Teaching Philosophy

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My teaching philosophy has so far centered around the attempt to convey to students exactly what it is about mathematics that we mathematicians get excited about. The strategy for this of course depends on the setting. In the context of a smaller classroom, I have leaned heavily toward encouraging and building my class around group discussion. In the context of a lecture hall, achieving this goal has been more complex, as the more traditional expository setting of lectures is not as conducive to a collaborative, interactive environment. So, in addition to still putting emphasis on after-class discussions, I have aimed to incorporate strategies that can either be loosely grouped under an interdisciplinary theme (relating mathematics to real life or to other fields of study, to a large extent via examples), or that involve conveying and translating ways of mathematical thinking (i.e., the ways in which research mathematicians think about mathematics). My aim here is to explore some of these themes, by describing teaching strategies that I believe are effective, some that I have tried to implement in my own teaching, and some that have left an impression on me and stayed with me since my days as a student.

To begin with, I will discuss several examples of how some of the most enduring teaching strategies I have encountered have parallels to how I access, understand, and communicate research mathematics.

Many of my favorite lectures have opened with a hands-on problem, a real-life situation to which the mathematics in question applies (particularly if the situation relates to current or recent events), an interesting mathematical law that can be intuitively grasped (such as Benford's law in a lecture on probability distributions), or even an analogy. This parallels how a very effective way of tackling a research problem is to work out concrete, specific examples and analogous situations. It works toward getting students interested in the mathematics in question by getting them hooked on a concrete, specific example and consequently getting them to wonder how that specific example could be solved or mathematically understood. *Example:* When I lectured on applied mathematics to first year undergraduates, the topic was epidemiological modeling. One of the lectures focused on real-life examples and the history of the models that we talked about. In the after-class discussion, I got the impression that the students found this grounding of the theory by real world examples very helpful. This concept worked well in my pure mathematics classes as well: I found that what seemed to work best at demystifying some of the new abstract concepts that students encountered, such as generalized eigenspaces or the Jordan Normal Form, was to compute some simple, direct examples.

In my opinion, students find it easiest to truly access new material if the new material relates to other knowledge that they already have. The technical aspect of this of course involves carefully designing the course curriculum so that all of the introduced concepts build upon previously introduced concepts and upon the prerequisite courses. Strategies involving the student aspect of this include: establishing a participatory environment with in-class discussions, encouraging asking questions, and (depending on the type of class) having students solve some problems or present some of their work in-class. This participatory environment accomplishes two things: one, the nature of the questions can tell a lot about any missing background (i.e., about how much the newly introduced concepts relate to previously understood concepts); and two, when students have to figure out on their own what kind of questions to ask when accessing new material, that leads them to the parts of the material that fail to resonate with them (and to the background concepts that they are missing). *Example:* In my linear algebra class, I aimed to review the material introduced in previous lectures at the start of each class, and throughout each class to, e.g., address concrete questions from previous classes that had alternative or easier proofs using the newly introduced theory.

A lecture is not really successful if the students are only able to repeat the core material and to go through the motions of solving standard problems. In fairly direct analogy with research mathematics, a lecture successfully instills new concepts only if it ends up painting a bigger picture of why each introduced method is useful and of the ways it can be generalized and applied in uncharted territory, and if it ends up allowing students to apply the material to not only solve new problems but also come up with them. *Example:* I aspire to involve motivated students in undergraduate research.

Going back to the human aspect of mathematical research, I believe it is essential to approach all teaching with empathy for the students. My mother, who is herself a professor of mathematics, significantly shaped my understanding of effective and empathetic teaching and I look up to her a lot when it comes to her care and the approach she takes when interacting with students. One of the many values I have picked up from her which I aim toward is to create more space and opportunities for students who are struggling with the course material. *Example:* Setting up consultation sessions and dedicated office hours.

In summary, while developing an effective teaching philosophy is a lifelong process, I believe that it is an effective guiding principle to think of ourselves as (often struggling) students of the profession, and to consequently aim to convey both our experience with studying mathematics, and (perhaps more importantly) what it is about mathematics that we are excited about.