Teaching Statement - John Nardini

My ample teaching experiences have made me realize that math anxiety is often the biggest hurdle for student success in math classes. From a young age, we are taught that math is a difficult subject that only the brightest minds can comprehend, and for everyone else, math class is just a necessary struggle of life. But this mindset prevents all student from experiencing the joy of solving difficult math puzzles and developing the critical thinking skills that a mathematics education nourishes. As a Transforming Education, Supporting Teaching and Learning Excellence (TRESTLE) Scholar in the spring of 2017, I learned about metacognition and methods that allow students to take control of their own learning process in the classroom. Metacognition is informally defined as “thinking about thinking,” in which students analyze their thought processes over time to assist their future learning. I have found that several metacognitive methods are particularly helpful for overcoming math anxiety, so I am sure to include them in my everyday teaching activities.

Students entering my classroom have math anxiety for a variety of reasons. Perhaps they struggled in previous math classes, have trouble understanding mathematical notation, do not understand prerequisite material, or come from a population that is underrepresented in mathematics. Before students can address these issues, however, they must simply feel welcome in the classroom. It is thus fundamental for an effective teacher to be personable, relatable, and excited in the classroom so that students are not afraid to ask questions and approach their instructor. To address this, I begin my classes by making a quick joke, asking about my students’ weekends, or asking about their feelings on current lecture material to communicate that I care about them and not just their mathematical ability. I also make an extra effort to let students feel comfortable discussing their personal and career development aspirations with me during office hours. I remember that while college is an exciting time for students, it can also be stressful as they make decisions that will influence the rest of their lives. For example, after learning about one student’s interest in astrophysics, I helped him locate and apply to an undergraduate research summer program that uses images from the Hubble Space Telescope to study black holes. I have also helped other students locate tutoring positions on campus after they completed a course with me. Developing these personal relationship with students helps them feel more comfortable asking questions in lecture, attending more office hours, and ultimately addressing their math anxiety.

Once personal relationships have been established, I am ready to help students deal with their anxiety. Metacognitive classroom activities help students gauge their learning process throughout the semester and gradually make them more comfortable confronting new material. One method I use is giving lots of examples for students to work on during lecture so that I can observe the types of problems students struggle with. I then include similar problems in future class examples because repeated exposure promotes long term memory of how to solve these problems, and I can help students monitor their growth in problem areas. For example, when I instructed Calculus I at the University of Colorado, Boulder (CU), my students had a hard time understanding the chain rule, so I incorporated lots of chain rule examples for them to work on when I was designing lectures. I was then sure to always check on students I knew had a hard time with the chain rule so I could help them identify when they made the same mistakes as before. Over time, they began to get more comfortable and answer these questions correctly. As students begin to demonstrate mastery during the semester, I am sure to provide positive feedback on their progress and remind them that this was something they had struggled with previously. These reminders help students observe their growth during the course, which gives them confidence in their ability to learn current and future class material.

I utilize technology as a tool to foster metacognitive activities in my lectures. The muddiest point is a common exercise in which students write down the hardest topics from lecture for them during the last three minutes of class time. This activity helps students recall what has been discussed and consider how
well they understand various topics from the class. As a Teaching Assistant in Differential Equations at CU, I used a similar approach to aid my weekly recitations by adopting a muddiest point at the beginning of recitation. My recitations began with an online poll from pollev.com that asked students which topics they were struggling with most, and students could comfortably text their answers in from the anonymity of their cell phones. The first time I tried this approach, I was amazed to see that students did not understand Picard’s Theorem, which I thought we had covered in detail the previous week! Starting recitation with the muddiest point helps students be more open about what topics they are struggling with, understand that other students have similar struggles, and helps me better structure recitations to address the students’ needs.

From my previous experiences as an Instructor and Teaching Assistant, my Ph.D. in Applied Mathematics, and my Bachelor of Science in Mathematics, I am confident in my ability to teach any core undergraduate mathematics course. As students develop as mathematicians and scientists during their undergraduate years, instructors should address how students can most effectively take their skills to the job market, graduate programs, or service programs after graduation. Developing strong reading and writing skills are fundamental for science and math students, as they will need to communicate complex ideas with nonscientists and scientists from other fields during their careers. Because most math curricula do not devote much attention to the communication of mathematical and scientific ideas through reading and writing, I will include term papers in my future higher level math classes. These projects will help students individualize their class experiences. Due to my research background, I am interested in designing and teaching a course on the fundamentals of mathematical biology. This course will focus on the study of fundamental mathematical concepts (such as differential equations, statistics, and numerical simulations) and how they relate to a wide variety of biological concepts ranging from microbiology to ecology. For example, I will discuss how differential equations can describe complicated biochemical networks in cells. This class will provide students with the opportunity to better understand how the math they have learned in college is applicable to the broader scientific community and provide an introduction to academic research.

To begin the class project, students will select a topic from biology that interests them during the first week of class. There will be a literature review of several pertinent biological and mathematical papers due after a third of the semester to help students practice reading and searching for sources. After the literature review, I will meet with students in person to see what areas of their literature review they would like to focus on and help them establish methods to continue work in this area. Such work may include more research into a model they do not fully understand, using a mathematical model to answer some question they have about the biology, or reproducing the results of a computational paper. Any of these choices are fundamental skills of a competent researcher, yet they are rarely discussed at the undergraduate level. I will meet with students again midway through the semester to monitor the progress of their project. At the end of the course, students will write a term paper that describes both the biology and math of their topic, which will also include a 1 page nontechnical summary page to practice clear science communication to the public. Finally, students will give presentations on their project to practice their presentation skills.

Helping students realize that math is a challenging but interesting topic is my top priority as an teacher. The metacognitive methods discussed above and personal relationships with students help them learn to see math in a clearer light. Once students develop a mastery of math, it is important to let them personalize their education in higher level courses by designing their own class projects. Developing strong communication skills will help students learn how to discuss their ideas with others. I will apply these strategies in particular to a Mathematical Biology course, where I anticipate helping students understand how mathematical methods can be used to study biological problems.
Diversity Statement:

Throughout my career as a mathematician, diverse mathematicians from all over the world have continuously inspired my studies. Evelyn Keller, for example, first described traveling wave solutions to chemotaxis equations, J. Nagumo described signal propagation along a nerve axon mathematically, and Phyllis Nicolson derived the Crank-Nicolson discretization method that I frequently use in numerical simulations. Mathematics knows no nationality, religion, gender, ethnicity, or geographical barrier. I understand that this field is the culmination of intellectuals’ work from many different backgrounds and will work to embrace plurality and divergent viewpoints by welcoming all students into my classrooms and promoting respectful dialogue. I will demonstrate the diversity of mathematics in my classrooms by discussing how the theorems and models we discuss are the result of many diverse mathematicians, scientists, and engineers from diverse backgrounds and areas of the world. I am further committed to making accommodations based on the needs of my students. When I found out that one of my Calculus students was the mother of a one-year-old, for example, I added an office hour slot right after class to make sure she could attend it. This change shortened her time on campus each day, which helped her spend more time with her daughter and saved her lots of daycare expenses. Making similar accommodations for students is a priority for me as a teacher.