Teaching Statement

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I have been teaching college and high-school level mathematics in several different capacities for the past 8 years. As an undergraduate at the University of Chicago, I was a "Junior Tutor"—essentially a Teaching Assistant, grading homeworks and running problem sessions—for calculus classes, and an instructor in the Young Scholars Program for mathematics for students from the Chicago public school system. As a graduate student at Rutgers, I have been the instructor for several classes, and, during the summers, have taught at programs for high school students.

I think that the best teaching strategies vary a great deal from course to course. For example, the first college-level course I served as the instructor for was Calculus II at Rutgers. This course, aimed at Engineering students and others needing to satisfy the Calculus requirement for a technical major, covers integration techniques and applications, sequences, series, Taylor and power series, and differential equations, among other topics. The pace of the course and the number of topics covered makes it easy for students to get lost quickly if they miss or tune out for a few classes. I decided to begin every class with a short quiz on the material from the previous homework assignment. Apart from encouraging students to show up to class, it created a great incentive for students to check that they actually learned the material covered in each assignment, which can be a serious issue when solutions to homework problems are readily available for major textbooks! As a result, students came to me to resolve their questions on homework problems they struggled with, rather than fudging their way through the homework assignment and then discovering they were in trouble when the exam came around. Although it might be expected that daily quizzes would be unpopular with students, I had very few complaints, and several students mentioned in their evaluations that the quizzes forced them to stay up to speed, and helped them succeed in the course.

Apart from developing practices to motivate student performance (and the skills to present difficult material in ways which make it easier for students to understand) I think it is also *very* important to be able to present material in a way that highlights its beauty and merit. The second class I instructed at Rutgers was 'Topics in Mathematics for the Liberal Arts.' The author of the textbook used for this course (Peter Tannenbaum, *Excursions in Modern Mathematics*) clearly shares this perspective, as the course covers topics as diverse as voting methods, fair division algorithms, scheduling problems, and so on, all in a way that highlights the versatility and applicability of mathematics in a variety of surprising and very 'real' situations. Fortunately, even a well-designed course leaves much to the instructor, and the topics in the course lend themselves very well to further motivation and discussion (especially when the section on voting methods happens during election season!).

But the problem of motivation is just as critical when the course topic is more technical and seemingly more mundane. Most students come into a course titled "Calculus II" because they need to fulfill a requirement about which they have no enthusiasm. And it is easy for them to finish the course with an even lower opinion of the subject than they entered with. But Calculus is actually a beautiful subject, even at the elementary level when rigorous

proofs are not involved. And it is filled with quirks that, although they are at first glance just annoyances to the struggling student ("You're not allowed to rearrange the terms in a infinite sum when it's not absolutely convergent!") are surprising gems that can emphasize the mystery and wonder inherent in mathematics ("Given *any* convergent series which is not absolutely convergent, you can rearrange the terms to get π, e, $\sqrt{2}$, or any other number that you want!" And this amazing fact can be convincingly demonstrated to every Calculus student.) With the right presentation, a course can leave students with their interests piqued, and their perspectives more positive. In fact, I think this is one of the reasons it is so worthwhile for research mathematicians to teach introductory or technical courses like calculus, as well as more advanced ones—our training, in some sense, makes us experts at finding beauty and depth in abstract topics which might seem tedious at first glance.

The course I have been teaching at Rutgers most recently is the honors section of the 'Topics' for liberal arts course. The honors section is really a completely separate course, and focuses just on cryptography. The material is not without its technical intricacies, but I have found that it is quite possible to rigorously cover the 'big concepts' in cryptography in a way which appeals to the nontechnical students who take the course. By introducing things like modular arithmetic when we cover classical ciphers at the beginning of the course, and reinforcing material as we go by keeping the class 'hands-on' (for example, we engage in code-breaking exercises where two groups are trying to exchange secret messages while a third eavesdropping group tries to break their codes) I find I can have students prepared to tackle the RSA public-key cryptography system at the end of the course. Even in spite of the diversity of topics presented in the regular 'Topics' class, I believe that the cryptography-focused course can actually be the most impressive to students from the standpoint of the intrinsic interest of the material: I think a good case can be made that the public-key cryptography systems developed in the 1970s like RSA and Diffie-Hellman represent one of the most significant practical breakthroughs in mathematics of the 20th century, and in this course we are able to show them—completely and precisely, in a way that students will completely understand them even as they are surprised at the very possibility of them—to students who may never have occasion to take mathematics again. (For the Fall 2009 semester, I have also had the opportunity to rework the curriculum of this course, replacing the textbook used in the previous semester with lecture notes and exercises I prepared to target the material most effectively at the students who take the class.)

I feel that one of the advantages of being at Rutgers, with its large undergraduate program, is that it allowed me to take on a wide variety of significant teaching responsibilities as a graduate student. I've really enjoyed my teaching experiences here, and especially appreciated the freedom to work on the materials for the cryptography class, to make it as accessible as possible to the students the course is aimed at. I'm really looking forward to staying involved in the teaching side of mathematics in my post-graduate career. Apart from teaching, I would also be very much interested in opportunities to shape the courses that are taught. It doesn't take long to realize that the quality of instruction *really* matters from the standpoint of what students will take away from a course, but the quality of a curriculum matters a lot too!