TEACHING STATEMENT: ERIC SWARTZ

Mathematics is difficult to teach, and, in my personal experience, it is much easier to identify bad teaching practices than it is to identify the good ones. It also does not help that most people are dismissive of the subject because of its perceived difficulty. How often have we heard the refrain, “I’m bad at math,” when someone hears our profession? More insidiously, I have found that the quickest way to get someone to guess my field of research is to say that it is most people’s least favorite subject. We as mathematicians are put in a tough spot: how do we convince students of the beauty of a subject they are frankly preconditioned to hate?

First and foremost, enthusiasm is key. If students sense that you are not excited about the material, they certainly will not be excited about the material. Beyond the actual material itself, students should come away from any math class with improved reasoning skills. Critical thinking is vital, and mathematics at any level helps instill it in students. Moreover, mathematics really is beautiful! The cleverness of looking at a problem exactly the right way can be as inspiring as the brushwork of a master painter or the solo of jazz musician, and it is our job as mathematicians to convey this to students.

Having discussed enthusiasm, I can also say that I have seen people who can barely contain their passion for the subject be terrible teachers. One can take things too far and put together a course that only the couple brightest minds will understand. A teacher (and I have seen this happen often) can be overly intimidating. Too “professorial.” There will be difficult points in any subject, and, if students do not trust you and do not feel comfortable coming to you for help, then there is a good chance they will remain confused. Students should always feel comfortable asking for help. Availability and friendliness is key.

My feelings on how I conduct my classroom are also informed by my personal experiences. I know how much coffee it can take to stay alert during lectures or reading mathematics, no matter how excited I am to devour the material. On the other hand, I rarely have trouble when I am actively engaged with the material. Student learning frankly does not happen when I talk “at” students. Perhaps students learn when they later reflect on what I have said, but it is not instantaneous. I am also of the opinion that mathematics is best learned by actually doing mathematics, and it is easiest for me to assist in difficulties if students are doing mathematics when I am present. This is not to say that there is no place for a traditional lecture; unfortunately, my personal belief is that the distractions of our world today make it less and less likely a student will read through the text. A little presentation makes the material much easier to digest. But I always schedule time for group work in my classes. That way, students are actively engaging with the material and can ask questions of me when they encounter difficulties. Moreover, some students will always be more comfortable asking a peer for help than their lecturer, and they can learn from each other as well.

Along this line, one technique that I have found useful is having students grade the work of their peers. For instance, in an undergraduate graph theory course I taught at Binghampton University, I had students come to class with three copies of a proof of a particular exercise. They distributed these copies to others and then graded them in the same manner that I had been throughout the semester. This allowed many of them to see how difficult it could be to read through a proof written by someone else, and it made many students reflect on their own writing in ways they had not before.

Nearly as important as having students being actively involved is being conscious
not simply to regurgitate material from the textbook to the students. Lectures should complement the text so that students have as many potential avenues as possible to learn the material. I see great potential in the flipped classroom model, although, like any other method for teaching, a nice idea still requires thoughtful execution.

I also feel that the manner in which mathematics is presented is not always the best for learning a subject. A neatly written proof is a straight line from one step to the next. On the other hand, the process of doing mathematics at any level is not a straight line. There are fits. There are starts. There are avenues that seem promising that actually lead nowhere. While the “straight line” presentation is economical, it is not (always) natural. How often are definitions stated out of nowhere, with seemingly no motivation, in order to build the material linearly? Why are we introducing the concept of a derivative? A student is more likely to care about the component parts of a sledgehammer if they first have an idea of what tool the parts will form and what walnuts the hammer can eventually crack. For instance, with respect to classes that introduce undergraduates to proof writing, I have taught classes where the basics of mathematical logic are introduced first and classes where students are “thrown in the deep end” by introducing the axioms of the integers straight away and going from there. While my inner mathematician wants to build things from the absolute basics, I found that the students who started with the axioms of the integers and wrote their first proofs in a context in which they had intuition ultimately grasped the material better.

Above all, my opinion is that the moment I believe I have teaching entirely figured out, I will definitely be a bad teacher. Self-reflection is essential. Not everything I try in the classroom will be effective. Delivering the same lectures again and again the same way when teaching a class one has taught before is a recipe for complacency and student boredom. I will not always be able to determine from the start what the best possible techniques for teaching are; however, if I always reflect when things go poorly (or simply not as I planned them), I can at least avoid the same mistakes. If I reflect when things go well, perhaps they will be even better the next time. I know this is good practice, since it has not always been just the mistakes of others that have informed my teaching. Indeed, while being friendly, approachable, and enthusiastic about the material have always come naturally to me, the manner in which I present the material has not. I have been guilty in the past of simply parroting back material from the textbook, and I have also presented proofs from scratch so linear one would think they were magically conceived precisely that way. The result afterwards was not what I intended, I reconsidered my approach, and (I would like to think) I became a better teacher because of it. I do not have all the answers to perfect teaching now, and I am equally certain that I never will. However, I will keep working to improve, and I will always try to make sure that I am a better teacher tomorrow than I am today.