Teaching Statement

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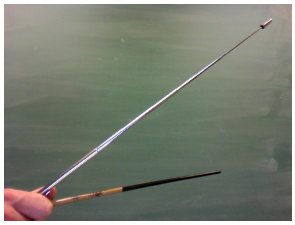
When I teach, I want my students to become confident in their ability to do mathematics. How do I pursue this goal?

First, I make myself accessible. This means that I learn the names of my students, I arrive to class early to answer questions as they trickle in, and I end each class by saying "That's it for today, but please stick around if you have more questions." My students are more confident knowing I'm invested in their learning.

Second, we discuss the pictures behind a concept. Students sometimes feel that even though they can solve the homework, they don't fully understand what is going on. I think that spending time on pictures helps here. For example, consider the equation $\mathbf{v} \cdot \mathbf{w} = \|\mathbf{v}\|\|\mathbf{w}\| \cos\theta$, where θ is the angle between vectors $\mathbf{v}$ and $\mathbf{w}$. To discuss this equation, I come to class armed with an extendable pointer and a chopstick (pictured). The pointer is vector $\mathbf{v}$, the chopstick is vector $\mathbf{w}$, and my fist is the origin. We discuss how the dot product changes as I vary the angle between the vectors, or as I vary the length of vector $\mathbf{v}$ by extending the pointer. My students are more confident in a topic after we discuss the pictures behind it.



Third, I make our class a conversation. Talking about math can be intimidating for students at first, so joining a mathematical discussion improves their confidence (while passively listening to me talk does not). How do I invite conversation in class? Knowing my students' names is a necessary first step. I give the students frequent opportunities to speak by asking recall questions, such as: "Subset $V \subseteq \mathbb{R}^n$ is a linear subspace if ... do you remember any of the three conditions?" I also use paradoxical questions, such as: "If $S = \{\mathbf{v_1}, \mathbf{v_2}, \mathbf{v_3}\}$ is a linearly dependent set, then can every vector in S be written as a linear combination of the other two?" Paradoxical questions lead to longer discussions — which I sometimes nurture instead of marching on with the planned topic — as the students try to reconcile their intuition with an answer they weren't expecting.

Fourth, I prepare my board work and solution sets carefully. I want my board to read like a terse set of notes, but I don't want to spend all of class writing furiously. Therefore I plan succinct yet clear language for my board work ahead of time. This carries over to the solution sets that I write for homeworks and exams: mathematics is a language that students learn how to speak, and by example I help them learn to speak efficiently.

When I began as an Assistant Professor at Colorado State University, my main strength as a teacher was *compassionate organization*, by which I mean the following. I make detailed publicly available notes for each class I teach (see [1] for these notes), about 100 pages per class. In LaTeX I write solution sets for every homework, every practice exam, and every

[1] Combinatorics: `https://www.math.colostate.edu/~adams/teaching/Notes_Math301.pdf`
Linear Programming: `https://www.math.colostate.edu/~adams/teaching/Notes_Math510.pdf`
Algebra: `https://www.math.colostate.edu/~adams/teaching/Notes_Math366.pdf`
Topology I: `https://www.math.colostate.edu/~adams/teaching/Notes_Math570.pdf`
Topology II: `https://www.math.colostate.edu/~adams/teaching/Notes_Math571.pdf`

exam that I assign, including graduate classes; these solutions sets clarify my expectations for student work. Having well-written resources allows me to make my class periods more conversational — I feel comfortable devoting class time to discussing an interesting problem posed by a student, as my written resources allow the main themes of the class to remain clear. I refer to this as *compassionate organization* because my preparation sends my students the message that I am invested in their education. This message is heard: around 25 students ask me to write letters of recommendation for them each year. My students are more invested in their learning after observing how diligently I prepare for them.

My teaching has since evolved and improved in three main respects:

- **Project-based instruction.** I have twice taught the undergraduate capstone class Math 435, Projects in Applied Mathematics. In this class I include few lectures and no homeworks or exams, and instead students are evaluated based upon their performance in group projects, presentations, poster displays, and writing assignments. After growing comfortable with students learning from each other in project-based work, I have added projects as a component of several of my other more traditional classes. Students who have struggled through the homework assignments and exams often impress me and better demonstrate their understanding through project work.

- **Incorporating research into teaching.** I have designed and am currently teaching an undergraduate class in my research area (DSCI 475: Topological Data Analysis), and designed and taught a graduate class in my research area (Math 580a2: Introduction to Applied Topology). Even when teaching an unrelated class, I now set aside a day in order to describe my research. I find this period to be one of the most interactive and inspiring classes of the semester for my students; these class periods have helped initiate several of the undergraduate research projects that I have lead.

- **Lessons learned from online teaching.** When COVID-19 moved Spring 2020 instruction online, I essentially "flipped" my classroom for the first time, with short online videos replacing traditional in-person lectures. More class time was then available for problem-solving sessions with students. Students gained confidence from sharing their approaches with each other. In some ways I felt that I had more time to interact with students, and to address their questions about the motivation behind the main themes of the class. Inspired by the challenge of online teaching, I created a webpage ([2]) sharing some of the online instruction tips I found to be helpful. In Fall 2020 my students and I took a different approach, and instead created 53 publicly-available videos on linear optimization that we recorded during class ([3]). When in-person instruction returns, I will still flip a portion of my class periods in order to create more blocks of class time set aside for learning by doing. Indeed, I am working with my colleagues Rachel Pries and Maria Gillespie, along with graduate students Kelly Emmrich and Shanon Golden, to transform my undergraduate combinatorics notes ([1]) into a publicly available "online textbook", accompanied by in-class worksheets and short videos.

I've thoroughly enjoyed my role as a teacher thus far, and I look forward to future opportunities to develop my teaching style while learning from my students and my colleagues.

[2] `https://www.math.colostate.edu/~adams/advising/onlineInstruction/`

[3] `https://www.math.colostate.edu/~adams/teaching/math510fall2020/`