What do I think of Teaching Math

My own philosophy of teaching mathematics centers on the question of "How can interesting or even mundane problems give rise to intriguing problem solving methods/techniques?." An innate sense of curiosity precludes this question and is exactly what I aim to impart on students. Not only is tackling progressively harder problems with increasingly sophisticated methods inherently interesting, teaching others to grapple with that in a critical fashion is as well. The breadth and depth of math itself is such that there are always sources of inspiration and continued learning. Having this intrinsic excitement for math, I think, serves as the core of my motivation to convey life skills to my students. Not to mention that the workplace is getting evermore technically oriented, so instilling precise quantitative thinking and creative problem solving is necessary. In any such invigorating imaginative endeavor, room to fail is not only needed it is an integral part of how I teach. Like a boxer blocking sparring blows, students learn to anticipate and embrace tricky problems:

An expert is a man who has made all the mistakes which can be made. - Neils Bohr

I consider myself successful if the student can recognize their own mistakes within problems (without them being pointed out!) and use that information to make corrective judgments in real time. My most successful students have shown this behavior and it seems to indicate that metacognition about problems is necessary and sufficient for success. At the end of the day, I should be able to clearly define how students have been holistically improved by this philosophy:

1. The individual course topics are familiar to the student at a conceptual level, such that routine keyword search can fill in any mechanical gaps in how to do the problem. (i.e. Students in data science understand that z-scores standardize datasets but might forget exactly how the formula goes.)

2. The student can use number 1 to succeed in any subsequent mathematics courses; if the course is a terminal one, then the student is able to tackle practical questions. (i.e. Students in MAT141 should be comfortable with interest type questions in their adult lives.)

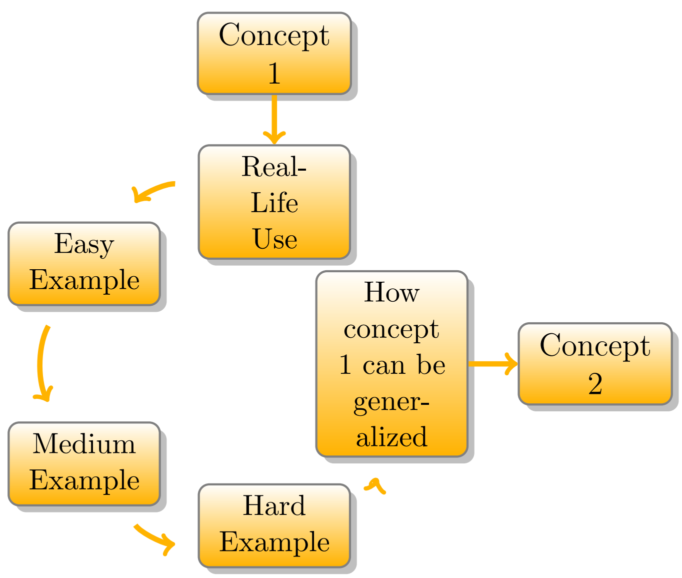
3. A scientific mindset about solving quantitative problems has been cultivated (i.e. How to ingest what a technical question asks, present a solution, and reason that the solution is correct.) I consider this the opposite of teaching to the test, as metacognition is striven for instead of cast away.

How my Philosophy is Implemented

A typical day in my classroom would proceed to implement these philosophical ideas and learning objectives directly. I like to start with a quick 2-3-minute video or idea which is mathematical (or scientific) in nature that is generally considered cool. Some of my favorites include:

- The origin of the Fibonacci sequence as immortal rabbits
- Is mathematics invented or discovered?
- Carl Gauss adding trick to sum 1 to 100 in 30 seconds
- The Monte Carlo casino incident highlighting the gamblers fallacy
- Many more that I am in the process of formalizing and customizing to specific course content. I am continuously updating my teaching page.

The idea here is to engage the students at first and create a sense of wonder; many students have mentioned they curiously Googled around after some of these. The preceding time uses hand-crafted pdf slides I make ahead of time (examples of this work are here) with the following structure:



The idea here is to create a sense of flow from one topic or chapter to another. It seems like it is usually mathematically possible to motivate the next topic/theorem based on pitfalls of the previous hard example. Coupled with the medium example I can come up with ways to point at common mistakes so that we can follow Neils Bohrs advice and make as many mistakes in a controlled environment as possible. Coming up with interesting examples that fit these last two steps becomes critical, here are some of my favorites:

- Using Simpsons method instead of rectangles for numerical integration, it becomes needed on fast exponential-like functions like if the mesh is coarse.
- Using exponential modeling instead of linear modeling for faster growing data.
- The Weierstrass nowhere-differentiable function as a counterexample to continuity implies differentiability.
- Anscombes quartet as a way to view the mean and standard deviation as non-unique to datasets.

Having a flow like this facilitates student metacognition and engagement, not to mention striking mathematical curiosity. Plainly said, if students can see a coherent story being told with the theory then it is my claim that they will internalize concepts more willingly which contributes to my goal No. 1. After going through this lecture slide structure, I end every day with a group activity using the same material that was just covered. These group activities are reviewed together to start off the following class period so that students receive timely feedback. I find that this ending routine engages the developmental students, as the examples they have seen now get life of their own when they attempt them. For efficiency, I have students submit these groupworks to Google Forms as one can take attendance without passing a sheet around and it also gives nice compiled results, so I can see what questions students struggle with immediately. This method creates a good sense of active learning and so far, my students have reacted positively to it. I actively take note of what the students are looking to accomplish in their careers and, if possible, add examples or content relevant to that interest. Besides standard office hours, I pass on helpful links and tutoring opportunities via announcements to better engage outside of the classroom as well.

Collaborative Efforts and Thoughts About Improving my Teaching

Seek first to understand then to be understood - Stephen Covey

While still in the early stages of development, I have some collaboration experience with material and course design as well. At Grand Canyon University, I am on the committee to inform their upcoming M.S Data Science degree program; I hope to use my software and data experience vis-a-vis my internship to great effect. At Arizona State University, I worked with professors to grade upper division coursework in numerical analysis, geometry, and calculus. Overall, collaborative work in improving my own teaching and developing new course material is one of the most exciting prospects for me personally. I see my teaching philosophy and implementation thereof as malleable and of utmost priority to hone as I learn from my students and peers. In particular, I feel that there is always much to learn about pedagogy from my peers and view the endeavor with great optimism. In the same disposition, I hope that some of my thoughts and practices help to inspire and improve the student experience.