

Statement of Teaching Philosophy

Zachary Sarver

One of the biggest challenges faced by mathematics educators is motivation. For better or worse, few people are intrinsically motivated to study math. As a teacher, my challenge is threefold. I must *a)* effectively communicate course material; *b)* motivate students without oversimplifying course material; and *c)* challenge students without discouraging them. I have found no collection of methods more effective at tackling all three of these challenges simultaneously than the methods of inquiry-based learning (IBL.)

1 Effectively communicating course material

As a student of mathematics, I have found that there is no more powerful tool for learning than *context*, which is exactly what I try to give my students. By context I mean various facts, useful or at least amusing, about the course material that can serve as an anchor in the students' minds, something that holds knowledge in place. Context is a mnemonic device which at the very least improves student recall, the foundation upon which understanding rests.

I've used various bits of context to make things stick. Often context is historical. Newton and Leibniz's dramatic feud frequently serves as a context in a first calculus course. Context is motivated by applications. To name one example, modern computer graphics depend heavily on linear algebra, giving any student who has ever played a video game a reason to remember. Context can also be a silly anecdote or a bit of trivia about historical terminology or notation. In my experience, most students do think that fluxion is a better word than derivative, and mathematical language today is worse off for it.

Context runs in parallel to course material itself, which I have delivered both in lecture style, as a first-year TA who didn't know any better, and using various IBL methods. While a well-written and well-delivered lecture *can* be captivating, it takes a truly talented speaker to hold the attention of every teenager in the room while talking about Taylor polynomials. Lecture-style teaching is also high-variance. A single missed cup of coffee can throw off your rhythm enough to let students' attention drift.

I find IBL methods much more reliable. Active learning, guided worksheets, student presentations, students working examples on the chalkboard, and simple question-heavy Socratic lecturing have all been effective for my classes. More than anything, I pride myself on being adaptive and flexible in my teaching. I do not believe that any one IBL method is the One True Method, and I will use whatever method is most appropriate, depending on course material, student ability, and student confidence. The most important thing is that students learn best by doing, not by watching.

2 Motivating without Oversimplifying

There is an easy way to motivate students. Make the material easy enough to be understood immediately. Make all the homework simple, and all the tests easy, all but guaranteeing good

grades. This is a bad way to motivate students.

My primary motivational technique is homework assignments that cover in some detail relevant applications of the material. For students who are not motivated by grades or the material itself, this works well.

Modern students tend to heavily use computers while doing their homework. There are several websites, which I will not name here, that host solutions to exercises in undergraduate math textbooks. The typical workflow for a poor student, as I understand it, is to attempt a homework problem, get frustrated, look up the solution, and then assume after reading the solution that they have mastered the skills needed to work this and all similar homework problems. For this reason, it is vitally important to write your own homework problems.

Even then, online tools such as Wolfram Alpha make problems that require only straightforward computation or algebra trivial. More tech-savvy students might have Maple, Mathematica, or SAGE installed on their personal computers. Because students are going to use these tools anyway, I have decided to embrace it and design homework assignments with computers in mind. My favorite thing to do is to ask for several computations, and then prompt the students to generalize the computations to a relevant theorem.

3 Challenging without Discouraging

There is a small mammal, adults weighing two and a half pounds on average, with long ears, bright eyes, a love for carrots, and a nonsensical association with Easter eggs. Let us call this animal a student.

It is a sunny spring day with clear blue skies. Warm, but not hot. You are at a window overlooking your back yard, with the window open to enjoy the breeze. From the bushes next to the fence, there is a slight rustle, catching your attention just as a student comes out from under cover. It stands for a bit on its hind legs, snuffling at the air, surveying its immediate vicinity for danger before hopping over to delicately nibble at a dandelion. Across the street, a car door slams, and the student bolts to the safety of its den.

Students are skittish. Failure is discouraging, and hence challenge is scary. This is unfortunate, because students learn when they are challenged. There is an art to writing assignments and assessments that are challenging, but not discouraging. IBL techniques achieve this very well. Active learning in particular gives students opportunity to practice and learn while under minimal pressure.

As an undergraduate, in the small handful of classes in which I was not motivated by the material itself, I was motivated by being graded. I was never discouraged by apparent challenge, because it was a sink or swim situation. If I have a choice between a guaranteed failure, or a chance at success, I always grasp at the chance of success. As a naive instructor, I assumed that the material or grades would also be the only thing my students care about, and I was wrong.

Despite my intuitions to the contrary, I have found that being likable is one of those auxiliary things that is important to class performance. It's easy for a student to dismiss an instructor that he or she thinks is a jerk. Thus I work hard to keep my classroom mannerisms light and friendly, without actually crossing the line to appear to be the students' friend. This encourages the students to take on the challenges that I deliver, or at least helps to keep them from being completely discouraged.

The pressure of assessment is by and large inescapable, which is why I always make sure to leave ample time for test review to help students feel more prepared. It is on test review days that I find bringing students to the chalkboard to work to be most useful. They are not (supposed to

be) just learning the material, so they can approach the chalkboard with some (sometimes feigned) confidence. Their classmates are also busy working problems, so they are able to approach the board without fear of being judged by their peers.