Teaching Statement

My effectiveness and success in teaching is the result of a combination of factors. I plan my classes using backwards design. Depending on the class and the audience, I choose an appropriate method to deliver my lessons, including Inquiry Based Learning, flipped classroom approaches, or a combination of more traditional lectures with active learning activities. Both when teaching in person and remotely, I use technology effectively in my classes to facilitate participation and learning. I take advantage of my background in physics to present the material emphasizing the role that mathematics plays in other fields. I work with the students as a mentor at every academic level, either for the class as a group, individually, or by supervising undergraduate research projects.

Backwards Design

When I plan a new course, I use backwards design, starting by identifying a list of goals that students should gain from my class. For example, for my Bridge to Higher Mathematics class that I taught during the Summer of 2021 at WPI, I had the following broad course objectives in the syllabus:

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.

Next, I create summative and formative assessments to measure these outcomes. In this case, I created three Proficiency Assessments to measure the first goal. These are small tests that the students are allowed to retake multiple times, to measure their ability in writing proofs and in creating examples to unfamiliar definitions. By contrast, to measure the second outcome, I designed a formative assessment making use of technology in a creative way. Using funding from the Morgan Teaching & Learning Center at WPI, I purchased one license of *Overleaf*. I created a very basic LaTeX document in that platform for every student, and I shared it with each of them so that we would both be able to edit it. The students used it to create a portfolio. This allowed me not only to provide them with feedback on their proofs, but also on their use of LaTeX. I have been invited to organize a *Section NeXT Workshop* during the 2022 Fall NES/MAA Sectional Meeting to share more details about this strategy, among other online collaborative learning tools that I use.

In addition to cognitive goals, my course objectives sometimes include affective or social goals. It is the case of the third goal listed above. Building a strong cohort of math majors is fundamental for their advance towards upper division classes. Learning mathematics is better done through discussion and collaboration with peers. Unfortunately, it is often the case that students do not encounter too many other math majors during their freshman year, since they are usually outnumbered by students in other fields taking the same lower division classes together. The recent COVID-19 pandemic only made things worse for our students. To strengthen their ties, I scheduled the screenings of two movies with follow-up discussions. I use this activity to feature diversity in mathematics, including mathematicians from different gender, sexual orientation, national identity, ethnicity, etc. In this case, we learned about the life and work of Maryam Mirzakhani and Paul Erdös, and we connected their work with topics and problems that we discussed in class.

IBL, flipped classrooms and active learning

As the last step in the backwards design process, I plan lessons and activities that will prepare the students for the assessments. At this point, I decide which method of instruction will be the most suitable for my course. In the case of an introduction to proofs class like the one above, using Inquiry Based Learning (IBL) is very appropriate, as it helps to follow the pace of the students and to make them own their knowledge. Because my class had to be completely remote and we only had seven weeks, I decided to use IBL in a flipped online classroom that met daily synchronously. I assigned readings from a good textbook as homework. These freed up time from our lectures, which we used to work on writing and discussing proofs, as well as clarifying concepts. Moreover, it allowed us to work on the skill of reading actively, generating your own examples to get familiar with new definitions and theorems, which is hard to do by only reading other people's examples (passive reading). Students presented problems sharing their screens, and the rest of the class decided whether a proof was correct or not, and gave feedback on how to improve it. The pace of the class was marked by the students, and they even chose the last topic that we covered in class. This was overall a positive experience, which I shared in the *2021 MAA MathFest Session on IBL and Teaching*. As a result of that presentation, I joined NE-COMMIT, and I am currently exploring new ways of introducing IBL in other courses. For instance, I am currently teaching a Topology course at Smith College using a pure IBL model, without a textbook. The students are creating the textbook as we explore in depth the concept of continuity and develop the basics of point-set topology.

When I teach courses for non-math majors, like Calculus or Linear Algebra, I combine traditional lecturing with active learning activities. In my Linear Algebra course at Smith College, I am following a Team Based Inquiry Learning approach using a free and open source book from the TBIL Resource Library. We introduce all the material in class through small exercises (usually around five per lecture) that the students do either in groups or using the think-pair-share strategy. Only after the students have explored first-hand the material, I summarize and give structure to our findings for future reference.

Technology in the classroom

During the COVID-19 pandemic, the more theoretical aspects of my classes were taught using asynchronous lectures, recorded with an iPad and a laptop, using a combination of OneNote with Geogebra appletts and other visualization tools. After learning about best practice recommendations for online teaching in the *2020 Online Pedagogy Workshop* at WPI, in my Calculus 3 and 4 classes, I broke my lectures into short videos of around 10 minutes. My student evaluations reflected a strong preference for this format. I used my previous experience producing Microtutorials in Mathematics at UCR to create these videos, which I later used for a flipped classroom course.

Since 2018, before the pandemic, I have been offering online office hours through Zoom in addition to in-person office hours. I do this either with the Learning Glass technology, or with just a tablet. Online office hours are usually very well received by non-traditional students, since they accommodate their schedules more easily.

Both when teaching online and in person, I make extensive use of software to enhance learning. My students particularly like me using Geogebra applets to visualize concepts in multivariable calculus, like Fubini's theorem or why a limit might not exist even if all the limits along lines exist. I also

use programming languages, or simply Excel, to study sequences and series in class, as a way to quickly understand, numerically, the notion of limit. I have also used online homework platforms like WeBWorK or MyLab Math, to provide immediate feedback on homework assignments and to administer short quizzes for students studying remotely.

My lectures

In addition to using innovative teaching methods to engage students, I focus my attention in presenting the material in a way that they can relate to and find interesting. Both at UCR and at WPI, I always start my Differential Equations class with the following motivational example. I derive the equations of motion for a freely falling body, $x(t) = x_0 + v_0 t + \frac{1}{2} g t^2$, solving an initial value problem. The process only requires basic calculus, so it is understandable to everybody. 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, is an eye-opening revelation. Many of them, even students in engineering and science fields, are taking the class merely as a requirement for their majors, and don't realize how important differential equations are to understand science. I use my background in physics to introduce these "aha!" moments and keep their attention throughout the term.

Mentoring

The final pillar that makes a good teacher is being an active mentor, in a broad sense. Mentoring starts in the classroom, where we can stimulate students to have a growth mindset. I do this by casually explaining, as an icebreaker, that people can not be classified as being or not being a "math person". These labels are limiting and have been shown to have a higher negative effect on women and underrepresented groups.

Mentoring can also happen at an individual level. I am proud to have been elected a WPI Campus Champion last year as part of the Great Minds/CoMPASS Scholars program. This is a scholarship and mentoring program for low income Pell-eligible students. The students, in my case a first generation student, choose a member of the WPI community to serve as their mentor throughout the year.

Another way in which I mentor students is by supervising undergraduate research projects. This allows me to guide the students in how to approach open problems, how to read and write an article, how to submit it to a journal and how to present the results in a conference. There are also ample opportunities to mentor students on other topics, like discussing the nuts and bolts of an academic career. After teaching an Independent Studies course, I engaged two undergraduate students at WPI in a project related to my research. As a result, we coauthored an article that was accepted and published to PUMP – Journal of Undergraduate Research. My students presented their findings at the *2021 MAA MathFest*, and both of them are currently pursuing their PhD 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.