Teaching Statement

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I have been teaching for eighteen years, both face-to-face and online, and I have a passion for improvement and innovation that I apply to my teaching with the same energy as to my research and development projects. I don't believe one can ever be finished learning how to be a better teacher, just as one can never finish learning mathematics or create the perfect software system. There are always ways to improve and grow.

During my time at Colorado State University, I have taught a variety of undergraduate courses:

- The precalculus course sequence (College Algebra, Logarithms & Exponential Functions, and Trigonometry)
- The complete Engineering Calculus sequence
- Differential Equations
- Linear Algebra
- Mathematical Reasoning
- Math for the Social Sciences

I have taught many of these courses in both face-to-face and online sections, and I have used a number of different classroom techniques to try to improve student learning, develop a sense of community and collaboration in the classroom, and improve students' attitudes toward mathematics in general, where some may have an aversion to the subject at the beginning of a course.

My personal background gives me a broad context from which to draw examples and applications, and I try to tailor in-class examples to the interests of my students. The first day of class is often an informal discussion, where I ask each student what their major is, and what made them take the course, even if it's just to fulfil their degree requirements. If they seem uncertain about a major, I try to probe what their interests are and what other majors they could be considering, and then use their collective interests to select examples and applications during the semester.

My undergraduate degrees are in Electrical Engineering and Physics, where I focused on optics and laser physics and on computer architecture and design. After college, I had a career in the private sector as a systems engineer, doing network engineering and software development for customers including General Motors, NASA, Nielsen Market Research, and the Department of Defense. Later, I worked in the game industry, and developed the "DirectArcade" API for Microsoft (briefly marketed as a component of their DirectX API suite) to interface arcade games to a national network for tournament play (in the pre-console days). When I returned to school, I completed my Ph.D. in Mathematics, doing research in diverse areas including molecular dynamics, biological cell communication and motility, and laser design and modeling. I have done architectural design and construction management, worked and as an electrician, and have developed software for mathematical simulation, optics and laser modeling, 3D rendering engines, and online education. This diverse background gives me a lot of material for examples and applications that I can bring to my classroom.

Teaching Philosophy

My most fundamental teaching philosophy is that I should be the student's partner and ally in their effort to learn. It should be the student and I, working toward a common goal, rather than the student seeing me as an external authority who judges and critiques their understanding. I try to create community with my students, and to demonstrate that I want them to succeed, both in my course and in their careers after College. I want to share my interest and passion for mathematics and for learning in general through my enthusiasm and engagement, and to try to inspire them to have the same enthusiasm.

In class, I strive to be clear and concise, and to use visuals as much as possible. Students can understand more from a picture or physical demonstration than they can by seeing equations or hearing a verbal description. I also try to find different ways of explaining something when a student struggles - simply repeating the same explanation will not help, so I work to find other viewpoints that get to the same goal, and I try to bring in real-world applications whenever I can. Even if the application is too complex to work through as an exercise, I like to present the application and describe generally how

the mathematics we are working on can be used. I often bring in examples from my own research or prior engineering or architectural experience as applications, and I feel that the personal connection with my background makes the application seem more concrete and genuine to my students.

Finally, I believe in clear, quick, and useful feedback. When students turn in a homework set, quiz, or exam, I try to have their work graded and returned by the next class period (or at worst, two periods later), and to provide feedback while material is fresh enough in the student's mind to do some good. When a student solves a complex problem but gets an incorrect answer, I work through their process and try to identify where they went wrong, and then give them a clear explanation so they can grow and improve. If they did not attempt a problem, I give them a few words on how they could have started, or what techniques could apply to the situation. I also make it clear to students that I'm available for help, even outside my published office hours, and am happy to work with students at times that are convenient to them if they are struggling.

Classroom Practice

In my classroom (whether it's a face-to-face room, or an online virtual space), I strive to create community and a sense of collaborative and collective striving toward a goal. I understand that students come from diverse backgrounds and cultures, and that an explanation or example that makes sense to me may not make sense to them. I try to probe students understanding with questions, and when confusion arises, I try to find new and different ways to approach the topic. If a student's question seems to show a lack of understanding at first, it could well be my failure to understand what they are really asking, so I focus on refining questions to get at the real misunderstanding. Often, the student's question was not as misguided as it sounded, but a very good question-in-hiding, just phrased imprecisely.

I work to reward questioning and trying new things, and to treat mistakes as perfectly normal and acceptable. If I ask a question and a student gives a different answer than I was looking for, I try to find an interpretation of my question under which the student is correct, and then if that interpretation seems to have some gaps in understanding, I frame my response as (for example) "you're absolutely right, if the numbers are positive integers - but what if the numbers are allowed to be negative, or rational?".

I often mix traditional lecture with active strategies. I usually reserve one day a week for active learning, and leave the others as traditional lecture and discussion. Some active learning techniques I have used include:

- Group work at the board or at tables, solving more involved problems collaboratively.
- Group discussions to set a strategy for a team project that will be completed outside of class.
- Exercises where students invent problems for me to solve, with the goal of making challenging problems, but ones that the student can solve so they can check my answer (my students have made up some excellent problems!)
- Sessions where each group (at boards around the room) solves the same challenging problem, then groups come together the explain their solution to the other groups, and to compare results and techniques. They often take very different approaches, and each group learns to think more flexibly.
- Reflective writing that individual students use to reflect on their learning and to inform my next lesson.

Goals for Improvement

As I said, I believe the drive to improve should be continuous, and I have several goals I am working toward in my teaching.

- I want to better understand the differences in background and culture of the diverse students in my classes, so I can better connect and communicate with them, and help foster in them a sense of confidence and enthusiasm for mathematics and the fields that build on mathematics.
- I want to increase my use of technology and interactive tools beyond simple PowerPoint slide shows and software demos on a projector. I want these tools to help me understand in real-time what my students are thinking and what confusions or misconceptions they have so I can adapt and clarify.
- I want to find better ways to engage students in online courses, which magnify the challenges in understanding what students struggle with soon enough to provide useful support.