TEACHING STATEMENT

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Over the past ten years, I have taught a wide variety of math courses to an even wider variety of students: disadvantaged eighth graders still struggling with arithmetic, inner-city high school students hoping to compete at the college level, and college students majoring in everything from art to mathematics. And even across such varied groups, I have noticed significant commonalities: students are frustrated by a subject that feels like little more than a disparate collection of memorized algorithms, embarrassed by their perceived lack of ability in math, yet tantalized by a subject that they believe to be useful and deep. I believe the core of mathematics education lies in overcoming these challenges while teasing out students' natural curiosity and desire to understand.

My students taught me how to do this. My first few semesters were solely lecture-based. Though I had spent my time in Teach for America designing effective hands-on lessons every single day, it didn't even occur to me to bring that into a college classroom. Every course I'd ever had was lecture only, and I feared students would be insulted by anything else. I crafted engaging, dynamic lectures, with examples carefully chosen to highlight specific aspects of the learning objectives. My students nodded in understanding at all the right times, and laughed at my jokes. I was a Good Instructor.

But after my students had done particularly poorly on a college algebra exam, and I noticed their online homework performance was equally grim, I gave the typical speech about the necessity of working hard and asking questions in class. Later that night, I got an email from a student that turned my teaching around for good. She said that my lectures were informative, but they made it all look too easy! The class didn't realize how difficult independently solving these problems was until it was too late, so they didn't complete the assignments in time and bombed the exam. "Maybe we could work out problems in class?" she said.

I was stunned. I'd thought for sure students would feel their intelligence insulted, or like they were back in high school. I could not have been more wrong. The students loved working out problems and presenting their answers to the class. As I got more confident, I began creating my own inquiry-based assignments, where students work through a series of scaffolded questions to come to their own realizations about how mathematics works. The less I said, the more they understood, and the more they began to take ownership of their education.

This has culminated in me teaching a purely inquiry-based abstract algebra course this fall. They read the textbook and go through activities and exercises at home, and we spend class presenting and workshopping their results. As a result, these students are developing a much deeper intuition for algebraic structures than in a normal class, and, more importantly, are starting to rely less and less on my approval to decide if a proof is correct or not. In addition to learning the content and how to present it well, they're building the soft skills a mathematician needs, but sometimes doesn't develop until much later: confidence, independence, and perseverance when solutions are elusive.

One of my biggest successes in teaching was in a course I taught to Masters-level students preparing for middle-grades education. Having taught in an inner-city middle school, I have developed a repertoire of hands-on activities for teaching mathematics, focused on the whys of mathematics and not the hows: sure you know how to add fractions, but can you explain why to a 12-year-old in a way that makes sense? My students started seeing the failures in their mentor teachers' algorithm-based approach: their kids could not keep the algorithms and mnemonics straight, and with no big

picture to unify the concepts, would consistently fail. But with my methods, a frequent comment from these teachers was "I wish I had been taught it like this in the first place!"

These activities extend to other courses as well: a favorite activity of mine is demonstrating why the derivative of sine is cosine through making a careful sketch of the sine function on waxed paper, folding creases in the paper for tangent lines, and then estimating their slopes and plotting them below. The graph of cosine jumps right off the paper. In my business math classes, the students use Excel to intuit the concepts behind derivatives and integrals numerically before the formulas are even discussed. In linear algebra, we use Sage in class to quickly compute many examples to develop intuition on how matrix transformations work, or to make conjectures on properties of determinants. And these activities work: one student wrote in their evaluation that mine was the most difficult class they'd taken, but was also the one where they learned the most. I have had multiple students change their majors to math after taking one of my courses.

Even given my strong teaching methods, students will still be tempted to give up if they believe their frustrations are unique to them. To overcome this, I encourage collaboration amongst the whole class, myself included. Beginning on the first day, I present clear expectations that all students will attack the problems together. In introductory classes, my students write their answers on the board all at once so they're not put on the spot. As they get more comfortable, we start doing more voluntary presentations, until eventually I can call on students to present their solutions. This develops a creative, nurturing environment that encourages student response and collaboration, and where mistakes are just a part of the life of a mathematician and not cause for an existential crisis. Setting the expectation that this is a time for work and interaction with me and the other students right from the start keeps my class engaged.

To create collaboration outside of class, I give an extra credit point on homework assignments to students who list a person they have worked with on any of the problems. To encourage students to view me as a resource, I also occasionally give an extra credit point to students who bring a question to my office hours. The amount of extra credit is negligible in the calculation of their final grade, but it is enough of an incentive to get them in to my office and start building a rapport. I make myself available not only during my office hours, but also with extra review sessions for exams, occasional prerequisite 'boot camps', and through scheduled Google Hangout videoconferences. This year, I'm also starting a math circle for underrepresented students at my university to build their problem-solving skills and their sense of their own mathematical efficacy.

These approaches have brought me and my students a lot of success and satisfaction in the classroom. Of course every student is different, and meeting their needs individually amongst a large class ultimately depends on how much effort they are willing to devote to their success. Even in large classes, we can have an incredible influences on students to help them re-evaluate their mathematical abilities, overcome their shortcomings in their previous knowledge, and begin to embrace a subject that so fascinates us.

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