

# TEACHING STATEMENT

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## 1. TEACHING PHILOSOPHY AND GOALS

I am very passionate about teaching mathematics and would be very excited to obtain a position at an institution that strongly values education. I would describe my approach to teaching as a “quasi-constructivist” approach. Helping students navigate their own learning process is one of my primary goals as an educator. I employ interactive and student-centered activities, and my classroom often has a democratic environment. However, I balance such explorations with direct instruction to ensure that course objectives are met. Finally, and perhaps most importantly, I infuse my classroom with a sense of joy and love of mathematics.

I have determined that I am most effective as a teacher when my students feel safe, engaged, and challenged. In the subsequent sections, I will describe the methodology I use to meet these goals.

## 2. TEACHING METHODS

**2.1. Improv techniques in the classroom.** I have performed as an improv comedian for nine years, and at some point I realized that my goals as an improviser and my goals as a mathematics educator were quite similar. During my time as a post-doc at the University of Arizona, I have developed a series of improvisational comedy games and exercises for use in my mathematics classrooms. Using techniques from improv comedy, I believe that I create a classroom environment that encourages original thought and stimulating discussion. I will describe two such techniques: namely, the circus bow and “I am a tree.”

I firmly believe that it is vital to the success of my classes to create an atmosphere where everyone feels comfortable participating. On the first day of class, I have the students stand, and I demonstrate the circus bow—a big, overly dramatic bow done while loudly saying “I failed”. The circus bow is used in beginning improv classes to encourage students to take risks and, if they fail, to fail shamelessly. I often employ the circus bow when I make a mistake, and I encourage my students to do the same. This simple and silly action helps diffuse the tension that can arise with a wrong answer, and it helps to create a safe space where students can fearlessly pursue mathematical knowledge.

Another exercise that I use in my classes is based on an improv game called “I am a tree.” The goal of this exercise is to help synthesize concepts in an engaging and dynamic way. The students take turns collaboratively creating tableaux representing relevant course concepts. I will often use this game before an exam in lieu of, or in addition to, a review.

One of the most striking instances of success I have had with this game was when I taught *Topological Spaces* in Spring 2010. We had just covered the countability and separation axioms, and the students were having a difficult time digesting all of the technical definitions. I decided to use this exercise to help the students see connections between the disparate concepts and solidify the ideas. After a few preliminary rounds, one of the students came into the middle of the circle, crouched down into a ball, and said, “I am a point in a metric space.” The next student entered the circle, started walking around the first student, and said, “I am a countable basis.” Another mimicked the first student’s physical position and said, “I am another point in the metric space,” at which time two students jumped out almost simultaneously, circled their arms around each of the “points” and cried, “We are disjoint open sets!” This round continued until all of the students were involved in the tableau, representing such concepts as uniform continuity, completeness, compactness, and normality.

In the future, I will continue developing more improv techniques and games for use in the mathematics classroom. I also hope to have more opportunities to educate other instructors about these techniques. At the University of Arizona Mathematics Instruction Colloquium, I have presented two workshops: “Improv Techniques for the Mathematics Classroom,” which focused on exercises that other instructors could use in

their classrooms, and “Improv Techniques for the Mathematics Instructor,” which focused on using improv to improve one’s performance as a teacher. I look forward to enhancing these workshops and to presenting them to a wider audience.

**2.2. Group Work and Class Discussions.** I have seen that students learn most effectively when they are engaged and participating in the learning process. As such, I often deviate from a more traditional lecture style format in favor of collaboration and discussion. During the current semester, I am teaching a course entitled *Synthesis of Mathematical Concepts*, which is aimed at senior secondary education majors and is the capstone class of their undergraduate mathematics curriculum. This class provides an extreme example of how I use group work and discussions in my teaching, as the majority of class time is spent engaged in one or both of those activities.

For example, the goal of one of the first classes was to explore what is meant by an “equation.” I began by writing several expressions on the board, such as  $x^2 - 3x + 4$ ,  $3x + 6 = 8$ , and  $3 = 4$ , and I asked the students to vote on which were equations. I asked various students to explain the reasoning behind their votes, and as a class, we discussed some of the more contentious issues (does an equation have to be true, does an equation have to include a variable, etc.) Keeping these issues in mind, I split the students into groups and asked them to write a definition of “equation.” After about twenty minutes of group discussion, each group presented their definition to the class, and after viewing all of the definitions, we discussed the relative merits of each one. This discussion spilled over to our online discussion forum, where almost all of the students posted their thoughts and ideas about equations. The seemingly trivial concept of “equation” inspired my class to think deeply about the importance of precise definitions in mathematics.

I think that leading discussions and group work requires a great amount of preparation and leadership. When my students are working in groups, I am always circulating throughout the room, listening to conversations, asking leading questions, and guiding groups when necessary. I pay attention to the group dynamics and draw out the more timid students. If I am going to lead a class discussion, I anticipate possible questions to fuel the discussion and possible issues that may arise. I moderate discussions in such a way that everyone feels comfortable participating, and I include the less vocal students by directly asking their opinions. When leading discussions, one of the difficulties I have encountered is that the class will not always arrive at a correct answer. For example, in the equation discussion, the majority of the class did not think that an equation had to be true. Ultimately, I had to declare that they were incorrect because most mathematicians believe that an equation is a true statement. In the future, I would like to hone my skills as a moderator and have strategies to deal with these situations less abruptly.

**2.3. Group Projects.** A final component of my teaching is the use of group projects. In every class I have taught at the University of Arizona, I have assigned one or more group projects that have counted for at least as many points as an exam. I design the projects in a way that allows the students to explore more challenging material that either reinforces or is applicable to course content. I also encourage creativity in both the exploration and the presentation.

For example, in Fall 2009, I taught *Topics in Geometry*, which was largely composed of mathematics majors with a secondary education focus. Instead of a final exam, I assigned a final project that consisted of a science fair style display, a presentation, and a written report. The students chose geometric topics such as soap films, origami, anamorphic images, stability of polyhedra, and halls of mirrors. The students created very imaginative displays and seemed inspired by their topics. They presented their projects at “Geometry Fest”, which I conducted much like a science fair. Their projects were judged by several faculty members, and prizes (in the form of extra credit) were awarded to the highest scoring team. Overall, it was a great celebration of mathematics and an opportunity for the students to discuss geometry with each other in a lively environment.

I plan to continue utilizing projects in future courses. During some classes, the students have had more success with their projects than during others. I would like to continue developing my ability to help them succeed, whether it be through giving more frequent feedback, having a better list of project topics, or providing some intermediate deadlines.

### 3. MENTORING EXPERIENCE

In addition to my experience teaching mathematics classes, I have also had several opportunities to conduct research with undergraduate and young graduate students. I hope to have more occasions to continue such work in the future.

**3.1. Arizona Summer Program.** In the summer of 2010, I acted as deputy director of the *Arizona Summer Program*, a research experience for undergraduates program held yearly at the University of Arizona. Dave Glickenstein, the director, and I designed the program which was held during four weeks in July. We admitted 13 undergraduate students from all over the country. We also managed a team of five graduate student assistants and were aided by two visiting faculty members. The overarching theme of the program was differential geometry, and we designed research projects and a lecture series to address various topics in this field. Dave and I were also responsible for planning and coordinating enrichment activities for the participants, such as a trip to the Arizona-Sonora Desert Museum and a hike in Sabino Canyon.

Each faculty member worked with a small group of undergraduates on a problem in either smooth or discrete geometry. In particular, I worked with four undergraduate students on two different problems in discrete differential geometry. Work stemming from the project with two of the students has been written into a paper and submitted to a research journal. The other two students were not quite as successful, but they still managed to obtain a few interesting results. I also encouraged my students to develop additional communication skills by providing lots of feedback and suggestions for their talks, posters, and papers.

Directing the Arizona Summer Program was an incredibly rewarding experience. I look forward to the opportunity to work with such a program in the future. The main thing I would do differently is to have the program be 6-8 weeks long. We found that four weeks was a little too short to accomplish all that we had hoped. One of the aspects of our program that I think was most successful was that all the students were working on problems in geometry. Having a unifying research theme enabled the students to discuss their work with students in other groups and often led to an atmosphere much like that of a research conference.

**3.2. Research Tutorial Groups.** I have also had experience acting as a research mentor to two second year graduate students. In the first semester of their second year, the graduate students at the University of Arizona participate in a *Research Tutorial Group* (RTG), wherein they work on a semester-long research problem with a faculty member. The program is intended to introduce the students to doing research well in advance of their dissertation research. I have mentored two female graduate students on problems in discrete differential geometry. I have continued work on a problem with one of the students, and this work will result in her masters thesis.

Mentoring graduate students has been both a challenging and valuable experience. One of the main challenges I have had is how to balance helping my students too much and being too “hands-off.” I had a similar sort of challenge when working with undergraduates on research problems. I hope that I will have many opportunities to hone these skills when working with students in the future. I see my role as a research advisor to not only help my students learn how to do research, but to also help them develop confidence in themselves as mathematicians. It may be pure coincidence, but I see many of the same struggles and insecurities in my female graduate students that I had when I was beginning graduate school. I benefitted greatly from the mentoring I received from several female mathematicians, especially from my advisor, Karen Uhlenbeck, and I strive to be a strong female role model to my students.