Teaching Philosophy

I am unable to trace my desire to teach back to a specific point of origin, but I am certain of two things: I have always loved sharing, exchanging, and dissecting knowledge with others, and I knew that I felt at ease in the role of teacher from my first day as a graduate teaching assistant. Since my first teaching assignment at Drexel University in the Fall of 2008, much has changed in my approach to my role as an educator and my understanding of how we learn. This continuing evolution is fueled by a growing set of experiences, a formal education in pursuit of a doctorate in education, continuing work as a researcher of mathematics education, and my exploration of the intersection of these roles as student and as teacher. What follows is, above all else, an account of the current state of an ever-changing philosophy of teaching and learning.

The classroom is a learning community

When I first began teaching as a graduate student of mathematics in 2008, I acted on instincts rooted in my experiences as a student and the methods and attitudes of the teachers I admired. I had identified as a common thread in these teachers the ability to model sustained inquiry and to foster a sense of community in the classroom. They treated the classroom as a learning community where each member’s contributions were valued, and mistakes were to be celebrated as learning opportunities.

My own approach to fostering such a sense of community begins with my view of the teacher not as a vessel for content, but as a facilitator of learning. In practice, this means that I expect a lot of participation and engagement from my students in the classroom and, in turn, provide a lot of feedback on in-class work, homework, and assessments. I ask my
students to contribute ideas for how to solve problems or prove theorems, and then explore their ideas to see where they went right and where they went wrong. I often have students work together in small groups on challenging exercises and concepts to open up a dialogue. When doing so, one of my greatest challenges is resisting the urge to give hints or answers too soon when walking around the room to check on each group’s progress. I find that when I am able to resist that urge, my students often end up thinking more deeply about a concept or problem and learning from their mistakes and from one another.

In lecturing, I attempt to model the types of behavior I hope to see in my students. First and foremost, I try to maintain a level of enthusiasm and curiosity about the mathematics I teach and about the ways that my students understand that content. Even after years of teaching calculus, I am always looking for new insights, and I relish the opportunity to make discoveries on the spot in front of the class. Secondly, I often interweave stories from my undergraduate career of times when I struggled with certain concepts or problem types in the hope of offering insights into how one overcomes such difficulties. Thirdly, I emphasize the importance of clarity in mathematics and the role of precision in our notation and exposition by writing clearly, without skipping steps, and with proper notation.

Technology allows for this community to stay active outside the four walls of the classroom, especially when teaching large sections, and I am always on the lookout for tools to facilitate and maintain meaningful engagement. To this end, I put a great deal of effort into maintaining a website with lecture notes, video lectures, and extra resources for my students. More recently, in the interest of collecting feedback from large numbers of students, I have implemented a survey that asks students to reflect on the practice problems that give them the most trouble. The survey prompts them to choose three problems from each homework set that gave them trouble: two that they were unable to solve, and one that they were able to solve eventually. They then answer multiple choice and free response questions that prompt reflection on what they tried on each problem, whether they know where they went wrong, etc. This allows me to easily look for trends in problem-areas, and to address them either in the classroom or with other supplemental materials.
The role of research in teaching

After two years as an instructor at Drexel University, I began my work on a doctorate in education. This formal education and the research I have done since completing my degree have had a profound impact on my teaching. First and foremost, the study of education has provided me with a language and theoretical framework to clarify, interpret, and build on my experiences as a teacher. In particular, I have found that the theory of constructivism, and in particular social constructivism, has validated my long-held belief in learning as an inherently social endeavor, in which knowledge is actively built up by the cognizing subject through social interaction. As I continue to develop and refine my own pedagogical practices and ability to foster a sense of community in the classroom, I do so grounded in constructivism.

In my work as a researcher I value both theoretical rigor and tangible applicability. With each new project, I aspire not only to make a contribution to the field, but also to gain new insights that will improve my teaching. Two particularly influential projects have been my study of the use of worked-examples and a collaborative study on teacher questioning.

Teaching with worked examples

My dissertation research was on the efficacy of a worked-examples-based framework for introductory mathematical proof-writing. In my research, I found that when students are new to proof-writing, they benefit more from studying worked examples of proofs (that provide explanations for each step and an overall framework for working through a proof) than they do from attempting their own proofs. After having an opportunity to study proofs that are worked out entirely, they attempt to fill in the missing pieces to partially completed proofs. Over time, this type of scaffolding can slowly be removed, placing more of the responsibility on the student until, eventually, they are problem-solving/proof-writing on their own.

In my calculus classes, I have attempted to apply a similar philosophy. When introducing a new unit, I will often give students several examples to study and discuss before they attempt to solve any problems on their own. Then, I give them problems that are very similar to the worked examples with some of the steps worked out for them. Gradually, they work their way to exercises, which differ significantly from the original
examples, without any scaffolding. Finally, I prompt them to reflect on the differences and similarities between examples. While I continue to improve upon this process, I have found it to be very successful thus far, especially when students are working in groups on challenging problem-solving activities.

**Asking right questions**

I recently co-authored a paper on teacher questioning with colleagues from Rutgers University, Montclair State University, and Temple University in which we examined the questioning habits of eleven instructors of upper level mathematics courses. In this study we coded each question asked during a recorded lecture according to the type of contribution it elicited from students. My work on this project raised my own self-awareness about the types of questions I ask in the classroom and the time I allow for students to think about the question dramatically. What I found through my own reflection is that, like most of the subjects in our study, many of the questions I ask of the classroom are either checks for understanding (e.g. “does everyone understand?”) or simple calculations (“what is the sine of pi over four?”).

I believe that asking questions that place more responsibility on the students to generate and contribute mathematical ideas/content is consistent with the view of the classroom as a learning community, and my work on this research topic has helped reinforce and refine my own questioning practices. Since conducting this study, I have put considerable effort into asking more substantive questions - e.g. “how can we apply the idea of the Riemann sum to find the volume of a solid of revolution?” This type of conceptually demanding question places more responsibility on the students to think through what they have learned and contribute mathematical content to the class.

**Community-based learning**

In the fall of 2013, I had the opportunity to teach a community-based learning course that I had developed while participating in a workshop series hosted by the College of Arts and Sciences. The content of this course was discrete mathematics (e.g. probability, combinatorics, graph theory, etc.).
In addition to learning this material, I tasked my students with developing lesson plan ideas for how to communicate some of the ideas in discrete mathematics to middle school students. Then, once each week, we would go together to Freire Middle School and run an after school math enrichment program where my Drexel students would run their activities. For example, while studying probability, they developed simple dice games to play with the students and then taught mini lessons on how to compute simple probabilities and expected values. While studying graph theory, we worked together to create worksheets that dealt with the Bridges of Koenigsberg and the Four Color Theorem. Running this course was very rewarding both for myself and for my students, and I believe that the challenge of learning to communicate mathematics to a younger audience pushed them to improve upon their own understanding of the material.

In addition to this community-based learning course, I have worked to stay involved in the Philadelphia area through various volunteering opportunities. In 2014, I gave an interactive presentation at the Philadelphia Science Festival on the intersection of mathematics and music. Since that time, I have developed a relationship with the event organizers at the Franklin Institute and have been invited to run mathematics-based activities at several of the After Hours events - e.g. I created and ran an activity based on the German Tank Problem that explored participants’ number sense. This partnership has also led to other mathematics faculty and graduate students participating in these events and running their own activities.

By providing opportunities to share mathematics with a different audience, the work in the community keeps me energized and excited about the work I do at the university.

Concluding remarks

As I continue to learn how to be an educator, my philosophy of teaching continues its evolution, influenced by my exploration of the intersection between practice, research, and reflection. Each day, I come to the classroom ready to play my role in that learning community, to help my students learn how to learn mathematics the best that I can, and to learn from them how to be a better teacher.