

TEACHING STATEMENT

ALEXANDER WOO

In my view, the most important goal of any course in a college of arts and sciences are to develop the students' abilities in creative and critical thinking. For mathematics courses, a second goal is to give students some understanding of how mathematics is done and how mathematics can be used or misused. Memorization of facts and technical proficiency at specific types of problems, while worthy, rank much lower, and, indeed, must frequently be somewhat compromised in order to better accomplish the first two goals.

To achieve these goals, I focus on challenging my students and listening to them. Providing a challenge is important because students best develop their thinking skills by working on problems near the edge of their abilities. Listening is necessary for discerning where students need help, and where they need to be further challenged.

In the classroom I usually spend about half the time lecturing and most of the time at the board in front of the students. While I occasionally have students work on problems in groups in class, I generally find it difficult to focus on the varying difficulties the different groups have in short succession. Instead, I frequently break up lecture by having students work on a short problem while discussing it with their neighbors and then with the whole class. On other topics, I go straight to having the whole class discuss the main ideas. Inevitably, some students are far more vocal than others. However, as long as the students doing the bulk of participating are roughly on the same level as the entire class, these exchanges seem to benefit everyone.

Not all listening can be done in the classroom. Some students are shy or fearful that they are wasting everyone's time with their questions. Furthermore, good listening frequently requires reflection to understand the source of confusion or difficulty, and while having students watch me stand there and think is worthwhile to a small extent, it is not generally a good use of class time. Also, in many cases, good teaching means engaging with the unique patterns of thought each individual has. While it is also valuable for students to see how other students think, this is usually an activity best done outside of class.

One way I get broader and more extensive feedback is to require students to read class material ahead of time and take 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 in asking questions on a reading quiz than in class. In particular, I frequently get useful responses from students who rarely speak 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 many students failed to understand current material.

The most important way I have to listen to students is to get them to come to my office, during office hours if possible, but also by individual appointment if necessary. I frequently give a short assignment during the first week that must be handed in at my office to help convince them that no dragons live there. On most weekly assignments, I give some challenging problems and make it clear to students that I expect them to come to my office for help in solving them. During my office hours in an individual or small group setting, I can watch how individual students are attempting problems, offer advice or stimulating questions, and prompt students to reflect on and improve their own problem solving process. Discussing the material with students individually also gives me a better sense of what was actually communicated during class time.

Of course I do not give challenging problems just to get students to visit my office. While students need simpler problems to check that they understand basic ideas, they learn more from working on problems near the edge of their ability. When working on challenging problems, students learn first hand not only what works but also what does not work for them, and they learn this even if they try but fail to solve the problem themselves and end up learning about the solution from someone else, whether this is me in an office meeting or their fellow students.

To develop the students' abilities to think about mathematics for themselves, I will frequently 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 methods and shortcuts for solving problems for themselves by reflecting on how they solve specific problems or on how we solve problems together during class. Students frequently ask for specific instructions because they are unsure of the goals for the course or insecure about their ability to think for themselves. In response, I remind them that I want them to learn to figure out mathematics for themselves, that I understand they will not be successful in every instance, but that nevertheless their skills will develop and they will learn to find answers for themselves most of the time.

In some slightly more advanced classes such as differential equations, I ask students to explore some significant aspects of the material in homework problems. Frequently I will discuss these problems in class as well as more routine ones after they have worked on them but before they turn the problems in.

I also try to get the students, especially those whose primary interests are not in mathematics, 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 point out that many of the concepts of calculus are reflected in the real world not directly but only as ideal approximations. Hopefully this helps students appreciate the important philosophical difference between a model and what is being modelled.

Properly challenging students requires listening to students to find the edge of their abilities. Listening carefully to students helps me tailor the next class session to where this edge is. 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.