TEACHING STATEMENT

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To many, mathematics is a means to an end: a set of tools that is useful for solving problems in another field, say physics, engineering, statistics, or any of a myriad of other sciences. While I appreciate the applications of math to other fields, the enjoyment I get from it stems almost entirely from the intellectual stimulation it provides. This is an aspect that I believe is unfortunately not emphasized enough in a typical class, and one which I like to push when possible. In other words, one of my goals as a teacher of mathematics is to instill a sense of curiosity into my students while simultaneously preparing them for their own careers.

There are some basic responsibilities that should be implied for any teacher, such as having a strong knowledge of the subject matter, creating day-by-day lesson plans, and other preparations. But it is more difficult to determine what the best approaches to a new topic will be – not every student learns the same way. I thus find myself frequently asking how to improve my methods, with the goal of reaching more students and increasing their retention.

To do this requires a willingness to approach material in multiple ways, and to critically evaluate the effectiveness of current approaches. The current push to improve the mathematical literacy among students in the United States is commendable, but without a simple solution. It is especially important in lower-level courses, where students are composed of the widest range of majors, to remain conscious of their often drastically different backgrounds. I have found that simply knowing the majors of my students, and explaining concepts in terms related to that field, has helped to keep them engaged in the material and in classes. For example, one student of mine struggling with the "big sigma" notation for iterated sums was able to immediately understand the process when seeing the connection to `for` loops.

Another effective strategy has been to encourage students to help each other during class. Most students I encounter do not think the same way that a professional mathematician does, through no fault of their own. But when one student in a class has come to understand a concept well, their explanations to other students may be more relatable to, and thus more effective for, other students. This also helps the student who has understood the concept to reinforce their understanding.

I also believe it can be very useful to incorporate technology in the classroom. Programs such as Mathematica are excellent for not just producing graphics, but for also producing interactive images. For example, when explaining to students in a calculus class that an integral of a function of the interval $[a, b]$ is the limit of Riemann sums, it is common to draw rectangles under a graph for partitions of $[a, b]$ of various sizes. A few examples might do the trick, but to supplement this, I would prefer to present an interactive graphic where one chooses the size of the partition of $[a, b]$ and the rectangles automatically adjust. Thus, we can instantaneously produce as many examples as we want, and watch what happens as we vary the partition size. This kind of manipulation can also be used to demonstrate the behavior of errors in approximations to the integral, and to visualize more advanced situations, such as anything three-dimensional.

Technology can be introduced into higher-level courses as well: software with visualization capabilities are useful for demonstrating topological concepts, say homotopy equivalence, deformation retracts, or with some planning, a program such as Macaulay2 can be very useful for demonstrations in algebra – even if the goal is to show how difficult computations can sometimes be.

In my experience, students also often do not seem to realize that mathematics is still a very active field of research. Nobody can blame them since research-level math can be esoteric, even among researchers in the same branch, but there are usually examples of open problems or recent results whose statements do not require specialization in their fields. The Riemann hypothesis has many easily-accessible equivalent forms, the Goldbach and Collatz conjectures are simply stated, and it is easy to describe even the basics of Ramsey theory. I believe that an exposure to open problems can transform a student's perspective of math as meaningless sets of rules for problems that are already solved to a perspective more of discovery and creativity – a switch that can help to reach more students.

It is very easy to get caught in a routine of courses being entirely lecture-style, where students merely listen and take notes. Not only will even the most intelligent and motivated students will get tired of this, but so do I. Whenever possible, I try to include activities that rely on group work and/or self-discovery. These kinds of activities not only more strongly instill the course material, but they also reflect how mathematics works at even its highest levels: people have mathematical questions, may try to find the answers themselves or with the help of others, and eventually might have to come up with new techniques to resolve their problems. And who says mathematics can't be creative?

Outside of the typical classroom I have helped with multiple Math Circles, helping to expose high school students to mathematical challenges that they would not otherwise be aware of. These sessions gave me insight on how to approach teaching mathematics in smaller groups of students, and to students who are self-motivated. Environments like this are helpful to show that math can be done outside of a classroom setting, without any pressure of tests or grades. They foster curiosity and creativity, traits that can be applied far beyond mathematics.

In summary, as a teacher of mathematics I aim to consistently reevaluate my own methods in order to reach as many students as possible. I am always aware that there are many different learning methods, and relying on one teaching method is not enough. By creating varying styles of activities, utilizing technology, and provide an exposure to current and active work, I hope to engage students and give them motivation to view mathematics positively and as a field worth studying. Once this is established, their work and progress will follow.

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