

# Teaching Statement

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Mathematics may be completely rational, but mathematicians are not. I believe in emphasizing the humanity in mathematics and in the classroom. I do this by focusing on four key principles: active learning, failure tolerant policies, metacognition and transparency. As more research is done on learning, and as I grow as an educator and a person, I will be continuously reevaluating these principles and the concrete techniques I use to realize them in order to ensure I am always supporting expression of authentic humanity.

## Active Learning

In a previous discrete math class session, my students and I had derived the finite sum of a geometric series. I asked the students to conjecture about the *infinite* sum of a geometric series for any real  $r$  with  $|r| < 1$ . I gave them 30 seconds to silently consider the problem, and then I asked them to discuss with their groups.

As I walked around the class, I realized they had no idea what to do next. It can be easy, as mathematicians, to forget that the impulse to try things out, to make guesses and test them, is a skill that needs to be learned, just as much as the formulas. So I brought their attention to the front of the class and reminded them about a standard mathematicians' trick. What do we do when we're stuck? We try examples. At the board, I started computing finite sums of powers of  $\frac{1}{2}$ , and together the class noticed the finite sums seemed to be getting close to 2. We decided we needed more data to make a guess about what happens generally, so we computed the finite sums of powers of  $\frac{1}{3}$ . Before I began, I quickly checked in with them: "do we expect this to be smaller or larger than the previous sum?" Primed with the knowledge this sum should be less than 2, we noticed the finite sums approached  $\frac{3}{2}$ . Then I let them loose to explore more. Someone came up with the hypothesis that the infinite sum of  $\frac{1}{n}$  would be  $\frac{n}{n-1}$ . "What happens if  $r$  isn't of the form  $\frac{1}{n}$ ?" one student wondered. But now they knew what to do without my intervention, and with their group, they started calculating finite sums of powers of  $\frac{2}{3}$ . When I finally showed them the limit derivation of the geometric sum formula, the satisfaction in the classroom was palpable.

The above anecdote shows that using active learning gets students thinking critically as well as building students' enthusiasm. I use active learning for a variety of cognitive demands. Sometimes I have students explore a question and form conjectures, and sometimes I ask them to rephrase a definition in their own words. There is an art to giving students the freedom to explore math while still steering them toward the topics on the syllabus. It's difficult, but when it's successful, it's magical.

Discovery takes more time than being presented with an idea, so I employ several practical time-saving measures. In order for students to spend less time writing and more time practicing mathematical ideas, I give out guided notes at the beginning of class each day. The first page of the notes has learning objectives and definitions for that day to help both the students and myself put the lesson into a big-picture context. I use the think-pair-share strategy in class; I find that these 30 seconds of silent thinking allow students to take a step back from their immediate anxiety regarding seeing an unfamiliar problem. They are

involved in the math, they develop good mathematical habits, such as trying examples, and they practice communicating with others.

In order for students to take chances in exploration, it's necessary to cultivate a comfortable environment. I tell my students explicitly that I want an environment that welcomes mistakes and I ask them to support each other's learning. I also ask them to call me by my first name, and I learn all of their names as quickly as I can. I ask for questions, and count to ten in my head before I move on. I check in after I've answered a question, to make sure I've succeeded. I don't hold back my naturally exuberant reactions when expressing joy and excitement in the classroom. I want to demonstrate to students that we can all bring our full identity into doing mathematics. We do not need to reject our emotional selves in order to study math.

“ Jenny was one of the first people in 3 years to basically make the classroom feel comfortable again. ”

- Student Evaluation from Math 2200, Summer 2018

## Metacognition

While teaching discrete math during the summer of 2018, every two weeks I assigned an article on metacognition, that is, thinking about our thinking. I had my students write a journal entry on each of these articles. Topics of articles included growth vs. fixed mindsets, and the prevalence of insecurity in mathematics. The journal entries were graded only on completion and kept anonymous, so that they could reflect on their own mathematical habits without any fear of judgment. Each time, I asked them to think about concrete techniques they could take from these articles and apply to their own study habits. I engaged them in thinking critically and taking control over their own learning. In one article about the prevalence of insecurity in mathematics (“The Secret Question: Are We Actually Good at Math?” by Ben Braun), I asked them to think about how they could support their classmates and how they could ask their classmates to support them. I hoped to help them recognize their own fears might be very common, recognize how fear and insecurity can disrupt learning, and recognize the humanity and potential insecurity in their classmates.

## Failure Tolerance

With so much research demonstrating the effectiveness of growth mindsets, I make sure my students know that mistakes are encouraged. When students make a mistake in classroom discussions, I tell them “I'm so glad for that misunderstanding, as it brings the subtleties of a problem to the forefront”. I often include examples of imperfect work and common mistakes in the guided notes for us to discuss as a group.

One technique to emphasize failure tolerance is through grading schemes, though the feasibility of the following ideas depends on the class. I have experimented with replacing students' lowest midterm scores with their final exam scores if it is higher, in order to emphasize that the learning is more important than the mistakes they may have made along the way. I've also experimented with accepting corrections on exams for credit back.

“ She also created a great environment in which to mess up, then improve upon your mistakes.”

- Student Evaluation from Math 2200, Summer 2018

## Transparency

By telling students exactly why the class is structured as it is, I engage them in their own learning, and I also connect with them as people. After I give my students my reasons, I say that it's possible there's a flaw in my logic or an idea I haven't considered, and I ask them to “please let me know if this is the case.” I give the entire class an anonymous feedback form approximately halfway through the semester. One example of my attempts to be transparent is that I explain to students that group work has been shown by research to be an effective way to learn, even though I admit that I personally find group work uncomfortable. When I was younger, I thought that group work existed in class as a treat for the extroverts, and I would try not to engage. I didn't realize I would learn more by trying to teach others and learn more by hearing my fellow students explain concepts in a different way than the instructor. I make sure my students know that many people don't necessarily enjoy group work at first, but it is helpful nonetheless.

Acknowledging my fallibility has the counter-intuitive effect of strengthening my authority in the classroom. When students ask me about class structure, I tell them all of my thoughts and reasons, and I ask for suggestions. Sometimes they have great suggestions, and sometimes they don't. Either way, however, they realize that I've deeply considered each aspect of my class. I gain authority, not through displays of dominance, but through displays of thoughtfulness.

## Conclusion

By using active learning, metacognition, failure tolerance, and transparency, I try to relate to my students both as humans and as mathematicians. By forming a relationship where I demonstrate that I see them as whole people, they can grow and flourish, and I genuinely grow to care about them. Not only does this make me a better teacher, but it gives me satisfaction in their achievements and nourishes my sense of purpose.