

As a graduate student at the University of Chicago, I have had the opportunity to teach six courses over two years as the instructor of record for undergraduate calculus and linear algebra sequences. Outside the classroom, I have (1) mentored advanced undergraduate students for three years through the University of Chicago Directed Reading Program (DRP), (2) helped to direct a project for undergraduates interested in research at the Cornell University REU, (3) and encouraged the greater recognition and participation of women in mathematics by working alongside the Association of Women in Mathematics (AWM).

TEACHING PHILOSOPHY

Through teaching I have developed the following philosophy.

1. Classroom engagement. Lack of engagement is one of the greatest enemies to good pedagogy. Research suggests that if students are not engaged with a question or activity in the first few minutes of class, they are vastly more likely to tune out the lecture.

- (1) *Continuity with previous lectures can be used to start classes with engagement.* I begin every class by asking three questions about material that was previously discussed. The questions encourage the students to recall a main idea and result from the preceding lecture and to work an example. This activity provides a way of equipping students with the relevant background needed to understand a lecture, while beginning a class with engagement.
- (2) *“Trivial steps” are opportunities for engagement.* Once the students are engaged at the beginning of a class, it is necessary to continue to engage them through the lecture. One means of doing this is by taking advantage of steps in proofs or examples that are often deemed “trivial”. Omitting so-called “trivial steps” can be confusing, but presenting them can kill a class’ interest; so when I encounter an elementary computation or deduction at the board, I ask my class to spend 30 to 60 seconds working it out themselves and then I ask a volunteer to describe their solution. This method converts a potentially tedious classroom moment into an opportunity for students to engage with the lecture, practice their logical reasoning ability, and receive instant feedback.
- (3) *Examples encourage students to care about theorems and their proofs.* When I was teaching linear algebra, one of my classes was dedicated to the rank-nullity theorem. To present the material, I came into class, wrote down different linear maps for my students, and had them compute the rank and nullity. The students guessed the rank-nullity theorem for themselves and were eager to see the proof. When students have a collection of understandable examples that they have engaged with and which suggest a pattern, they are substantially more interested in understanding the deeper reason for the pattern. More briefly, stoking curiosity is one of the most powerful tools that teachers have.

2. Nudging. Students often understand the basic keys to success in a class, but frequently fail to implement them. Part of good pedagogy is structuring a class to encourage students to engage in these productive behaviors.

- (1) *Review games with stakes encourages students to study.* The class before an exam, I hold a Jeopardy! style review game in class for bonus points. This incentivizes students to prepare in advance for exams and consequently affords them time to identify points of confusion and resolve them.
- (2) *Frequent short homework encourages students to keep up with the class.* Although students recognize the value of staying on top of class material, often they fail to do so in practice. By assigning frequent short homework assignments (ideally one per class), students are nudged in the direction of keeping up with the course material.

3. A supportive classroom environment. A supportive classroom is crucial for students to continue to persevere and succeed.

- (1) *Reframing assignments can create a supportive environment.* Grades are an inevitable source of anxiety for students, but creatively framing assignments may help alleviate some of this stress. For example, as an instructor I give quizzes worth bonus points to my classes. Instead of having the assignment take away points from students, it gives points back to them. Students who are struggling in the class often view these quizzes as a second chance to succeed instead of despondently assuming that the assignment is yet one more task that will put them further behind in the course. By creatively reframing the way we discuss assignments with our students, teachers can create an atmosphere in which students are supported and continue to persevere.
- (2) *Practice materials help support students.* A major source of student dysphoria in the classroom is the feeling that the expectations the instructor has for the students are opaque. A useful tool in creating an environment where students feel that success is possible through hard work is creating practice materials. By having questions on quizzes be framed in similar ways to those on tests and by creating practice exams students clearly understand which skills they are expected to master. Clearly defined goals from the instructor allow students to self-assess and such clear communication is a precondition for healthy teacher-student interactions.

4. Advice from other teachers. My teaching improved the most by interacting with other teachers. As an instructor, faculty who specialized in teaching observed my classes and offered detailed feedback. These observations were invaluable and could only be gleaned from another teacher observing my teaching. Last year, I was able to participate in a similar arrangement, when the department gave me the opportunity to have a younger graduate student observe my classes and ultimately teach one. A community of teachers supporting each other is one of the best means of ensuring that teaching is conducted effectively.

5. Inclusion. It is paramount that teachers create a space where everyone can learn. For struggling students, this could mean creating problem sets that reinforce more elementary concepts and meeting with students individually, as I have done in several classes. For underrepresented groups, such as women in mathematics, this could mean encouraging students to go to a lecture describing recent breakthroughs of female mathematicians - as I encouraged my classes to do when I was speaking on the work of Marina Ratner and Maryam Mirzakhani at an AWM symposium. Teachers should be active in including every student from every background.

6. Sparking curiosity. Stoking the curiosity of students is one of the most powerful tools that a teacher can employ. In a class this can be as simple as providing students with bonus problems that lead to deeper mathematics. Outside of the classroom, my experience mentoring students through the DRP and Cornell REU suggests that an effective means of sparking curiosity is to encourage students to explore areas of interest while suggesting directions that lead to rich subjects. This technique is complemented by encouraging students to consider easily-phrased special-cases of deeper problems as a means of developing intuition. Experimentation is another tool for sparking curiosity - allowing students, often using computers, to test their hypotheses and explore.

These elements are the core of my teaching philosophy. I hope that my writing has communicated my enthusiasm for teaching. As one parting note, I wish to emphasize that as a young teacher, I fully recognize that my teaching philosophy will evolve as I gain experience and interact with veteran teachers. As such, I want to end with the comment that I look forward to this document changing as I learn through experience and from the example of others how to be a more effective teacher.