Teaching Statement

My effectiveness and success in teaching result from a combination of factors. I plan my classes using a backwards design approach. Depending on the class and the audience, I choose an appropriate method to deliver lessons, including Inquiry-Based Learning, flipped classroom approaches, or a blend of traditional lectures with active learning activities. Whether teaching in person or remotely, I leverage technology effectively to facilitate participation and learning. Drawing on my background in physics, I emphasize the role of mathematics in other fields. Finally, I actively work as a mentor for students at various capacities, either for the class as a group, individually, or by supervising undergraduate research projects.

Backwards Design

My course planning begins with a backwards design process, where I outline a list of goals that students should achieve in my class. For instance, in my Bridge to Higher Mathematics class at WPI during the Summer of 2021, I established the following broad course objectives:

1. Develop our mathematical reasoning, proof writing skills, and ability to read mathematics.
2. Create documents in LaTeX.
3. Rebuild and strengthen our student peer community.

Subsequently, I create both formative and summative assessments to gauge these outcomes. To measure the first goal, I designed three Proficiency Assessments – a series of small tests that students can retake multiple times to assess their proof-writing skills and their ability to generate examples to unfamiliar definitions. To evaluate the second objective, I introduced a formative assessment using technology creatively. With funding from the Morgan Teaching & Learning Center at WPI, I procured a license for Overleaf. I generated a basic LaTeX document on this platform for each student, sharing it to facilitate mutual editing. Students utilized it to compile a portfolio, enabling me to provide feedback on their proofs and LaTeX usage. This innovative approach led me to organize a Section NeXT Workshop during the 2022 Fall NES/MAA Sectional Meeting to share details about this strategy and other online collaborative learning tools I employ.

In addition to cognitive objectives, my course goals often encompass affective and social elements. This was evident in the third objective listed above. Establishing a robust cohort of math majors is pivotal to their progression to upper division classes. Collaborative discussions with peers significantly enhance the learning of mathematics. However, freshman math majors often have limited interaction with their peers, as they are outnumbered by students from other fields in lower division classes. The recent COVID-19 pandemic further exacerbated this issue for our students. To reinforce their connections, I organized screenings of two films followed by discussions. This activity showcased diversity in mathematics, featuring mathematicians from diverse gender, sexual orientation, national identity, ethnicity, etc. Through this initiative, we explored the life and work of figures like Maryam Mirzakhani and Paul Erdös, connecting their contributions with topics covered in the course.

IBL and active learning

Concluding the backwards design process, I develop lessons and activities that prepare students for assessments. I then determine the most suitable instructional method for the course. For upper division courses primarily targeted at Mathematics majors, Inquiry-Based Learning (IBL) proves highly effective, enabling students to grasp concepts at their own pace and take ownership of their knowledge. I employ this approach in my Topology class at Smith College. At the semester's start, I create the skeleton for a Topology textbook, outlining the course's content with missing proofs and examples. This LaTeX-based textbook, hosted on Overleaf and shared with the entire class, becomes a collaborative tool. On Mondays, I introduce definitions and theorem statements, and students work in groups to develop examples and proofs. On Wednesdays and Fridays, half of the class is dedicated to problem-solving, and the other half is dedicated to students presenting their work, followed by peer feedback to assess the accuracy of proofs and presentation skills. During these presentations, I remain in the background, intervening only when a significant issue arises. I also conclude each problem highlighting connections between different theorems and concepts. Over the weekend, students who presented their work add it to our textbook, enabling me to offer feedback on their mathematical writing and LaTeX usage. My interest in IBL led me to join NE-COMMIT in 2021, an organization of math educators interested in using inquiry-based methods in teaching.

When teaching courses for non-math majors, such as Calculus or Linear Algebra, I combine traditional lectures with active learning activities. In my Linear Algebra course at Smith College, I employ a Team-Based Inquiry Learning approach, utilizing a free, open-source textbook from the TBIL Resource Library. In-class, we introduce concepts through small exercises (typically five per lecture) that students engage with using the think-pair-share strategy. After students explore the material, I summarize and organize our findings for future reference. Our Calculus courses at Smith College are tightly coordinated among multiple instructors, featuring active learning throughout the semester. To alleviate math anxiety, we prioritize conceptual learning and we put a lot of emphasis on learning how to communicate mathematics. We employ worksheets for content delivery, which students complete in groups. I periodically rearrange these groups, allowing students to form connections that extend beyond class hours. I pay particular attention to group dynamics, making sure that everybody's voice is heard and valued, and I explicitly mention this in class so that students are aware of their role in establishing a welcoming environment in the classroom.

Technology in the classroom

Amid the COVID-19 pandemic, I adapted to remote teaching by conducting the more theoretical aspects of my classes through asynchronous lectures, saving synchronous or in-person time for active learning activities. Using an iPad and a laptop, I recorded lectures, combining OneNote with Geogebra applets and other visualization tools. Following recommendations from the 2020 Online Pedagogy Workshop at WPI, I divided my Calculus 3 and 4 lectures into concise videos of around 10 minutes each. This format received positive feedback from students. Drawing from my experience creating Microtutorials in Mathematics at UCR, I produced these videos and later applied them to a flipped classroom course. Since 2018, preceding the pandemic, I have offered online office hours via Zoom, utilizing either the Learning Glass technology or a tablet. Non-traditional students particularly appreciate online office hours, given their ability to accommodate diverse schedules.

Whether teaching online or in person, I extensively employ software to enhance learning. My students particularly appreciate Geogebra applets for visualizing multivariable calculus concepts. I also use programming languages or Excel to delve into sequences and series, providing a numerical grasp of the concept of limit. Additionally, I have utilized online homework platforms like WeBWorK and MyLab Math. Currently, I am exploring potential applications of ChatGPT in mathematics teaching. I am especially interested in how ChatGPT can be used to facilitate the creation of open-source materials, including customized WeBWorK problems or PreTeXt-based textbooks.

My lectures

In addition to innovative teaching methods, I focus on presenting material in an engaging and relatable manner. Both at UCR and at WPI, I started my Differential Equations class with a motivational example. I derived the equations of motion for a freely falling body, $x(t) = x_0 + v_0 t + \frac{1}{2}gt^2$, solving an initial value problem. The process only requires basic calculus, so it is understandable to everybody in that class. But at that stage in their learning journey, the idea that one can derive those familiar equations from basic principles or the fact that Newton's Second Law is a differential equation proves to be enlightening. Leveraging my physics background, I infuse these "aha!" moments into my teaching, maintaining student engagement throughout the term.

Mentoring

An essential aspect of effective teaching is acting as an active mentor in various capacities. Mentoring begins in the classroom, where I foster a growth mindset among students. As an icebreaker, I casually explain that labeling people as "math persons" or otherwise is restrictive and has been shown to negatively impact students, particularly women and students from underrepresented groups.

Mentoring can also happen at an individual level. I'm honored to have been elected a WPI Campus Champion as part of the Great Minds/CoMPASS Scholars program. This initiative – a scholarship and mentoring program for low-income Pell-eligible students – consists of students, like a first-generation student in my case, selecting a member of the WPI community as their mentor throughout the year.

Another way in which I mentor students is by supervising undergraduate research projects. This allows me to guide students in approaching open problems, navigating article reading and writing, submitting work to journals, and presenting results at conferences. Opportunities for mentoring extend beyond these topics, including discussions about pursuing an academic career. After teaching an Independent Studies course, I engaged two undergraduate students at WPI in a research project aligned with my research. Consequently, we co-authored an article published in the PUMP – Journal of Undergraduate Research. My students presented their findings at the 2021 MAA MathFest, and both are currently pursuing their PhDs in Mathematics.

Conclusion

In conclusion, what makes me an effective teacher is a combination of good planification, innovation in teaching, proficiency in the use of technology, resourcefulness in making connections between mathematics and other fields, and a predisposition to actively mentor students to provide them with the best possible college experience.