# TEACHING STATEMENT

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For me, teaching is all about challenging my students and listening to them.

Of course this does not mean that I do whatever my most vocal students are telling me. For one thing, students like everyone else are best at telling me what they think they want. This is not the same as what they need, or even what they actually want. Also, what the most vocal students need may be quite different from what the other students, individually or as a group, need.

In particular, many students, especially first year students, expect that learning consists solely of memorizing facts and perhaps a few procedures. However, memorization is a skill that most of my students have mastered; it is also a skill which is much less relevant in a world where most information is available somewhere on the Internet and many computer programs can calculate integrals. Instead, most students need to develop skills in creative and critical thinking, and I generally interpret complaints about difficult problems as requests for more practice and for assurance that their skills will improve.

Especially in courses where most of the students will not major in mathematics, I try to get the students to think about how mathematics is done and how mathematical ideas can be used and misused. For example, when teaching optimization in calculus, I discuss an example of a partially discrete problem where naive use of calculus techniques can lead to incorrect results. I also try to point out that many of the concepts of calculus are reflected in the real world not directly but only as ideal approximations. Hopefully this will help students appreciate the important philosophical difference between a model and what is being modelled.

I have not found the classroom an easy setting in which to listen to students. Their natural expectation is that I, the expert standing in the front of the room, will just tell them what they should know. Furthermore, students are sometimes reluctant to ask questions because they fear that they are the only ones with the question and therefore that the question is wasting everyone else's time. In addition, it is sometimes difficult to quickly decipher the source of a misunderstanding while standing in front of a class.

Nevertheless, I spend most class time at the blackboard. I have tried various activities involving dividing the class into smaller groups, but I have found that I am not as effective in such a setting. Instead I frequently try to engage the class in discussing some problem or idea. Sometimes only a few students regularly engage in discussion during the semester. Even then, as long as these students are roughly on the same level as most of the class, these exchanges seem to benefit everyone. However, since not all students are willing to speak up in class, I also have other ways of learning what individual students need.

In some classes I have required students to read class material ahead of time and given reading quizzes electronically with course management software. Usually, I ask one or two questions which gauge how much students understand of the material to be covered from reading the book, and also ask students if they have any particular questions. Seeing the results of these reading quizzes allows me to focus on what students seem to have trouble with and go quickly over topics students seem to understand. In addition, I can frequently pinpoint the source of some misunderstanding from responses and prepare in advance to address it in class. I have also found that many students are much more candid with questions on a reading quiz than in class.

In some classes, I also assign short homework exercises every class in addition to weekly homework. These assignments are due the next class and I grade them immediately to quickly find out if there is some topic that many students have not understood.

Both to foster creative and critical thinking and to encourage students to see me outside of class, I put some challenging problems on most weekly homework assignments. Beyond general encouragement and explanation of the ideas behind some of the problems, there does not seem to be much I can do in class to teach problem solving. Each student's mental process for problem solving seems to be unique to him or herself. Furthermore, learning to solve problems requires an interactive and reflective approach which proceeds at a different pace for each student and each problem. This is best done in office hours. To encourage students to come in, I give a short assignment during the first week which must be handed in at my office. I also sometimes will give extensions on homework to people who come to my office hours.

In many cases I will decline to give specific step by step instructions for solving problems or refuse to tell students about shortcuts. Rather I prefer to have students work out such instructions or shortcuts for themselves by reflecting on how they are solving specific problems, or how we as a class solve problems during classtime. In my differential equations class, I am also asking students to explore some aspects of the material in homework problems. Frequently I will discuss these problems as well as more routine ones after they have worked on them but before they turn the problems in.

In the context of a liberal arts education, the most important goals of a mathematics course are neither recall of facts nor technical proficiency, but rather development of critical and creative thinking and appreciation of the methods of mathematics. Emphasizing critical thinking may mean that students are less capable at specific types of problems, but developing general skill at figuring stuff out is far more important to their future.

Listening carefully to students helps me tailor the next class session to their needs. It also helps me find out what does and does not work for me in the classroom. What I cover in a course and how I cover it changes from semester to semester based both on the specific students I have and on reflections from what has and has not worked in previous semesters. Both to teach better now and to teach better later, I try to keep hearing and understanding what students have to tell me.