Teaching Statement

Elisha Peterson
Department of Mathematics, United States Military Academy,
West Point, NY 10996

Introduction

I will always remember the moment when I first decided that I could learn any mathematics there was to learn. It was also my first time in front of a classroom. I was a senior at Harvey Mudd College; I had just finished presenting a proof of the Monotone Convergence Theorem from Folland's text to my classmates in real analysis. And in my youthful exuberance I believed that I could teach anything.

I understand now that my 'undergraduate self' viewed teaching as a *problem* to be solved by *lecturing*. I have since developed a great respect for the teaching profession through my classroom experiences. There is not a single correct way to teach; rather, teaching is an art that requires a unique approach for each semester, each section, each student. My single greatest lesson as a teacher has been to continually strive to improve myself and to try out new things in the classroom, in order to reach these diverse audiences.

My Personal Teaching Principles

When I am in the classroom, I find it helpful to keep the following principles in mind:

First, *learning mathematics is sometimes like learning a foreign language*. Often, students struggle more with learning mathematical notation and language than with the concepts; while a first grader could easily count the number of squares under a curve, the average adult cannot explain what it means to integrate. Because of this, rather than presenting new concepts or definitions as lists of facts to memorize, I try to connect them with my students' real-world experience. In vector calculus, I make frequent use of the "classroom coordinate system". In linear algebra, I might use a textbook to demonstrate that rotations are not commutative, while a piece of paper can be used to explain basic group theory. When physical objects are unavailable, technology can be a good resource. I have designed and built an open-source framework called *Blaise* for quickly constructing Java applets that demonstrate a concept. For simpler situations, I frequently use Mathematica, Geogebra, or other computer algebra systems. Both props and computer demonstrations can help students develop the mathematical intuition that is vital for a deep understanding of the subject.

Second, I try to *provide students with a sense of context and a sense of beauty of the subject*. When teaching about invertible 2×2 matrices, for example, I will emphasize that the condition $ad - bc = 0$ is a special case of a much more general picture, even if determinants are two chapters down the line. I believe this not only helps students gauge the relative importance of concepts and better retain the more important material, but also gives the more advanced students the opportunity to ask themselves interesting and challenging questions. I also frequently devote a few minutes at the beginning of a class to related historical anecdotes, applications of the material we're learning, or "fun facts".

Third, I rely heavily on *asking questions of students*. Whether in a lecture, discussion session, or office hours, questions provide students the time to formulate their own answers, and thus to build connections between the concepts at hand and their own real-world experience. These connections are always more lasting and valuable than those I can provide. And as the students grow, I encourage them to begin asking their own questions.

Fourth, *students need opportunities to learn independently*. A student in one of my first courses commented on an evaluation that I *"taught the material very well in class so that a student would always be able to learn the material without having prior studied it."* I was happy to see that this student was learning, but realized that I was not helping him/her learn how to grasp difficult material on their own. My lesson from this situation was to be intentional about which material I cover during class and which material I allow students to learn on their own. In early calculus courses, I give "reading quizzes" on simple material that students have not seen in class. In advanced classes, I may leave certain proofs for students to learn on their own.

Finally, *let the students write their own story*. Otherwise stated, don't "pigeonhole" students. I will always remember a particular student in my first semester teaching pre-calculus to freshmen at West Point. David was active in my class, but he had significant trouble communicating; I could never quite understand the questions he was asking. I was fairly certain that he had little chance of success. Two weeks into the course, we were discussing ways to manipulate functions. I brought David to the front of the class and asked him to imitate $f(x) = x^3$, and he did his best John Travolta impression. I asked him to illustrate $f(x - 3)$ and he stepped to the right. I asked him to illustrate $f(x) + 3$, and he looked around, then climbed up on my chair. From what I saw that day and through the rest of the class, I came to realize that David understood the math better than most of his peers. I was pleased to later learn that he will become a mechanical engineer. Through this experience I learned to treat each student as a unique individual; the moment I think I know what a student is going to do in my course, I can expect to be surprised.

Conclusion

At West Point, I have been fortunate to work with several undergraduate students on independent studies and advanced research projects. These experiences have been some of the most rewarding of my teaching career thus far. I love seeing the transformation from that time when a student has no conception of what their research experience will be to the "aha moment" that comes at the end of several months. I continually think about what aspects of my own work would make good undergraduate projects, and hope to continue working with students in this capacity.

I had the opportunity last year to work with an exceptional student in my real analysis class. Near the end of the semester, he presented all the gory mathematical details of his project on the brachistochrone problem to his classmates. Talking with him after that class, he said precisely the same thing that I had thought after my first "teaching" experience so many years ago: "I could teach anything". From my own experience, I know that his feeling was not so much about teaching as about learning, but this moment captures perfectly why I became a mathematics professor, and why I enjoy the experience so much.