Teaching Statement

Elizabeth Drellich

Across a diverse collection of student bodies, from coed and women’s liberal arts colleges to large state schools, I have developed and refined my teaching techniques to create effective and engaging learning environments in which students discover their love of mathematics. I have taught undergraduate mathematics at Swarthmore College, University of North Texas, Smith College, and University of Massachusetts, Amherst. My courses include the entire Calculus sequence, mid-level Linear Algebra and Discrete Math, and upper-level Abstract Algebra, Combinatorics, Graph Theory, and Probability.

Outside of the classroom, I have mentored undergraduate research students whose work has included a contributed talk at the JMM (2015), a website for 3D printing models of Cayley graphs, and coauthoring research and expository papers with me. Currently I am co-organizing Swarthmore’s Putnam team and a study group for the GRE Math subject test. I have given outreach talks to middle and high schoolers through Girls Inc. and MathILy, led a session of the Philadelphia Area Math Teachers Circle (PAMTC), and worked with Post-Baccalaureate students at the Center for Women in Mathematics at Smith College. I even talked about the Math of Hockey to elementary school girls participating in an ice hockey clinic. In all contexts, my students’ enjoyment of and enthusiasm for mathematics increases as they learn to stand on their own as mathematicians.

1 Upper-level courses: Seminars and student presentations

My goal for upper-level courses is for the students to become leaders in the classroom. I am currently teaching Combinatorics as a seminar, so before each class meeting I have individual meetings with the two students who then prove that day’s theorems to the class and present illustrative examples.

In classes with more students, I elicit leadership from students by assigning short presentation problems before each class so that motivating examples, exceptions, and short proofs are taught by students. For example, on the day we learned about variance in Probability, I defined variance as $Var(X) = E[(x - \mu)^2]$ and then had a student give a proof they had prepared that $E[(x - \mu)^2] = E[X^2] - (E[X])^2$. As a result of these daily presentations, each student experiences being the authority on a subject. They take great pride in the fact I and their classmates refer back to “Tessa’s proof” or “Joe’s proof” for the rest of the semester.

2 Mid-level courses: Group writing assignments

The transition from computational to theoretical mathematics can be a hurdle for some students. To help them make the leap, I have created a series of mathematical writing assignments for my Discrete Math course. Since Discrete Math is a writing course at Swarthmore, I have collaborated with the Writing Center to design assignments that teach students how to write mathematics. In groups of three, the students write and edit a \LaTeX document explaining a proof method (induction, contradiction, generating functions, and the pigeonhole principle) to an interested high school student and then use that method to prove a given statement. Their 1-3 page papers go through an extensive peer editing process and I give them feedback on both their mathematics and their writing style and notation. One student, whose group had struggled with writing an inductive proof early in the semester, told me that he now considers induction to be the easy way to prove many statements about graphs. By the end the semester, all students, including those who initially wrote math as lists of equations, create informative and well-written formal proofs and are ready dive into upper-level proof-based classes.
3 Lower level courses: In-class group problem solving

In lower-level courses I focus on transitioning students away from a mindset that math is given from on high, and teach them that they can discover mathematics for themselves. For example, after deriving $\frac{d}{dx} \arcsin(x)$ and $\frac{d}{dx} \arccos(x)$ on the board in a calculus class, I broke the class into four groups to find the derivatives of the other inverse trigonometric functions. At the end of the semester, the students reported that they felt confident computing these derivatives and even enjoyed doing so.

4 Technology in the classroom / Technology as the classroom

I often use technology in my classes to illustrate complex concepts and show students the beauty and utility of seemingly dry equations. In Multivariable Calculus, I show my students weather maps with wind as a vector field and isobars as the level curves of the air pressure function. In Linear Algebra, I use a free online textbook (Beezer) that teaches students to use Sage for matrix operations. In Graph Theory we explored the Online Encyclopedia of Integer Sequences and Sage’s graph drawing capabilities. Though I typically have students hand in written homework, I have used WebWork, WebAssign, and MyMathLab when teaching coordinated classes. I have also taught an entirely online course in which students watched video lectures and attended office hours via Skype from around the world, and a teleconferenced course which some students attended via real-time video link. These formats introduced me to Camtasia and GoToMeeting for recording lectures.

5 Undergraduate research

Working with undergraduates has been quite rewarding for both myself and the students. Smith Post-Baccalaureate students Pamela Badian-Pessot and Sarah Carr gave a contributed JMM talk on their work on graph models of folded RNA molecules in 2015. Julianna Tymoczko and I coauthored a research paper with Francis Black, at the time a senior at Smith College, which appeared in the SIAM Journal of Discrete Mathematics.

In the summer of 2017 I worked with Swarthmore students Cassandra Stone and Kate Collins as part of Swarthmore’s SPEED program. SPEED funded the students for 8 weeks, during which they created the website [reflections.swarthmore.edu](http://reflections.swarthmore.edu) to teach users about reflection groups and use Sage to create 3D printable models of the Cayley graphs of certain groups. Subsequently I applied for and was awarded funding to pay Kate and Cassandra for an additional month, during which we wrote and submitted an expository article on reflection groups. As a continuation, Kate attended a Women in Sage workshop at Harvey Mudd College in Claremont, CA and the two of us applied for and won funding to travel to Minnesota over spring break to participate in a Coding Sprint at the Institute for Math and its Applications.

In the summer of 2018 I mentored a new group of three students, Amaechi Abuah, Gabrielle Kerbel, and Charles Yang. Each studied algebraic splines from a different perspective, and we culminated the summer with a trip to a SageDays workshop at ICERM where the students had to learn a new math term every day, talk to professors from other universities about their research, and interact socially with mathematicians of all levels. I continue to work with Gabrielle and Charles via reading courses this semester.

I look forward to continued collaborations with students in the future. To this end, several of the projects mentioned in my research statement have parts suitable for students. A list of problems for interested students to try is available at [http://www.swarthmore.edu/NatSci/edrelli1/ResearchProjects.pdf](http://www.swarthmore.edu/NatSci/edrelli1/ResearchProjects.pdf).

6 Summary

I am a creative, engaging teacher for students at all levels of college mathematics. From first-year introductory courses to research projects and beyond, I am prepared and excited to guide students as they achieve deeper levels of mathematical understanding and appreciation. I see educating the next generation of mathematicians as one of the twin pillars of my career.