Teaching Statement

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Courses taught:

1. Symmetry (TA, non-major course, 4 semesters)
2. Introduction to Calculus (non-major course, 2 semesters)
3. Calculus I (2 semesters)
4. Calculus II (Spring 2008, 1 semester)
5. Mathematical Neuroscience (TA, 1 semester)
6. Math and the Arts (TA, non-major course, 1 semester)

Courses I would like to teach:

1. Any non-major course
2. Calculus I, II, III
3. Real Analysis I, II
4. Differential Equations
5. Numerical Analysis
6. Probability
7. Dynamical Systems
8. Any applied math course, especially math and biology or neuroscience

Training

In the summer program Institute for College Teaching at Tufts University, I attended workshops on teaching for one month, and then co-taught Introduction to Mathematics as a summer course for one month. The workshops discussed issues such as grading, designing a course, attaining student interest, cheating, and writing across the curriculum. As a co-instructor for an intense summer course, I was able to observe my mentor, Daniella Schnaps, and she was able to observe me and give me feedback each time I taught. Being able to receive constant feedback was the primary reason I participated in the program, and my teaching improved greatly. She taught me how to write a lesson plan and gave me many helpful ideas such as highlighting my lecture notes and using an opening question at the beginning of class.
Teaching Philosophy

I arrive early for my 1:30 PM class and write the lecture title “Volume by Slicing” on the top left corner of the board and block off a space for homework questions. I write an opening question to the right of that “Before we found the area by estimating with rectangles. How can you use integration to find the volume of a sphere?” to give students something to think about during the hustle and bustle of class. I hand back the students’ homework, which has enabled me to remember all of their names, even tell the twins apart. Someone asks me a question about the homework, then “Is that a watermelon?” I say “Yes, and I hope you’re hungry. So does everyone have all the problems they want to go over up on the board?”

Most of the time when I tell someone that I am a mathematician the reaction is “(Gasp!) Better you than me!” Even many people who are comfortable with math abandon it because it seems irrelevant. My goal as an educator is to convince my students that math is accessible, relevant, and perhaps even fun. To attain my goals I strive to present concepts so that students understand the reasoning behind them and their relevance to the world at large, to engage my students so that they are involved in the class, and to develop their problem solving and communication skills.

When introducing a concept, I take pains to go through the details of what role the concept plays at large and why the concept works. I do this by tying concepts to real life examples or at least other material in the course. In explaining “why” I outline the ideas visually and orally using the socratic method. I also show the proofs for some theorems even for lower level and non-major courses so that they can appreciate the logic behind the theorem and see where it comes from. For non-major courses I reassure them that they do not need to know the proof, I’m only doing it “so they will believe me”.

In many math classes, we have to teach an abstract method or idea. In order to make this accessible I use the plenty of examples. I generally start out with an example from real life or from previous material before stating the main concept. This grounds the material and puts the concept in context. I immediately follow up with a variety of examples that build in complexity.

Using examples from real life not only helps students connect something that they are familiar with to a new concept, but helps make that concept relevant. For instance, in Calculus I draw a function of the distance from my house on the way to my Grandmother’s house as a function of time to illustrate how the velocity is connected with slope and acceleration is connected to curvature. We discuss examples of how you feel the “jerk”, the derivative of acceleration, in cars, elevators and amusement parks rides. For Symmetry, I collect wrapping paper so that the students can see that the theory of wallpaper patterns really applies to any pattern. I also try to use humor, such as using the Intermediate Value Theorem to show that my father and I were the same height at some point as I grew and he shrank.

I am careful to present material both orally and visually. Many seemingly simple concepts are not so simple to state, so I spend some time thinking of catch phrases for them as well as mnemonic phrases. For example, in Symmetry I use the explanation “rotation number - number of times you rotate the picture (and have it fall on top of itself) to come back to the beginning” and to remember the derivative of a quotient “(Lowdy High - Heidi Lowe)/Lowe^2 - that rascal Lowdy always has to go ahead of Heidi.” Visualization is very important in understanding mathematical concepts. In many instances, drawing a graph (or several) on the board is sufficient. However, I don’t refrain from using outside sources if it will help. When I tutored a blind student in college, I explained graph theory by arranging knitting needles as edges on the floor. I have a pumpkin solid of revolution to use in calculus, and recently used a watermelon to illustrate volume by slicing. Next time I teach Cavalieri’s theorem, I plan on bringing in a stack of paper discs shaped into a cone. In a talk I gave for the SIAM student chapter at Tufts, I had students act as cells in a cellular automaton, standing up when the cell turned “on”, in order to illustrate how the cellular automaton worked.

I engage my students by involving them in active learning as much as possible. Using the socratic method, I do this by asking a lot of questions, trying to lead them to the answer when I’m lecturing or tutoring. When giving repeated examples, I gradually ask them to fill in more blanks as I go along. I often write an opening question on the board before class begins so that students can get a head start thinking about the concepts we will cover that day. On occasion, I break students into groups and assign each of them a problem to present to the class. This not only gets them more involved, but allows them to think about challenging questions in a group and to practice their presentation skills. One activity I designed for Symmetry is to
have the students take a stack of small identical pictures of Elvis Presley and arrange them into as many patterns as possible. This introduces them to the idea of what a wallpaper pattern is and how wallpaper patterns can differ. Students can see that some patterns are not so different and get ideas on what can be used to classify patterns - introducing them to the idea of 17 different wallpaper groups.

Problem solving and communication skills are essential in any discipline. Mathematics lends itself especially to problem solving skills. These are emphasized when I ask students how to go about solving various problems in class, and we see which ways work best. I emphasize a structured protocol for solving word problems - such as drawing a picture, identifying the knowns and unknowns, and assigning variables. Communication skills are often de-emphasized in math classes but are still essential. This semester many of my students were confused as to how much work they should show in exams at the beginning of the semester. Because of this, I took the initiative to outline what students should show in class and give examples of a well-written solution. Students especially need examples of what to say in a proof. Having students present problems in class also helps, as it can be used as a small master class for communicating math problems.

Assessing these methods is a continual process. The simplest way to assess a part of a lecture is to simply ask the students. Therefore, I check in often to see if there are any questions or whether anything should be repeated. I find that asking if something should be repeated is more effective in non-major courses as students who are less comfortable with the subject matter in general have a harder time formulating questions. I also like to take the opportunity to talk to students before and after class and in office hour. Another way of assessing is to look over exams and homework before I hand them back. The most general feedback can be taken from midsemester evaluations and ultimately end-of-semester evaluations.

I try to be inclusive in several ways. In the first class, I have everyone say their name and one thing about themselves, as well as encourage working on homework together. I learn everyone’s name by handing homework back to individuals before class. When asking questions of the class, I will consciously ask for “someone else to answer” so that a number of students can participate, and call on students who haven’t had a chance to speak before. I encourage students by saying that they don’t have to know the answer, but should make an educated guess. This is especially important for non-major classes where there are times, often at the beginning of the semester, when no one wants to answer. In upper level classes, there may be more diversity of levels between the students. In this case having students present answers or work in groups helps.

Other Experience

I have a good deal of tutoring experience. I tutored math independently in high school and through Centralized Academic Tutoring Services at Connecticut College. I also tutored in weekly help sessions offered by the Connecticut College math department. This past summer, I tutored two students in Differential Equations. Presently, I am a volunteer tutor for Reaching for Higher Ground, which offers free tutoring for middle school and high school students in Dorchester, MA.

As President of the SIAM student chapter, my goal is to introduce undergraduate and graduate students to as many mathematical applications as possible. Through speakers and article discussion, students have been introduced to how math is applied to: crime policy, neuroscience, actuarial science, fluid flow, chem-bio threats, global warming, and human relationships. We have also taken tours at Schlumberger-Doll Research and a ceramics laboratory at the mechanical engineering department at Tufts University.