Teaching Statement

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During my career as a mathematician, I have had the opportunity to teach a variety of courses at many levels. Each class provided a different perspective on how students learn mathematics and how mathematics can be taught. In my experience at Colgate University, University of Connecticut, Cornell University, Dartmouth College, and University of Iowa, I have become very conscious of the high expectations students have for good teaching. In order to meet and exceed these expectations, I have worked hard to make my classes valuable to the students; I want to help them to cope with the inherent complexity of mathematics and to appreciate its beauty. While teaching certainly demands professionalism, it is the personal, communicative, and cooperative aspects that make the processes of teaching and learning interchangeable and mutually rewarding. To this end, I have developed a teaching philosophy that rests on three pillars: 1) an active, student-centered approach to teaching; 2) careful planning and preparation; and 3) a thorough understanding of the material, coupled with interdisciplinary examples and visual examples of the concepts discussed.

In the courses that I have taught so far, I have found that active involvement by students is an essential part of effective teaching. What I strive for in my classes is a give-and-take approach. To foster active learning, I have found that informal, two way conversations are a more effective means of teaching than one way communications. To develop students' analytical and critical skills, I encourage them to justify their answers rather than to deliver yes/no responses. Justification not only facilitates a better understanding of the material, but also helps students improve their solutions to the more challenging problems in their assignments.

As an instructor for both introductory and more advanced classes, I have realized that although communicating with students and engaging them in class discussions is important, class preparation is equally significant. A comprehensive lecture preparation includes not only planning and structuring the lecture material, but also anticipating students' questions and misconceptions. Before going to class, I always take time to think about potential misunderstandings and prepare significant and intuitive applications of the material discussed in class. An efficient tool that I have used in many of my classes is to display a prepared outline on slides, while working at the blackboard. The use of two medias allows the main ideas to be displayed while carefully chosen examples, questions and problems serve to motivate theorems and ideas.

To help students structure their material and better prepare before tests, I provide extensive review and practice material for their exams, and I run review sessions and set-up individual student meetings before each exam. This has been well-received by students. They are very pleased to get this extra feedback. It helps them build up confidence as they go over the material for a last review with an updated perspective. I have observed improvement on exams for students who utilize this additional help.

In my efforts to train students to think like mathematicians, I aim not only for them to understand and apply the mathematical ideas and concepts, but I also want to convey to students the thrill of mathematical discovery. The most effective strategy that I have found for achieving this goal is to let students rediscover some of the key facts and results. I stimulate discovery either by guiding the students through a few carefully chosen questions, or by using computer technology. I have witnessed with great pleasure the large smiles of my students when they "discover" a variety of concepts – from limits and derivatives, to addition of vectors, to the Law of Large Numbers. I have coupled such methods of discovery with study-cases and group work.

One experiment I performed with the students from an honors section of the probability class that I taught at Dartmouth College was to ask them to formulate and solve their own problem for the final examination. The challenge was that the students had to propose a realistic problem which they had to derive from and apply to a "real life" situation. They had to use both theoretical and experimental methods to complete their project. I was amazed by the variety of problems that the students suggested. They ranged from games played in the dorms to problems about piloting airplanes. The experiment helped students acquire a more profound knowledge of mathematics, and it helped them to understand the ramifications of mathematics in everyday life.

Inspired by the success of the experiment that I described above, I decided to adapt it and use a similar idea in the Introduction to Statistics course that I have been teaching for the last three years at Colgate University. Namely, students had to turn in a final project at the end of the semester. While I provided students with a list of previous such projects, each of them had to come up with their own topic to study. My main advice for them was to pick a topic that they actually liked. To my delight, most of the students followed up on my advice and they worked on finding answers to questions that they really cared about. The topics that they picked varied from student's life at Colgate, to sports, to politics, to U.S. and international economical and health issues. The main catch was that students were supposed to collect their own data for the project either via the internet or via a survey administered by the Math Department. While I took care of the technical part of the survey, students had to upload on the survey their own questions that were relevant to their final project. Thus, students realized first hand how important and difficult was to carefully design questions with multiple choice answers for a survey. Once students collected their data, they used Excel to provide the statistical analysis that they needed for their projects. In order to make students work efficiently, I broke up the project into smaller parts and I provided them with a strict time-line: first students handed in a description of the project that they wanted to pursue; a few weeks later they provided a detailed description of the data that they have collected; the last step supposed providing a statistical analysis of their data and the final writing of the project. This time-line ensured that the students collected their data early so that they had enough time to perform rigorous statistical analysis. To help students with the complexity of their projects, I spent a significant amount of time in and out of the classroom demonstrating how to perform common tasks in Excel. At the end of the semester, most of the students told me that they have worked much harder and much longer on their final project then they have anticipated. However, they were excited that they learned a lot in the process and that they knew how to use mathematics in the real world.

I strongly believe in the use of technology in the classroom. I already mentioned the intensive use of Excel in the Introduction to Statistics courses. In addition, I have taught several courses using Matlab, Maple, and Mathematica at the University of Iowa, Dartmouth College, and Colgate University. In particular, I used Matlab extensively to teach a dynamical systems course at Colgate University. At the beginning of the semester I spent a significant amount of time to teach my students the fundamentals of Matlab. By the end of the semester, students became quite versatile in using Matlab. I was pleasantly surprised by the depth and complexity of the topics that they analyzed using Matlab for their final computer projects.

Another important piece of technology that I have used when teaching Calculus classes at Dartmouth College, University of Connecticut, and Colgate University was an online homework system, either webwork or webassign. Some students were reluctant to use webwork the first time I used it at Dartmouth College back in 2005. However, I noticed with great delight that the students attitude towards using such an online homework system has changed dramatically over the last few years. For example, my students in the Multivariable Calculus class that I taught during Fall 2012 at Colgate University fully embraced the system. They found webwork to be of invaluable

help, because of the instantaneous feedback that they received, the hints provided for most of the problems, the solution availability immediately after the deadline, and the easiness of contacting me from within webwork when they got stuck on a specific problem. They told me that knowing immediately whether their answer was right or wrong motivated them to find the correct answer to a problem in case they got it wrong the first time or the first ten times. They spent more time on their homework than they would have spent without webwork, and they also paid close attention to numerical computations. I noticed with great excitement how their solutions to exam problems improved as the semester went along. By the time of the final examination, most of the students performed the computations for the problems that they knew how to solve without any numerical mistake. This statement was far from the truth at the beginning of the semester.

In addition to the tools that I mentioned above, I asked my students in the Real Analysis course and the Capstone course at Colgate University to type their homework solutions using LaTeX. The real value of using LaTeX for students homework is that it forces them to take a second look at their solutions and spend some time proofreading them. I have seen a great improvement in the quality of the homework solutions that the students provide. I also feel that it helps to improve their overall writing skills. I was impressed by how quickly and enthusiastically the students embraced this idea. While I was there to provide them support for installing and using LaTeX, I was pleasantly surprised to see that most of them did not need my help at all. Moreover, many of them started typing solutions using LaTeX for other classes that did not require it, to the delight of my colleagues.

Each of my classes has inspired me, but perhaps one of the most fulfilling experience for me occurred while teaching a capstone class at Colgate University. This course is offered to math majors seniors to help improve their writing skills and to help raise the level of sophistication of the problems with which they can deal. I tried to accomplish these goals through written and oral feedback, through individual meetings outside of class, through class discussions, and, especially, through individual projects. In addition to developing theoretical concepts and supplying clear proofs, a special challenge of this class was to connect the course topics with those that students have learned in other classes. Mediating class discussions on assigned applications, proofs, and examples proved to be very efficient for revealing multiple uses of theoretical concepts and in revealing their widespread implications. At the same time, the discussions helped students perceive mathematics as a unified subject. I helped each student choose a project in an area that she or he liked. My strategy was to guide them towards topics that required the use of multiple concepts from various courses that students took. Watching young math majors develop and learn to appreciate the unity of mathematics was a very rewarding experience for me.

All the courses with which I have been involved have reinforced the importance of teaching in a mathematician's career. I have enjoyed every class that I have taught and I look forward to having many more opportunities to help me grow as a teacher.