Jason Miller

Teaching Statement

I believe in the importance of tailoring my teaching to match the needs of both the students and the course. I have taught a large variety of courses; therefore, I have taught students with a wide range of mathematical abilities and levels of maturity. In all of my courses, I work to create an atmosphere where students are comfortable engaging with the material, and I provide my students with the resources and support that they need. I continuously reflect on my teaching methods and experiment with new ones in order to better help my students. I consider teaching to be one of the most challenging and rewarding things that I have done in my life. Though I have made much progress from when I first began to teach, I do not consider myself to be a finished product; I am constantly striving to improve.

Many of the courses I have taught have been first year courses for non-math majors. The material in these courses can be quite abstract and dry for many students, and it is often a nontrivial task to connect it to things the students find intrinsically interesting or relevant. Many students feel that they won't really need to comprehend the material for their future careers and interests. Students often wonder why they should spend so much time and endure such frustration learning material that they feel is so removed from the skills they will need in their future jobs.

I work to help my students develop a more positive view of mathematics. I do this by emphasizing that mathematics is not just a collection of algorithms and symbolic manipulations. It is the study of structures and patterns, abstracted from phenomena in the real world, regardless of whether it be from statistics, physics, engineering, biology or economics. I try to convey to my students the importance of using visualization techniques and heuristic ways of thinking to develop an intuition for these structures. This intuitive grasp of the concepts not only helps students become better at performing calculations; it helps them understand the meaning behind all the formulae that they are learning and also when to apply them.

My belief in the importance of stressing a holistic understanding was underscored by my experience teaching a math course for elementary school teachers. This course is directed by mathematics education experts in our department, and when I taught it, I led the group work portion of the course. In this class, the students are asked to revisit mathematics with which they are already familiar, but the class requires the students to ask questions about how and why these computations work. They are pushed to think deeply about the mathematics, to understand and conceptualize. The students are asked to write out paragraphs explaining why an addition or multiplication algorthim provides the desired answer. The students push back against this depth; they desperately want to just give the answer. The goal of the course is to get the students to eventually realize that teaching mathematics well involves helping their elementary school students to understand why mathematics works the way it

does. This course was very challenging to teach, but it made me more cognizant of how a student's correct work does not always imply that they have a conceptual understanding of the material. This was the first time I taught a group-work-based course, and I was impressed by how teaching in this manner often makes students' thinking more transparent to the instructor and to the students themselves. This has shaped my approach to teaching, making me more diligent about focusing on the reasoning behind each problem and disposing me to include group work in my courses when appropriate.

I believe that carefully chosen examples and problems can be very beneficial in introducing mathematical concepts. Students can easily disengage when confronted with just pure theory or standard calculations. I have found that instead of these two options, it is helpful to interlace these two approaches. This way I can illustrate the theory and concepts in a more concrete manner. Sometimes the problems chosen will highlight a new computational method or an important conceptual theme. Whether I am teaching a lecture or a recitation, it is not enough that I simply solve problems in front of the students. In my experience, students have the most difficulty with developing a strategy for solving the problem. I ask leading questions to help guide the students to a better understanding of the problem at hand. I get them to investigate and ask questions about the context of the problem. What are they trying to accomplish? Are there any visualizations of the problem? What techniques or methods are available to tackle this kind of problem? What theorems or definitions are relevant? This gives them insight into the methods that mathematicians use to think about and solve such problems. They begin to see that no superhuman mental abilities are necessary to do mathematics. Just as in any other endeavor, all that one needs is experience and the proper perspective.

As a particular example, during my Differential Equations course, we learned about deriving solutions to the heat equation. The method was quite complex and involved synthesizing several previous techniques from earlier in the course. However once one understands this method and its rationale, one can easily modify it to solve the other partial differential equations in the course like the wave equation. In this case, there was a formula that could be memorized, but then one would have to memorize the formulas for all the other possible cases. Despite my student's natural tendency to try to just memorize the formula, I impressed upon them the importance of truly understanding the derivation of the solution so they could generalize it. I chose homework, quiz, and exam problems that required them to have a conceptual understanding of the solution. While I was not under the perception that the students would remember the memorized formulas or the detailed derivation years later, I believe that learning the derivation and the concepts behind it will give them a better holistic understanding of the subject of differential equations and mathematics in general.

I strive to be approachable to my students. I believe teaching is about not only delivering content but motivating and encouraging students to engage with that content. It is easy to have misconceptions in mathematics and to not be fully aware of them. It is imperative that students seek out help when they are frustrated. I work to create an atmosphere where students feel comfortable asking questions and comfortable eliciting my help before class,

after class and during office hours. This includes making students feel comfortable asking about prerequisite knowledge that they are lacking or with which they are struggling. I can assist them in overcoming this obstacle by helping them learn rather than criticizing their past failure to learn. Despite creating a comfortable atmosphere, I nevertheless maintain high expectations for my students.

Another way in which I am constantly looking to improve my teaching is by using learning technologies when it is appropriate. In one of my recitation sections for multivariable calculus, the students were having difficulty with the material as we moved into the final weeks of the course. We were studying line integrals in vector calculus. They weren't having troubles with the computations but rather with understanding the new concepts and how they were situated with respect to one another. I decided to use my newly acquired smart pen to work out a number of problems for a review. The smart pen not only records my writing in real time, but it also can capture my speech. This allowed me to include a great deal more information than just writing out the solutions for the problems. A number of students later emailed me and expressed their appreciation for the recordings and how helpful it was to hear the solutions worked out in real time with commentary.

This past summer I taught a second semester calculus course aimed at engineering students. The department had recently began a Technology Enchanced Lectures program that provided support for instructors to use certain technologies in the classroom. In this program, the lectures are presented by writing on a tablet using digital annotation. This method of teaching also allows the instructor to use other tools on the computer such as preprepared slides, graphics, and interactive figures, as well as allowing one to record the lectures and put them on the internet for later viewing. I had never taught a course in this format and, before trying this approach, I felt I might be awkward at using such tools in class. However, I had heard that the Technology Enhanced Lectures had garnered a positive response from many students in previous courses, and I wanted to make use of some of the features such as interactive figures, recorded lectures, and slides prepared before class. It was indeed somewhat awkward at first. I felt like I was teaching for the first time; I had to consciously think about how I was writing, where I was standing, etc. However, I quickly become comfortable with the new format. Students were very enthusiastic about this style of teaching. Both during the class and on the official student evaluations, students expressed appreciation for the technology and a belief that it provided them useful resources that improved their learning.

One of the most challenging episodes in my teaching career has been my recent work in the development and implementation of one of the first fully online math courses at OSU, Math 1116: Excursions in Modern Mathematics. I am one of the two co-creators of the material for this online course, and I have been the instructor of record for the first three offerings of this course. Excursions in Mathematics is a liberal arts math course which has traditionally been taught using large lectures and group-work based recitations. One major clientele for this course is nursing majors. With the advent of an online nursing program at Ohio State, it became necessary to put this course online quickly. We wished to design an online course which still used group work as a central teaching method.

Students work through interactive online lessons asynchronously before class meetings. Then, the students attend synchronous online class sessions using Adobe Connect. In these class sessions, students are broken into groups using breakout rooms. Students work on problems collaboratively in their groups. They talk to each other using both microphones and a chat box and write on a common handout on the screen. The instructor jumps from group to group, asking leading questions and guiding the students. Despite some technical difficulties, we have found that this format really does engage students in learning the mathematics.

The online course was originally developed to fulfill the needs of the online nursing program, but I have now expanded and revised this course as part of a university initiative to create ten online general education courses in the College of Arts and Sciences. Part of this revision has involved creating online lessons in Articulate Storyline to replace the original lecture videos. These interactive online lessons scaffold the students' learning experience through short videos, interactive slides, quiz questions, and choices for students such as what they want to learn next or how many examples they would like to see. Beginning this spring, these interactive lessons will replace traditional lectures in all sections of Math 1116, including the face-to-face sections.

During this process, I have discovered that teaching online necessitates a very deliberate approach to teaching. Because I am not able to interact with these students in person, I have to spend more time thinking about how to motivate and encourage them. This course has helped me become more clear, efficient, and frequent in my communication with students. I have learned the advantage of using the course webpage as an organizational tool for the students, making it easier for students to know exactly what is expected of them and providing them with key resources. Teaching this course requires a certain flexibility due to the tendency for the technology to malfunction. I have developed a greater ability to quickly adapt to unexpected challenges. Although I have developed these skills in the context of teaching an online course, I believe that these skills are transferable and will enable me to be a better instructor in all the courses I teach.

I hope to continue to experiment with new methods and learn new ways of helping students see the beauty and utility of mathematics. Mathematics is a beautiful subject that is essential for humanity's success in science and technology. Learning mathematics can assist students to think in a more logical and precise manner and can enrich and change their view of the world. I hope to show students that mathematics is an interesting and worthwhile subject to study that can benefit all students, whatever their future aspirations may be.