Miguel O'Malley

Teaching Statement

Methods and Experience

As mathematicians, often we have significant experience in the development of software and visualization tools which lecturers in other fields would require significant training to match. What's more, we are further asked to mentor students in quantitative tasks which lend themselves well to effective visualization and gamification. So, naturally, when we turn to the classroom, we immediately fall back to our strengths in verbal communication and freehand drawing.

This, I think, is a shame. Students often associate math class with dry, rote lectures and repetitive homework, meant more to drill lessons in rather than make them fun to learn. In every pursuit I make towards instruction, I first consider how the problem can be made to be more engaging. Through outreach at the MPI Leipzig and the ScaDS.AI institute of Universitat Leipzig, we have found that complicated mathematical concepts can be made enjoyable to participants through game design. Where otherwise students would need to be cajoled into working on a problem, gamification offers the ability to get students to self-motivate through engaging visuals and solid gameplay loops. We have had great success in this vein through projects such as the fence challenge.

Game design is also a force for the democratization of mathematics from the game development standpoint as well. In developing a game, multiple skillsets are required. Artists are needed for visuals and design. Software engineers are needed for the actual game's construction. People with mathematical skillsets are needed for more complex problems arising while making key systems work, and so on. Game design offers the opportunity for people who would never have interacted so closely with a quantitative task to see part of what research level mathematics looks like from the inside, as we have done in Erika Roldan's group.

Further, game design represents a key tool in advancing diversity in mathematics. Regardless of background, a good game can take complicated concepts and make them understandable, as we did with the fence challenge. Good visuals and game design can make problems which would otherwise be inaccessible to students with no formal experience and connect them to life experience they already possess. While isoperimetric problems and optimization might be foreign concepts to non-math majors, maximizing area contained in a fence is easily understood by anyone. Making as many problems as possible accessible in this way reduces the initial burden of reading myriad textbooks to even understand the basics of a question in mathematics.

But while game design can make math class one of the best experiences students have in their educational career, lectures and assignments are still critical for skills which cannot be communicated any other way. At Wesleyan, in the Elements of Calculus course, we focused specifically on students who had not had any formal experience with mathematics for potentially years beforehand. Teaching

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students who either have had no experience or exclusively bad experiences with mathematics in the past helped me to understand that effective mathematics communication is comprehensible, responsive to the student, and flexible. There will never be one right way to present a concept, so the most important skill when speaking with students remains listening.

Beyond lectures, I've found group work is critical to teaching mathematics, and I try to make sure there's always an opportunity for it. Math is an inherently communal subject, where the understanding you have is only as good as your ability to communicate it. Having students work on problems together not only reinforces concepts, but exposes problems before they appear on examinations, or in their eventual careers. We don't teach math to students, especially non-majors, because we want them to calculate the tip. We teach them so that they can communicate what they've done to others, and their compatriots are the first opportunity. This is something I see as critical for students to understand, as important as the content of the course itself.

In the future, I hope to develop projects which can democratize mathematics education and spread interactive mathematics beyond the classroom. While math can be challenging, there are plenty of areas where people with no formal training have made major advancements and discoveries. I aspire for game design to be the tool that helps people escape their current apprehension towards quantitative tasks, making mathematics a significantly more approachable discipline.

Teaching History

- Instructor for Math 119 Elements of Calculus Fall 2020, covering limits, derivatives, exponential functions, logarithmic functions, and applications.
- Instructor for Math 119 Elements of Calculus Fall 2021.
- TA for Math 122 Calculus II Fall 2017.
- TA for Math 222 Multivariable Calculus Spring 2018.
- TA for Math 132 Elementary Statistics Spring 2019.
- TA for Math 231 An Introduction to Probability Fall 2019.
- TA for Math 229 Differential Equations Spring 2020.
- TA for Math 261 Abstract Algebra Spring 2021.
- TA for Math 244 Point Set Topology Spring 2022.
- Drop-in tutor for the Math Workshop Fall 2018.