

Teaching Philosophy

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When I teach mathematics, there are three facilities I want to encourage in my students. I want to impart quantitative intuition, techniques, and abstractions for solving problems. These principles guide me to develop a teaching style where students must be active participants in learning. I will describe the practice using first year calculus as an example.

I see my students for about forty hours over a semester. Most of them are in the College of Arts and Sciences, and few will become math majors. For many, their choice to take calculus is made under the duress of other majors' requirements. In the time I have with my class, what is the most valuable thing I can help them understand?

I want my students to be able to express their beliefs quantitatively and be able to test whether those beliefs align with the real world. Almost every student will experience an application of the inexorable growth of the exponential function. Volumes of solids are positive numbers with cubic units. An third example is the absurd sum of nonnegative powers of two; the geometric series formula gives a negative result. My students stare in disbelief. After a silent interval, several students suggest that the series doesn't converge.

I want my students to be experimenters. Our segment on methods of integration provides lots of tools. When we work examples in class, I have students suggest methods for some integration problems. This is a chance to emphasize that exploration is necessary and one often cannot know beforehand how a problem will turn out. I want my students to feel free to try things and discover. Sometimes they find solutions I had not considered. For instance, a student showed me a nonterminating integration by parts resolve as a telescoping series converging to the solution.

The primary abstraction presented in Calculus is convergence. Every time a limit process appears, we write out the definition of convergence. By the time we get to improper integrals, most students know how to translate the infinity symbol to a sentence beginning "for every positive epsilon, there is a big N such that for all little n bigger than big N ...", although the words to this incantation sometimes get garbled. Their recitations become much more accurate after we cover power series. Besides the poetic definition, we see graphical and algebraic versions of convergence. My favorite format is a dramatic representation, with the roles of The Adversary, who chooses epsilon, and Myself, played by students. My hope is that my students re-

tain the meaning of convergence and continuity from at least one of these representations.

When teaching courses besides Calculus one difference is the emphasis I place on the different aspects of competence. Senior math majors have a better intuition for sensible answers and the techniques in those courses depend on abstractions learned before. These students have also learned to play the abstraction game with less concrete examples. In an undergraduate number theory course, we can discover, with some suggestions, quadratic reciprocity by distributing primes across the class and collating the data on quadratic residues found by exhaustion.

In every course, beyond the specific content, I show that math can be beautiful and that we can value the human endeavor. I often put results, like the development of calculus, in historical context. Alternatively, I show how mathematics has artistic merit. One example I cite is the view across a field of corn. The sight from each angle can be described using continued fractions.

Recent Teaching Experience

At Cornell, I have taught a range of undergraduate courses, including the upper division algebra sequence, a middle division number theory course, and calculus. This year, I have adopted and added to the “Good Question” project of Maria Terrell while teaching first semester calculus. In Spring 2004, I will teach a new course on cryptography targeted at nonmajors. In Fall 2002, I was on the short list for the department teaching prize.

As an alumnus of Ithaca High School, I have been fortunate to have special opportunity to support math education there. I organized a new seminar at Ithaca High School for their dozen students who completed the math and related courses offered, with David Bock, of Ithaca HS, and several Cornell math graduate students. I plan to present a module on cryptography for Cornell’s outreach program, Math Explorers Club. I have been on the Cornell math department committee to award the Ithaca High School senior math prize for several years.