Teaching Statement

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1 Teaching Experience

My first formal teaching experience began six years ago as a teaching assistant for Math 171 and 172, Calculus I and II. These courses was part of the "Prism" program at the University of Miami, a program created to integrate first year science and math for precocious freshmen on the fast track to medical school. In addition to teaching classical material, I was able to teach students fundamentals for coding in Maple and Sage. We met weekly in the computer lab and used software to verify calculations that had been presented in lecture or given in homework. Students were given case studies where they investigated epidemiology, using concepts from mathematical modeling. It was a gentle transition into classroom management and I felt grateful to work with such bright and inquisitive students.

The next year I graded for discrete mathematics, and two different linear algebra courses– one lower level, and one more advanced. This grading was more time consuming, but still rewarding, though I missed interacting with students. I felt a strong duty to give informative written feedback on homework, as these students were learning to write proofs and developing basic techniques that they would need for future courses. I often gave detailed summaries of class performance to the primary teachers, summarizing common mistakes that may need to be addressed in lecture.

Throughout my time in Miami, I also worked as a tutor in the university's math lab. Here, any undergraduate students could drop in for homework help. Though the questions were often fundamental, I discovered that fundamental does not always mean easy. I found that "non-theorems" are sometimes as pedagogically necessary as theorems. Students see professors use $\frac{a+b}{c} = \frac{a}{c} + \frac{b}{c}$ without comment and infer that $\frac{a}{b+c} = \frac{a}{b} + \frac{a}{c}$. A few "non-examples" go a long way in encouraging students to have a healthy amount of algebraic skepticism.

My favorite area to tutor was linear algebra. The word "dimension" is no longer taboo, and abstract theorems are seen to have heavy consequences for computer science, physics, and almost all areas of math. Even more than calculus, I see linear algebra as the biggest tool for working mathematicians and loved to introduce this beautiful subject to students.

I have been fortunate that The University of Miami allows its experienced graduate students the opportunity to lecture for lower level math courses. As a graduate student, these experiences have been extremely rewarding, and have been an excellent complement to my personal research. The communications skills I have developed through lecturing have helped me in writing and communicating my research. At the same time, the excitement of discovery that accompanies research is something that I love to bring to students in the classroom.

Recently, I have been an instructor for Pre-Calculus, Calculus I, and Calculus II. These courses are all large, with several lecture sections. The positions involved lecturing on course material, setting quizzes, setting grading policies, and grading homeworks, quizzes, and exams.

Building on my earlier experiences as a TA, I have developed new skills while lecturing. I am learning the arts of pacing a course, writing good quizzes and exams, and selecting motivational examples. I have been grateful for the ability to collaborate with other lecturers who have given me pointers on what has and has not worked for them in the past.

It has been gratifying to see students respond positively to my teaching methods. Class discussion is exceptional for eight o'clock in the morning, and there is regular attendance during office hours. My teaching reviews reflect this. Last semester I had a students say that my course was "the first time I understood math." Some students who are not even enrolled have asked to sit in my lectures at the recommendation of their peers. I sincerely enjoy teaching and am looking forward to having more opportunities to do so in the future.

2 Teaching Goals

As a student, I have been the recipient of both effective and ineffective teaching methods. As a teacher, I have tried to adopt the good and leave the bad. Moving forward as an educator, here are a few of the areas that I wish to focus on.

The Concrete vs. The Abstract I believe that experience makes it easy to forget the power of wrote memorization. Once one has mastered a subject, it is fun to prove all theorems from first principles, with no appeal to examples or intuition– explaining *why* something is true, but not why one would *guess* that it is true. This is a good exercise for professors, but it is often hazardous for younger students, who are swimming through a sea of abstraction without anything firm to hold onto.

I believe that it is my responsibility to give students– especially younger students– concrete pillars to hold onto. I try to carefully consider which theorems and examples are good life rafts– things for students to memorize and hold onto in times of trouble. Then I drive these points home. Abstraction is a good thing, but it needs to be proceeded by intuition.

Meaningful Repetition. The first time seeing new material, examples are more important than theorems, and theorems (conjectures) are more important than proofs. Examples lead to conjectures, conjectures lead to proofs, and proofs make a theorem. Teaching mathematics in this way recreates the excitement of discovery, rather than instilling a feeling of inferiority. The classical theorem⇒proof⇒example ordering is meant to impress peers– not educate pupils.

By contrast,the ordering examples⇒conjecture⇒proof not only recreates the original discovery; it also allows for ample repetition. The danger of forgetting what one has set out to prove is mitigated by having conjectured the theorem for oneself.

Responsibility and Respect. I have found that students work more diligently when it is clear what is expected of them. When a professor says, "You will be required to state and prove one of these seven theorems on the exam," students will (usually) learn all seven statements and all seven proofs– even if it is a lot of work. If they fail to study, they feel that they have no one to blame but themselves. In contrast, if a professor says, "anything from the book or the notes is fair game," students will peruse both the book and notes, but are likely to place their hope in the curve or their professor's charity. I want my students to feel like they have earned the grades they receive– not like they were "given" a grade. I believe that fair and transparent grading earns the respect of students.

I want to be responsible and respectful of my student's time. For lower level courses, online homework platforms such as WebAssign, WeBWorK, and MyMathLab are great because students don't have to wait for their work to be graded– they can see their mistakes right away and correct them. On the other hand, these programs make it very easy for teachers to assign too many problems, and students may feel that their time isn't being respected. Homework should not be an unnecessarily heavy burden. It should be, as the word suggests, "exercise"– to strengthen students for the work that is to come. It should augment and enhance what is being discussed in lecture, providing a working familiarity with key concepts.

As a student, I have had professors assign "rudimentary" exercises which they never completed themselves. On several occasions, after hours of struggling, I would go to office hours and watch the professor struggle through the proof, only to realize that the "statement wasn't quite right" or the technique was "more involved than he initially supposed". While every professor is bound to have buyer's remorse after assigning certain problems, I felt extremely encouraged when my professors would write up their own solutions to exercises. Knowing that they felt responsible for my understanding of the material made me take greater responsibility myself and it gave me a deeper respect for them and the material they were teaching.

Context and application. As an undergraduate I sometimes felt like the classes I took were taught in a vacuum. It was exciting when a professor would bridge the artificial gaps created by course titles to show how the theorem we were proving was used in another area of mathematics. In purer math classes, this is sometimes the closest we get to "application" and so I feel a duty, whenever possible, to at least allude to such connections.

For lower level courses, motivation is even more necessary. If a student is not ready to appreciate math for its beauty, they can at least be convinced of its utility. Why do we care about derivatives? We care about maximizing pleasure and minimizing pain. Why do we care about Boolean logic? We enjoy digital electronics. Why do we care about number theory? We care about internet security.

Historical Context. By the time new research mathematics reaches an undergraduate textbook it has usually benefited from decades of filtration, revision, and reworking– hopefully by people with a good understanding of how the subject fits into a modern story. The trouble with this is that the new narrative which students find in their text may masks or ignores the original motivation and historical complications that arose in proving the theorems they now see in nice little boxes. The original narrative of examples⇒conjecture⇒proof sometimes spans hundreds of years and this realization may lend encouragement to struggling students who don't understand the proof the first time through. It is likely that in five years time, most of the students in the class will have forgotten the proof. Few will forget the story.

Passion. Mathematics is beautiful and studying it can be very fun. This is why I research, and also why I teach. I want students to experience the same sense of discovery that researchers experience, and I want to encourage them to continue enjoying mathematics.