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Statement of Teaching Philosophy

Throughout my 20 years of being a student (and several being a solo instructor), I have realized that for mathematics to be effectively conveyed, several core components are ideal: proper motivation, an interactive environment, and conceptual understanding through interdisciplinary examples. I was granted the Teaching Excellence Award at Arizona State University by adhering to these principles.

To foster participation, I ask open-ended questions. Instead of asking "does this series converge or does this series diverge?", a question which has a correct answer and an incorrect answer, I prefer to ask "what tests would you choose to evaluate the series to determine the convergence, and why?" The previous query has a "yes" or "no" answer and, whether the student is correct or incorrect, they, and the class, have learned nothing from this answer. With the latter question, there are many possible answers, which any student can volunteer, as well as a small explanation on why they chose that test. When one student answers with their explanation, I ask if other students have a different suggestion. Even students that do not volunteer an answer benefit from hearing the other students' explanations and thought processes. Extending upon this technique, when presenting problems on the board, I consistently ask students what they think the next step should be. This interactive method of learning allows the students to "do" the problem as it is being presented. If no students venture a response, I break the question into smaller, more digestible components, leading back to the original question.

When I first taught Calculus I, I noticed that my students were hesitant to answer prompts and questions. No matter what I tried, I could not get most of the students to volunteer an answer. Instead, I decided to assign group work to be done during class. In addition to allowing students to exchange ideas with each other, it also allowed for a more informal interaction with me, as some students were more hesitant about speaking out or asking questions in front of the whole class.

In addition to in-class group assignments, I assign both written homework and online homework. Both formats have their strengths and weaknesses and, by blending assignments, I feel that the students experience the best of both. The first time I taught Calculus II, I only assigned online homework. Many students had near-perfect scores on their online homework regarding finding the radius of convergence. However, when grading exams, I observed that although many students were able to obtain the correct answer, they were unable to properly format or explain *why* it was the correct answer. Online homework allows for many problems to be completed and checked for correctness but it does not ensure that the student really grasps the material. By assigning written homework, as I did the second time I taught Calculus II, I was able to understand the thought processes of the students and ensure that they were formatting their answers logically and correctly.

I strongly believe students will understand how to apply a theorem if they obtain the conclusions for that theorem. I like to present an applicable motivation and then have the students conceptualize the result themselves, before formally stating the result on the board. When teaching the Mean Value Theorem, I use an example about a highway speed trap. I explain the problem set-up (a car enters a toll road at 5pm and exits 70 miles later at 6pm), then the actual problem statement (they are issued a ticket for going over the 65 mph speed limit, which they fight in court, saying there is no physical evidence that they ever sped). Then I invite them to share their thoughts. Usually, at least one student realizes that the person must have sped at some point during their drive, since their average speed was 70 mph. From here, we translate this result into mathematics. When students derive the conclusion on their own, they feel confidence in their own abilities.

I motivate diverse groups of students by using a variety of other disciplines, such as physics, biology, and engineering. Most students taking introductory calculus classes are not mathematics majors and I want them to see the connection of mathematics to their own fields. I recently developed *Differential Equations for the Life Sciences*, a course that introduced biology majors to differential equations and mathematical modeling of biological processes. At the beginning of the semester, I collected information about all student interests and majors so I could tailor the course to include subjects that engaged them. Most students were unaware of the interdisciplinary applications of mathematics, and became enthusiastic when they realized that mathematics can be used to model tumor growth.

I often create my own problems that explore themes that are not emphasized in textbooks. Because of my passion for infusing scientific disciplines into mathematics, and to increase the accessibility of mathematics, I have developed exercises, including real-world and technological questions, for several chapters in both an open-source pre-calculus textbook and an open-source calculus textbook (links listed at the bottom of this statement). I strive to make mathematics interesting and relevant for not only the students in my classroom, but also for anyone who may use these open-source textbooks.

Unfortunately, mathematics has not historically been the most inclusive discipline, and I support diversity in my classroom. Having taught at large state universities (Arizona State University and North Carolina State University), I have instructed students from a wide range of backgrounds and life stages. In my *Differential Equations for the Life Sciences* course, students came from a variety of mathematical backgrounds and some had not participated in a math course in several years. It was difficult to optimize course structure to ensure that those with stronger mathematical backgrounds were not bored, and those with less strong backgrounds were still able to thrive. In order to facilitate learning, I requested constant feedback to tailor the class towards their interests.

I enjoy teaching undergraduate courses in calculus, differential equations, and modeling. I have not yet had the opportunity to develop a graduate-level course, although I have routinely guest-lectured in both a graduate-level mathematical biology course and a machine learning course. I would be particularly interested in establishing a graduate-level course investigating inverse problems, specifically parameter estimation, sensitivity analysis and uncertainty quantification.

Throughout my time as a research technician and a postdoctoral scholar, I have had the privilege to mentor several undergraduates. I prefer a hands-on approach during initial training, but allow students to extend the research into areas that interest them. I take a relaxed approach for two reasons: firstly, I believe the purpose of mentoring is to teach students how to formulate their own research questions and secondly, I believe a student will work harder for a project that piques their interest.

I invite the interested reader to view my full teaching portfolio, including student evaluations and materials, at my website: https://erutter.wordpress.ncsu.edu/teaching.

References:

1 Jed Harmon. *Calculus*. Openstax College, 2016. Calculus Volume 1. Calculus Volume 2. Calculus Volume 3.

2 Jay P Abramson and Valereee Falduto. *Precalculus*. Openstax College, 2014. Precalculus. (Listed as a reviewer and consultant in the preface, here)