TEACHING STATEMENT

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When I teach mathematics, my goals are to help students

(1) learn and understand important and useful concepts;
(2) learn and develop useful skills;
(3) see the beauty and joy of mathematics, its simplicity and power;
(4) prepare for future classes and for non-academic settings where applying math is key to understanding and dealing with complex phenomena; and
(5) learn that they can do hard things that are worth doing.

When lecturing in the classroom, I focus on two aspects: first, explaining the simple, core ideas that are applicable in many settings; second, illustrating these ideas with specific examples. I hope that by showing them the simplicity of the core ideas, they will not only be able to apply them in many different situations, but they will also come to appreciate the beauty of mathematics. I find it amazing that a few simple ideas can provide such powerful tools for approaching problems, and hope to instill some of that wonder in my students.

In my teaching in the classroom, I try to accommodate as many different learning styles as possible. For example, I make it a point never to simply write on the board; I try always to say what I've written at least once. Conversely, I also try to write down everything important that I say out loud, or anything that might help some students understand better by seeing, in addition to saying it. I sometimes like to combine different classroom styles throughout a lesson by mixing periods of lecturing, short individual time to work out short example problems, small group work with somewhat longer problems, short student presentations, full class discussions, questions for individual class members with the whole class listening, and frequent breaks to check for student questions.

I find that different styles help students best for different parts of their learning. Let me illustrate with one of these methods: small group work in class. At the University of Michigan, where I obtained my Ph.D., there is an emphasis throughout the whole introductory math program on small group work, both in class and for weekly homework assignments. Because teamwork is complemented by weekly team homework, it fits naturally into the classroom environment. Prior to teaching at the University of Michigan, I had not been able to facilitate this well in the classroom; however, the teaching program at the University of Michigan provided a week of in-depth training, with continued mentoring in the following months, and I was able to incorporate this approach effectively into my teaching. I found that it greatly helps students remain alert and active in the learning process throughout the class time. Additionally, many students, while uncomfortable asking questions during a lecture, will freely seek help from me while working in small groups; it often takes some encouragement before they feel comfortable asking their peers, but I find they learn well when discussing problems together.

Even though alternate styles such as small group work often assist students in learning, however, I still find lectures to be one of the best ways to help students learn in many situations. Students often struggle, alone or in groups, when they are not first given one or two examples that apply a concept to a problem, and I think lectures are a good way to provide these examples. Early in my teaching experience, I was able to have an experienced teacher visit my classroom and watch the class. I later asked him what he would recommend to improve my teaching, and he suggested that students—in introductory classes especially—benefited much more than I suspected from examples: many examples, and examples very similar to some of the problems they would encounter in their homework. Reflecting back on my career as a student, I realized that when I first started learning mathematics, even though I loved to work to see ideas in their simplest form, I found it very difficult without being walked through some examples myself. I have found this instructor's advice very useful in my teaching, and I often use it as a way of measuring the effectiveness of a lecture I am planning: Are there enough examples, so that students have been walked completely through some type of problem that applies what they've learned? Once they have been completely walked through some example, it is much more reasonable to expect them to figure out something new, based on similar principles.

Students come from diverse backgrounds and have widely varying interests and degrees of preparation for any class. These factors affect the speed we can go through examples in class, and the complexity and difficulty of those examples. Additionally, although the majority of students seem to appreciate "real life" examples of mathematics, some applications resonate with some students, but not others. For instance, I once had an example from football during football season; some of the class became really enthusiastic about it, in particular some of the freshman males. But others had trouble seeing what was going on in the example, and they didn't really care. It is a challenge when teaching to find examples that resonate with each student, to help them understand that math is "for them," not just for some other group of people.

Another side of this idea is that it's often easy to misunderstand because, as a mathematician, I am so accustomed to the way words are used in mathematics. For instance, we say a function is decreasing on an interval if it is decreasing everywhere on the interval, not if the average rate of change is negative (which would make more sense in many areas outside math); if this is not made clear to students, they will likely become frustrated with a quiz or test that expects them to use the terms in the way mathematicians use them. As another example, I was once asked by one of my precalculus students about a problem in which you state the range of a function. "I don't understand why the answer is not $[0, 2040]$," she told told me. My first reaction was to say, "Because there's a gap in the the outputs of the function." But this was clear in the problem, so instead of responding this way, I took a mental step back and thought, "Wait, in statistics the range of a data set just reflects the highest and lowest values. If you're used to that meaning of the word range—which is in a very similar context—it's easy to be confused by the different meaning we use in mathematics." So I responded by saying that in mathematics, we say range for a function to mean all the output values that actually get hit by the function, not just the highest and lowest values. I find that isolating little sources of confusion like this provides me with an invaluable tool to avert misunderstandings which hinder students from learning.

Often, in various settings, I work with students on a problem they are trying to solve. It is sometimes difficult not to show them how to do the problem, which is straightforward and fast. But since I want the students to learn how to solve problems on their own, I have to be patient and try to guide them through the problem. This usually takes longer and much more ingenuity on my part, but the students understand much better what they are doing and the process of solving problems.