a physics Teaching Assistant, I have come to embrace teaching methods that stimulate active learning and collaborative work among students. These techniques are often referred to as "flipping the classroom," where students work on problem sets during class in the presence of instructors. I have found that these methods give students access to guided practice during class time, and provide the instructor with valuable feedback from students as the course progresses.

When I was in college, all of my physics courses were taught according to the same structure: I would spend three hours a week copying down what the professor wrote on the blackboard in lecture. The time spent taking notes did little to help me understand the material – often I would go home after class and read (and re-read) the passage from the textbook containing the same information conveyed in that day's lecture. Even then, I never trusted myself to understand the course material until I actually found ways to use the proofs and principles from lecture to answer a question. It wasn't until I sat down to work through example problems that I actually began to understand physics.

Physics is not a subject where one can succeed by memorizing information. Rather, physics teaches one to solve problems by arguing from a set of fundamental principles. Physics is a skill, and the only way that students can learn a new skill is if they practice. For this reason, I believe that activities that force students to practice and discuss the material are much more effective and useful ways to spend class time.

In contrast with the passive classrooms that I experienced, active learning is ideal for teaching the problem solving skills required for physics courses. To succeed, students practice applying the material when they come to class instead of passively watching a lecture. They can ask questions as they go and receive hints and suggestions directly from the instructor.

Creating an active learning classroom also has a lot of potential benefits for the instructor. When I teach discussion sections, I always have to guess the extent to which my students understand the course material. Grading their homework sets can be misleading, and relying on a single evaluation of a final exam at the end of the semester does little to shed light on how effective my instruction was. A better way is to directly observe students as they work in a flipped classroom. An instructor can pose a single question to the class and receive direct feedback from students through iClickers or other means. Unlike in a traditional lecture, this gives the instructor access to quantifiable data that reveal how well students understand new concepts.

As a TA, I have already incorporated active learning into my discussion classes. At the start of the semester I announce to the class that discussion will feature very little lecturing, and that students must be prepared to work through and discuss example problems when they come to class. Each week I select a set of practice problems that students work on together in small groups. Students are free to work on any or all of the example problems – I announce ahead of time which skills are required for each problem, so students may work on whatever they think is most important. I then walk around the classroom and observe what my students are working on and what they're struggling with.

This format for discussion section is chaotic, but it allows me to be flexible and adjust the course's difficulty level according to how well the students understand the assigned problems. If I see a lot of students struggling to get started on one problem, for example, I may announce to the whole class some hints for how to begin. Alternatively, I can give that hint to a small group of students and, when they realize how it reveals a strategy for solving the problem, encourage them to talk to other classmates and help them also get started.

I avoid telling my students what the correct answers are. Instead, I offer suggestions for how they can check that their answers are correct, or I recommend that different groups compare answers. This forces the students to focus on what they know and understand, rather than how much I already know. By the end of discussion section students have more experience approaching problems and applying physics to new situations on their own, and so are better prepared to work on their own than if I had simply delivered a lecture.

Open Dialogue

I believe that maintaining an open dialogue between instructors and students is important for establishing a supportive learning environment. Certainly, when I was taking physics classes as an undergraduate there was not much dialogue between instructors and students – the lecturers seldom even knew our names. Since becoming an instructor myself, I now know that a dialogue about the material is essential for the instructor to design an appropriately challenging course that may be adjusted according to the needs of the students. The ongoing dialogue is also important for building trust between the students and their instructors.

Creating a classroom environment where students feel free to discuss their work and express confusion about the material is difficult in any course, but can be particularly difficult in a physics classroom. In physics, there is tremendous social pressure on students to hide intellectual shortcomings and to always have the correct answer. Often, undergraduate physics students are introverted and shy and so they often do not speak up in class. I have found that even graduate students are reluctant to volunteer an answer questions publicly in lecture.

The key to changing these stressful and detrimental social norms, I believe, is to create a continuous dialogue between instructors and students. This dialogue can take place in class as part of the active learning environment. Over time, students will become more comfortable speaking with their peers and the instructor, such that the instructor can get a better sense of how each individual student perceives the material.

I have also had success in strengthening the interactions between my students and myself by soliciting and publicly responding to anonymous feedback in the middle of the course. If a suggestion is reasonable, then I may change the course accordingly; if the suggestion is unreasonable, then at least I can explain to my students why we cannot change our course policy. In the past, publicly seeing how I have received, considered, and responded to their feedback has led my students to open up to the point where they feel comfortable enough to provide honest feedback. This, to me, is a strong sign of a trusting learning environment.

Developing Teamwork Skills

A stereotype exists that great physics research is accomplished by solitary geniuses who hide away from the world for long periods of time before revealing their works of astonishing scientific brilliance. (Newton, notably, worked this way while writing the

Principia.) This mode for thinking about how physics is done is outdated and, at worst, may stymie the development of valuable interpersonal skills. In the courses I hope to teach in the future, I plan to incorporate small group collaboration into the format of the course in order to teach my students communication and collaboration skills. Learning how to share responsibilities and to clearly communicate one's ideas to others are essential skills regardless if one goes on to work as a physicist or in some other occupation. When two or more students sit down to work on a problem together, they have an opportunity to improve their communication skills, regardless of whether they are aware of it.

Rooting Physics in Demonstrations and Experiments

Physics, unlike other abstract and mathematical disciplines, has access to lots of real-world demonstrations that drive home the physical laws and principles that are covered by any course. I want my students to always be aware that the real-world predictions they make in class and when solving problems are not true because the equations say so – they are true because there is ample reproducible empirical evidence that supports what the equations say. Even though my own research is largely theoretical, it is crucial to drive home the notion that even the most abstract theoretical physics derives its authority from real-world experiments.

Ongoing Professional Development

A few years ago, I got in the habit of taking notes after each discussion section that I taught as a way of keeping track of which students were struggling with which concepts. Over time, the notes became a weekly ritual where I reflected upon whether a lesson was successful in driving home a concept or technique, or whether I needed to change something about my teaching approach.

I have created an online teaching portfolio as a formal way to present my development as an instructor. The portfolio includes examples of lesson plans and assignments that I have used in the past, along with annotations. The annotations serve as notes to myself – I can clarify for myself the rationale behind a particular decision, or make a note if a new idea was successful or not. I see my teaching portfolio as a tool for organizing my ideas for how to create an effective learning environment through planning and practice. I will continue to reflect upon my teaching by periodically updating the portfolio to reflect my new experiences with teaching.