

TEACHING PHILOSOPHY

ADAM MARTENS

Historically, I tended to dislike the idea of teaching philosophies. As an undergraduate, I found them generally unhelpful — after all, I had to take the class regardless of the instructor’s philosophy. Early in graduate school, I would often dismiss them as bureaucratic requirements, useful only for checking a box on an application.

Over the past few years, however, I’ve transitioned from the role of a student to (primarily!) one of an instructor. Over the past decade plus, I’ve taken 37 math classes, been a TA 12 times, and taught: in 8 semesters; dozens of classes; and thousands of students. Over this time, I’ve tried to stop, look back, and reflect on what makes an effective math instructor at the university level and what kind of teacher I aspire to be. Through this process, my opinion on teaching philosophies has done a complete 180. I now believe that, as a teacher, it’s absolutely essential to have a clear understanding of what it is that you are exactly trying to achieve when leading a classroom through a semester (spoiler: it isn’t just to convey knowledge of mathematics!). I try to treat this document as a type of “teaching roadmap”; it is easy to get lost in the whirlwind of a semester and forget why we do what we do. Hopefully this helps me remember.

1. Math is hard! (But...)

I bet I really blew your mind on that first one, eh? All those years of reflection about mathematics teaching, and my number one point that I can muster is a thought that quite possibly *every single person with a high school education* has had. Yes, of course math is hard! Despite this unanimous feeling, I feel that this point is not acknowledged enough when we discuss teaching (in particular, first-year calculus).

I often remind my first-year students that what they’re learning is the culmination of a thousand years of mathematical advancement, capstoned (debatably) by the greatest scientist to ever live, Isaac Newton (also debatable). The calculus we teach today is even more rigorous and expansive than what Newton envisioned, yet we expect students to master it in just one or two semesters. It’s natural to feel lost and confused when grappling with such material. The key is not whether you get lost, but whether you’re willing to put in the work that is necessary to get *unlost*.

Learning mathematics is not a passive activity; it requires active engagement and persistent effort. Watching lectures, YouTube videos, or your favourite AI chatbot talk isn’t enough — you would never learn to ride a bicycle by watching someone else do it. The way that students learn best is by working through complicated problems by themselves or in a small group. This is an uncomfortable process to learn how to do! It is human nature to try to find an easy way out: ask Chat, copy from your friends, look up the answer, etc etc etc. But this discomfort needs to be overcome (and *fast*!) if a student wishes to succeed in mathematics. One of my roles as an instructor is to make students aware of this early in the course, to emphasize the importance of working through challenging problems by allowing class time for students to work on them with some guidance, and to encourage students to be open to making mistakes. In mathematics, it isn’t about the mistakes you make, but rather about how *quickly* you can self-correct; you are going to fall off the bike a lot, so you need to learn how to land gracefully and get back on.

This all didn't really click for me until my third year undergrad. While taking a particularly challenging abstract algebra course, I discovered the deceptively sweet feeling of finding answers to the homework questions on Math StackExchange (read "AI" today!). So naturally, I did that naughty thing that we all do and I made less work for myself (at this point, I was not thinking about long-term consequences!) by automatically just turning to MSE for the answers. Yea, well needless to say, I got hopelessly, disparagingly lost. About halfway through the semester, in desperation, I went to my professor's office hour, nearly in tears. I felt like there was no way I could pass this class. I don't know what I went to her office hour hoping to achieve, but the advice that she gave stunned me and certainly helped me get to where I am today. She said: (here is the resolution to the unresolved "But..." in the title)

... "*You just have to do it*"

Now that I am looking at those words on a page (or more accurately, a screen), it looks silly. But truly understanding what it means in the context of learning math takes some time. It means deliberately setting time aside *every day* to work on mathematics without looking at someone else's solutions, working problems out from scratch while showing all your work until you understand every implication thoroughly. When you're stuck on a problem, start by writing down everything you know (definitions, relating equations, possible techniques), and just ask yourself what the only possible thing that you can do is given the information in front of you. I still have to take this approach to learning; when reading a paper, for instance, I find that I don't *truly* understand it until I have written it out myself, line-by-painstaking-line. You can't allow yourself to fall into a false sense of security by thinking something looks correct until you actually understand every implication. Eventually, you get comfortable enough with the material that such a rigorous process is no longer necessary, but it takes a *while*. Communicating this to my students, I believe, helps them to take ownership of their learning and to embrace the struggle as an essential part of their maths journey.

2. Learning math should be fun and memorable!

Since my first point was painfully obvious, I kind of figured I should go highly controversial on the second one. A vast majority of our first-year cohort is (at best) ambivalent about mathematics or (at worst) thinks math is demonic (and naturally, so are their instructors!). Knowing this is very disheartening to me, as someone who is passionate about this material and has seen first-hand how (capital) FUN it can be. I view a large chunk of my job to convey this passion and excitement for the material to my students.

But, Adam, what does this mean practically?

Well, for starters, I am dynamic and animated when "lecturing"¹. I know from personal experience that, no matter how interesting the subject matter, a lecture that is delivered by someone standing in one place writing on a document camera the whole time can be very challenging to remain focused in. This 'standing in one place' is precisely the opposite way that I try to physically conduct myself; I'm always moving around the chalkboards, running up and down the stairs (sometimes talking from the back of the lecture hall!), which helps to decentralize students' attention and keeps them on their toes. Of course, the energy should also come through *vocally*: Altering the pace, volume, timbre, and tone of my voice keeps students engaged in what I'm saying and help drive home the key points of that day's topic. And the energy shouldn't start and end with me! I also encourage the class to be physically engaged (chatting, moving, asking questions, laughing) – I never want the class to be too quiet, and never for too long!

¹I don't like this word due to its connotation, alas

The other ways that I try to keep a high level of engagement is:

- (1) *What* I talk about. I do my best to tell jokes, relay the history behind the subject, share personal anecdotes (this works best if it is self-deprecating), and use relatable analogies and catchphrases that make abstract concepts stick.
- (2) Clickers! I love IClickers, **especially** when most of the class gets the answer “wrong”². Having that whole-class groan when I tell them “*it’s not answer (A)!*” – despite 90% of the class thinking it is! – is such a wonderful community-building experience.
- (3) I also try to inject as many ‘distraction’ moments as possible, meaning that I try to draw students’ attention *away* from the board. These distraction moments can be as simple as Desmos graphs, but often take the more informal/lighthearted form of short YouTube clips from popular media that is relevant to the material (classic examples: “*Ogres are...like onions!*” (Shrek) – when introducing chain rule; or “*the limit does not exist!*” (Mean Girls)). I find these moments so important because they relieve the pressure of intently focusing, but, more importantly, because they help to maintain a relaxed, approachable, and engaging environment.

I have often heard from students that my energy and passion for the subject are contagious and that my teaching style made the class very engaging and the “highlight of their week”. Now I don’t labour under the delusion that everyone is going to enjoy learning mathematics just because I try to make the class fun, but it certainly helps.

3. Privilege and Barriers

I’ll start with the groundwork: I have benefited **extremely** in my life because of my being a white man. This *white-man*-privilege is not something that is earned, it is not right, and other groups (other ethnicities/genders) do not experience life in the same way I do.

Unfortunately, I have met countless people (let’s face it, usually white men) who say “*Oh, there is no such thing as white privilege in today’s society*”, or even worse “*white men are more discriminated against than any other group*”. Precisely because I have heard this so often, I have worked to find a way to define “privilege” in a way that doesn’t usually raise hackles:

Privilege is being in the majority of people who are right-handed, and walking up to a public computer **knowing in advance** that the mouse will be on the “right”³ side for you. The world is ‘built’ for you, and it is (purposefully) *not* built for people who are “other” than you. On the (extremely rare occasion) when the mouse is on the “wrong” side, it is *inconvenient* for you. In such times, you feel like someone has (in a very small way) wronged you.

Society (more specifically “academia”, or more more specifically “mathematics”) is – wrongly! – ‘built’ to accommodate a particular subset of people. Trying to fix this – or, let’s be realistic, *improve* this – is obviously not a simple task. Just as learning mathematics cannot be done with a passive approach, neither can the approach to breaking-down-barriers-that-nonwhite-men-face-in-mathematics be a passive one; “*avoid discrimination*” is not enough!

What can I do about it as an instructor?

Well, I think the first step with any social issue is acknowledgement. Now I don’t know if having a debate with a student in class about privilege is the best use of my calculus class time, but there are some less in-your-face things that I *can* do: land acknowledgements, syllabus statements expressly

²more on utilizing wrong answers later, stay tuned

³no pun intended

saying things like “*all race/gender/orientations are welcome in my class...*”, making small mentions about privilege in class, etc. etc.

But mere acknowledgement is not enough on this issue. I, as an ambassador of the mathematics community to my students, need to actively encourage student groups in my classes who would otherwise have barriers in their way. One practical method that I have found helps encourage participation from those who may otherwise feel that they don’t ‘belong’, is to deliberately encouraging wrong answers in class (I will sometimes *purposefully* make mistakes myself, as a lesson). This might sound counterintuitive for a math teacher, but I believe it helps de-stigmatize mistakes, encourages participation, and builds a culture where struggling with the material is the norm rather than the exception. I try to: praise the correct aspects of an incorrect explanation; ask questions that have more than one (or none at all!) correct answers; and ask questions that are deliberately misleading so that the whole class can learn and be guided together. Another practical approach is by being conscience of who I call on: I limit the number of times an individual student can answer questions in class (to one!) and deliberately call on underrepresented groups to ensure that a more variety of voices are heard. By continuously encouraging participation and ensuring that everyone’s voice is heard, I hope to contribute to a more inclusive and supportive learning environment. I have found that these practices help strengthen the sense of belonging, and allow for more equitable participation.

This has been reinforced by positive feedback including, for example, that I have been “exceptionally welcoming and compassionate”, “very empathetic with students who are struggling”, that I have “helped to quell the notion [that] the general culture of mathematics [is] quite isolating”, etc. Hearing these first-hand accounts that I have had a positive impact on my students’ mathematics journey is the greatest motivation that I could ask for to continue to improve.

My biggest hope for **all** of the students is that, through my passion and excitement for this subject, I will inspire in them a lasting appreciation for mathematics, in spite of (or maybe even, because of) the fact that it may be one of the most challenging courses they will ever take.

Thank you for reading.