Emily J. Evans - Teaching Philosophy

My teaching philosophy is that students learn by example, and master by doing. This philosophy applies to every class I teach, whether basic or advanced, and any advising that I do.

I tell my students that learning math is like learning to swim. Math and water are two things that many people are afraid of, and it takes a patient teacher to help them overcome their fears and gain the self-confidence necessary to swim or to solve problems. When learning a new swim stroke, it is insufficient to merely watch someone demonstrate the new stroke. Similarly, in math, mastery cannot be obtained simply by watching someone do problems on the board. Eventually, students must jump in the water and try for themselves. As a teacher, I encourage the students to “jump in the water” in four distinct ways.

1. I make class an interactive instead of a passive experience.
2. I designate class time to practice skills.
3. I use tiered homework sets.
4. I require student projects.

Interactive Class Experiences

In an undergraduate analysis class, I make the class an interactive experience instead of a passive experience by involving students in the proof of a new theorem. After precisely stating the theorem, I ask the students which prior theorems they think would be helpful in proving the new theorem and write them on the board. Then, as a class, we prove the new theorem together. I have found this technique is helpful when students are still learning to write proofs because it gives them the confidence to attempt proofs on their own. Another example of a way I make class more interactive is by occasionally bringing in a prop to help visualize a mathematical concept. For example, to help calculus students remember concavity I bring a bowl filled with markers. I explain that when the concavity is positive the bowl will hold the markers, and when the concavity is negative the bowl will not. The act of dumping markers on the floor surprises the students and helps them remember the concept.

Practicing Skills in Class

By designating class time to practice new skills I get students “into the water” while the material is still fresh. I motivate the reluctant in-class problem solver in two different ways. In a large lecture format, where it is difficult to monitor individual students’ work, I utilize iClicker technology to ask questions to the students. Although occasionally I will ask a quiz question of the students, most of my iClicker questions are designated as a work with a neighbor questions. Also by using iClickers (or a similar in class polling system) I can quickly gauge the students’ understanding. In a smaller class I form small groups of students and give each group a problem to work on. Usually these groups also present the solution and the techniques they used to the whole class. In both scenarios I have found that the ability to collaborate with other classmates helps the students to engage more fully in the material and to better retain it.
Tiered Homework

The third way I get students “into the water” is by creating tiered homework assignments. Since each individual student is unique I give four types of problems: easy problems, standard problems, challenging problems, and discipline specific problems. A typical homework assignment contains both required and optional problems. The required problems are usually standard problems with a few very easy problems and an occasional discipline specific or challenging problem mixed in. The optional problems are a mix of easier problems for the struggling students, challenging problems for the stronger students, and discipline specific problems so that students can see how the math they are learning applies to the discipline they are studying. With both the in-class and homework problems, my goal is to give students the confidence to apply their skills to future problems. The ability to explore an unfamiliar problem for a solution is a skill that is useful not only for mathematicians and engineers but also for liberal arts majors.

Student Projects

The final way I get students “into the water” is by the use of student projects. As an instructor I have assigned two different types of projects and have had success with both. The first type of project is an individual or small group project where all of the students are given the same project to complete. For example, in differential calculus students were asked to compute the area of a circle in the manner of Archimedes using limits. The second type of project I have assigned is a student designed final project. For these projects I ask the students to submit a proposal at least one month before the due date. In the proposal, they explain not only what they plan to do but also how the project relates to the class being taught, and how the project relates to their future course of study.

As mentioned in my opening paragraph, my philosophy is to teach by example but to have the students learn by doing. Providing sufficient motivation for the doing can be difficult, but I believe the best motivation comes internally from the student. As such, I want students to feel like they are making progress, so that the inertia of progress propels them forward. For example I recently taught a graduate class in mathematics that was half engineers and half mathematicians. In order to make the class relevant to both audiences I took special care to provide balance in both the motivation of the topics being studied and in the homework problems assigned. Two techniques that were especially helpful were allowing the students to resubmit their homework assignments as they gained a better understanding of the material, and allowing the students to design their own final project. In the end every final project was relevant to the class and every student stretched the boundaries of what they (and I) knew on the topic.

I feel that my background is especially helpful when teaching students with diverse backgrounds and goals. Before obtaining a PhD in mathematics, I received an undergraduate degree in economics and worked as a software engineer. This gives me the experience to relate the math students are learning to their chosen field. Moreover my research interests span numerical methods, analysis, computational mechanics and mathematical biology. As a professor, I frequently reference how a particular mathematics topic is used in other fields such as engineering or biology. When students recognize the value of the topic they invest the effort to gain mastery of it, resulting in improved learning outcomes.

To return to the analogy between learning swimming and math, learning math in a
college environment is just as strange as trying to swim in an ocean, when in the past you have swum in a swimming pool. Both college and the ocean are exciting, filled with new experiences, possibilities and adventure. As a college professor, I expect to rescue students from confusion, to coach through challenging spots, and eventually watch the students swim off into the sunset. If at the end of my career I have done more than teach math concepts, but have inspired, and guided my students, I will count myself a success.