TEACHING STATEMENT

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The emphasis of the Department of Mathematical Sciences at West Point, of which I've been a part of for the past three years, is on student learning, and there are many teaching styles and philosophies to learn from the folks there. Through my brief teaching career, I have had the opportunity to teach classes ranging from Pre-Calculus to Abstract Algebra, and I've come to realize that the most important aspect of learning is this: students learn best by solving problems on their own, and sometimes in their own way. Of course, teachers are there to facilitate this learning, but ultimately what the student gets out of the class is what he/she puts into it. Therefore the question that I ask myself before each lesson is: what can I do to help them *want* to learn about this material? In what follows I will discuss a few things that I have tried to motivate my students.

I try to present new material in a stimulating way. I sometimes introduce new topics with an example or experiment whose outcome is unexpected. I find that this grabs their attention. For example, when discussing limits in an introductory calculus class, I once started with $\lim_{n\to\infty}(1+1/n)^n$. I made an argument that the limit will be one, and another that the limit will be infinity, let the class take a vote, and then let the class determine the limit experimentally. Natural questions came up: Why does this have to be the case? Why does "e" pop up so often? Surprisingly, many of them found it "neat." I noticed that this got them asking questions about math, instead of the usual "will this be on the test?" Another example that comes to mind is from my numerical analysis class. Before studying Newton's method, I had the class work through two examples: one where the method works beautifully and another where it fails miserably. Then the natural question is: Why does it work in one case and not the other? My hope was that these experiments would generate questions that my students would really *want* to know the answer to. Of course, I've had my share of failures when attempting in-class experiments... just ask me about the Great Spline Debacle of 2007 [1].

I try to foster an appreciation for the practicality *and* beauty of mathematics. One way I do this is by incorporating real-world applications into my teaching. Certain classes that I have taught naturally lend themselves to applications, like linear algebra and numerical analysis, but it is just as important to discuss applications in "abstract" classes, like topology, geometry, and algebra. I feel that they are empowering for the students; it adds another dimension in their appreciation of the subject. At the very least they can give concrete answers to "what can you do with that?," a question that will always plague mathematicians at social events. For example, in an abstract algebra course I taught recently, the students did a research project on elliptic curves and their application to public-key cryptography, a topic being studied closely by the cryptography community, and the NSA in particular. In linear algebra, I once based several lessons on eigenvalues and eigenvectors around discrete dynamical systems. However, I should add that I only discuss applications when there is a legitimate link to the material. I've seen many teachers (myself included), with the best of intentions, give problems based on artificial or contrived "applications." In my experience students see through this, and it tends to hinder their appreciation of the subject matter.

[1] Long story short: Keep it simple, stupid. It was a valuable lesson in staying away from over-elaborate activities, which in this case distracted many of my students from "the big picture."

Often I remind my students that it's not the applications themselves that are powerful, it's the *beautiful mathematical concepts* behind those applications that are powerful. It's especially important to emphasize this point when teaching non-math majors. One of my favorite places to do this is in linear algebra class. Understanding what a change of basis is leads to compressing sound files so they can fit on your iPod. To predict the ultimate fate of a population, i.e. determine the long-term behavior of a discrete dynamical system, we *need* to understand what eigenvalues, eigenvectors, and a change of basis are. One can use the "abstract" geometry of vector spaces, and the simple pictures one can draw from them, to derive powerful techniques like least squares - a very powerful technique indeed!

Finally, and most importantly, I try to inspire my students by simply getting to know them, and letting them know that I care about them as individuals. This is beneficial to all students, but in my opinion it is most important for those who are struggling. Even at a school as selective as West Point, there are students who have a hard time with mathematics. Some courses are sectioned by past performance in mathematics, and I have had the opportunity to teach some of the "lower" sections. In the weeks after a long discussion with a student that was doing particularly poorly, I noticed an increase in his motivation and interest in the class. This student eventually even wanted to know about my research! In all my classes, I've found that making the extra effort to let those struggling students know that I have genuine interest in their success is one of the most encouraging things I can do. I know it is impossible to reach all students, but I have found that students that know you care are less likely to let you, or themselves, down.

As any teacher knows, there are countless considerations one can entertain to try to improve one's teaching: assigning the right problems, designing student projects, assessing student work, preparing for class time, etc. However, before I consider any of these, the fundamental question I always find myself coming back to is "what can I do to help them *want* to learn about this material?"