Teaching Philosophy Statement

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My main goal when teaching an undergraduate math class is to help my students develop some of the skills needed to become scientists, doctors, educators, and, more generally, contributing members of society. My teaching style is largely motivated by my own experience as a student: in particular, my struggles with math earlier in life (a topic that I openly discuss with my students) have left me with a strong sense of empathy for students who are learning something new and, very often, unfamiliar. As a result, much of my efforts as an instructor are geared toward finding the clearest and most efficient ways to communicate with my students.

With an eye towards encouraging instructor-student communications, one of first goals is to establish a friendly and interactive classroom environment. Whether teaching in a small classroom, or in a larger auditorium, I begin each semester by introducing myself to my students. This introduction typically involves saying something about my family, outside interests, and current research in non-technical terms. One student later commented that this was the first time that she had ever heard anyone talk about math with excitement and enthusiasm! Afterwards, I ask my students (via an official homework assignment) to write an email to me and their TAs describing their interests and previous math experience. This lets me get to know my students better, and helps them become more comfortable communicating with me and their TAs.

Having established a friendly (or, at least non-intimidating) environment, I then try to enthusiastically solicit questions and comments. My typical procedure for addressing an in-class question is as follows: First, I will restate the problem, briefly recalling facts needed to relate the question asked to the topic at hand. Once a problem has been clearly framed, I will then answer the question, and when possible, relate the answer with something we might have discussed earlier. This entire process of actively incorporating questions and comments into my lecture usually plays out rather quickly, but is important in that it highlights to students the value of their contributions during lecture.

Another key feature of my teaching style is the use of examples to describe general mathematical phenomena. As an example of my approach, consider the following prelude to Wilson's Theorem: Students are asked to fix a prime p and consider $(p-1)!$ mod p, starting with the case $p = 7$. Via brute force, one computes that $6! = 720 \equiv 6$ mod 7; at this point, students are easily convinced this is probably not the best way to proceed in general. Seeking an alternative, we observe that 6 and 1 are the only classes equal to their own inverse modulo 7, which shows that $5 \cdot 4 \cdot 3 \cdot 2 \equiv 1$ mod 7 (as each term in the product pairs with its inverse and "cancels out"), and thus that $6! \equiv 6$ mod 7. In this discussion, students are able to deduce the method for proving the general statement, i.e., that $(p-1)! \equiv -1$ mod p whenever p is prime. This illustrates a general technique I often use in class: before discussing a theorem or algorithm, I run through an experimental case that students should be comfortable with. Throughout, we highlight all of the key ideas being used, and organize them into a "roadmap." Using this "roadmap," students are often able to actively participate in generalizing our example, since it is usually clear to them what steps they should take. Additionally, this process of "proof via example" provides students with a method for attacking homework and exam problems, and also helps them identify the "right" questions to ask when they get stuck.

To eliminate any possible sources of confusion, I try to keep arguments as simple as possible, and tend to omit unnecessary technical details. In addition, I also stress to students the importance of seeing the "big picture." For example, rather than diving right into the construction of the integers modulo n, I instead start with a (light!) discussion of the general mathematical principle of using equivalence relations on a collection of objects to build new, related objects. This discussion begins with the geometric examples of constructing the circle and torus as quotients of $\mathbb{R}$ and $\mathbb{R}^2$, respectively, and ends by pointing out how new "number systems" (e.g., $\mathbb{Q}$) may be constructed from old "number systems" (e.g., $\mathbb{Z}$) via equivalence relations. Throughout, I try to point out

insight gained via this process. In light of this discussion, the construction of $\mathbb{Z}/n\mathbb{Z}$ is now seen as a natural process. In my most recent course, a student mentioned that she had never realized that different areas of math could have so much in common, and was excited to seek more connections! In general, by emphasizing the big picture, I seek to motivate the topic at hand, and to provide students with a sense of satisfaction in knowing *why* the topics we discuss in class are interesting and worth their attention *before* actually starting our discussion.

In addition to planning lessons and trying hard to reach students in class, I also try to be as active a mentor as possible. In lower-level classes, this often involves stressing the importance of good study habits, projecting enthusiasm for the subject at hand, and convincing students that hard work in math class will pay off, both in the short and long term. During my postdoc, a handful of students have mentioned to me that my enthusiasm and attitude towards math had even inspired them to add a math minor (and even major). In the upper-level course I taught, I encouraged students to ask me any questions they might have regarding other areas of math, graduate school and other after-graduation career options. To my surprise, all but a handful of students took me up on this offer. In some instances, these discussions have led to short reading courses and senior projects, and in others, have helped a couple of students decide whether or not to seek a Ph.D. in math. It is this aspect of teaching that I find the most personally rewarding.