Teaching Philosophy

I believe that one successful approach to teaching mathematics is a style that draws on real-world problems. The advantages of this parallel to my interdisciplinary research are several: 1) problems in this context are often more stimulating than toy problems; 2) these problems nearly always require the combination of mathematical tools; 3) these problems allow for creativity in solutions; and 4) creative approaches provide new mathematical directions to explore. It was real-world problems that inspired me to become a mathematician—I was in a series of engineering courses at Purdue when I realized that it was the mathematics behind the theory that I was drawn to, and subsequently changed majors to mathematics—and I try to facilitate this connection through problems generated by my research while teaching.

Interactions with biologists have stimulated the idea that tailoring mathematics courses to specific disciplines could be beneficial for both the external discipline and mathematics. I feel there is a need for a course for biologists designed to expose them to the ideas of differential equations, linear algebra, and numerical methods. This course, with only one semester of calculus as a prerequisite, would touch on these subjects without too much depth of theory, and instead give biologists a basis of knowledge for reading more technical papers and for working with engineers and mathematicians in interdisciplinary settings, who, in turn, benefit from the improved fluency of biologists in the mathematical language.

Inter- and multi- disciplinary studies enrich students at both the graduate and undergraduate level. Asking students to interact directly with peers from other areas of research and study will forge an appreciation for these other disciplines and also break down the traditional barriers developed by classical university structures, which are only recently being changed with interdisciplinary institutes and programs. One additional place where this type of interdisciplinary work can be implemented is in the senior project or thesis. I would propose that students from several diverse disciplines choose a project that is multifaceted and work as a team to investigate all aspects of this project. This idea can be carried out at the graduate level in some instances, and would be a very exciting way to bring together students across campus, with the added benefit of forging new bonds between departments.

Teaching Experience

My teaching experiences have been a combination of small and medium (15-40 student) classes, direct mentoring of summer students, and seminars to colleagues and the public.

Teaching I taught five very satisfying semesters of Intermediate Algebra in small classes. These students were almost universally uncomfortable with mathematics, and it was a rewarding challenge to de-mystify the material. I encouraged students to think beyond the current algorithm and develop their own problem solving skills. My mantra for exercises was: "First read the problem, think about it, and estimate what a reasonable answer might be. Then solve the problem. If your answer is not reasonable, find out why!" My casual, conversational style in the classroom relaxed students who were anxious about the material, and I thus had an excellent rapport with my students.

Next I taught two semesters of Finite Mathematics to mostly sophomore business majors. Though the curriculum was very broad, fascinating real-world problems abound in this course, and I drew upon them heavily in lectures, homework, and quizzes. Larger class sizes forced me to formalize my lecture, but I used small group exercises with real-world problems to promote direct interactions.

Finally, I taught a semester of Multivariate Calculus with 25 students. I was excited to teach this course because it is the entryway to the physics that I use in my research, and I spent time trying to relate the material to my real-world problems. Examples included deriving mass transport equations, domain transformations, and optimization. I used a combination of formal lecture, small group exercises, and interactive computer demonstrations with some examples from my research. Quizzes and homework also drew heavily from my experiences with real-world problems.

Mentoring For three consecutive summers John Critser, my biology advisor, participated in an engineering REU program, and hosted four undergraduate engineering and applied mathematics students for eight weeks. Prof. Critser asked that I take control of the entire process. I reviewed and ranked applications, and mentored the students, working with them to define and solve tractable problems. I learned a great deal about mentoring students during these summers. I learned that it is time consuming, that it can be frustrating, that student's grasp of concepts is only academic until put to real-world tests. I also learned that it is an extremely rewarding experience and probably one of the most prominent reasons why I want to work in academia. At least two of the students revealed to me that their experiences and conversations with me inspired them to pursue doctoral degrees in computer science at Binghamton University and in mathematics at Washington University St. Louis.

In addition to the "trial by fire" approach to learning mentoring skills, I also participated in two, semester long, mentoring courses, one at Purdue, and one at the University of Missouri. These experiences and courses leave me well equipped and excited for the chance to mentor both undergraduate and graduate students as they begin their research career.

Public interaction Throughout my academic career, I have jumped at opportunities to present my work to the public. I am lucky to be a mathematician working in an applied field that is interesting to a lay audience on many levels. For two consecutive summers, I developed and presented a poster at the University of Missouri "Adventures in Education" Graduate Research Fair, attended by the public. I presented my application, cryobiology, in a way that was interesting to children of all ages (and their parents as well). I integrated key scientific concepts while entertaining kids of all ages, ending my presentation with a demonstration that both illustrated these concepts and delighted children (while startling parents): I had children eat marshmallows fresh from liquid nitrogen!

Because of the success of this presentation, Graduate Dean George Justice and I struck up a long lasting relationship, sparking several presentations to other lay audiences, including a presentation at a local conference on literature entitled "The Body Project," and several well received talks to university administration and state legislators.