

# Statement of Teaching Philosophy

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There are two key principles that drive my teaching philosophy: The first is the use of active and inquiry-based learning (IBL) techniques, and the second is the use of empathetic, inclusive and equitable teaching practices. The former idea explains how I teach course content, whereas the latter explains how I engage my students. Together, these two ideas describe my current approach to pedagogy. These principles grew out of my experience teaching a variety of courses, ranging from large calculus sections, to small first-year signature courses, to training undergraduate TAs how to teach mathematics. Furthermore, my teaching philosophy continues to evolve as I engage with pedagogical research and reflect on my teaching experiences.

## Active and Inquiry-Based Learning

*"In mathematics, the art of asking questions is more valuable than solving problems."* - Georg Cantor

One common misconception that I've come across is the idea that everything in mathematics has been figured out. Years of math classes and homework have taught students that there is always some formula or theorem that can be applied to easily solve the problem. However, this is neither the case in research mathematics nor in real-world applications. Oftentimes the most difficult aspect is in coming up with the right question in the first place!

Therefore, I teach the mathematical context and the motivating questions in addition to the formulas, theorems, and proofs. Moreover, I teach my students the art of asking questions, namely how to use questioning as a tool to clarify ideas, to stimulate new ideas, and most importantly, to communicate mathematics. To this end, I design my courses with an emphasis on student collaboration. I have found that this active and inquiry-based approach is useful in teaching at all levels of mathematics, from first semester calculus to graduate level mathematics.

**Calculus.** In my calculus discussion sections, I use inquiry-based and active learning techniques to make my discussion sections a welcoming environment where students are encouraged to actively engage with the course material. In particular, I run my discussion sections as collaborative problem solving sessions. In a typical session, I dedicate the first 10-15 minutes to soliciting and discussing student questions. This routine allows me to gauge student understanding, and also gives my students a voice in the classroom. Following this question period, the remainder of the session is dedicated to active and collaborative student learning. For each session, I prepare problems that focus on illuminating a particular concept, and have students solve these problems in groups of 4-6. In the last 5-10 minutes of class, I ask a group to present their solutions.

In designing these problems, my preference is to pick a single problem that is more challenging or more involved than their typical homework problems. However, I use the technique of scaffolding to reduce the problem into more manageable pieces. In other words, I carefully design sub-questions that guide the students towards the solution. This is another way that I model how to ask effective questions. And eventually, as the semester progresses, I ask my students to scaffold problems for themselves.

Collaboration is the other key component that makes my discussion sections an active and engaging learning environment. My emphasis on collaboration empowers my students to become resources for each other, under my guidance (and occasionally, intervention). It also teaches them how to communicate mathematics to each other through asking questions and explaining ideas in their own words. Similarly, student presentations provide another opportunity to practice communicating mathematics in a structured and positive learning environment.

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**Minicourses.** Asking questions is perhaps even more important in teaching advanced mathematics. From Summer 2017-2020, I have taught minicourses in homological algebra and spectral sequences for graduate and advanced undergraduate students. In designing my minicourses, I run collaborative daily problem-solving sessions to supplement my lectures. For these sessions, I create thought-provoking problem sets that feature enlightening examples and interesting applications. I also write problems that allow students to further investigate material not covered in lecture. For example, some problems ask how one might generalize statements proved in lecture, either by weakening the hypotheses, or by analyzing the proof method. I find that these types of questions are extremely useful in stimulating mathematical conversations.

**Directed Reading Program.** I ask similar questions as a directed reading program (DRP) mentor. Every semester, I mentor an undergraduate student in algebraic topology through the DRP. As a DRP mentor, my goal is to teach my students interesting mathematics, and to also build their mathematical confidence and maturity. In a typical meeting, we begin by having my student explain their assigned reading, or present a solution to a question I assigned as homework. However, I also emphasize to my students that they can (and should) also bring questions and/or partial solutions. This is because one of the most important facets of mathematical maturity is the ability to have a productive mathematical discussion when one is confused. As a DRP mentor, I help my students develop this skill in a structured and positive learning environment.

## Empathy, Inclusivity, and Equity

While teaching in small, personal settings, such as mentoring for the DRP and in teaching a first-year signature course (UGS 303), I developed tools to connect and build relationships with each and every one of my students. My experience training undergraduate TAs to teach mathematics in M 371E helped me articulate the importance of demonstrating warmth and empathy as an instructor, and it also led me to emphasize inclusivity and equity in my own teaching. In particular, I teach mathematics in ways that inspire, affirm, and empower my students.

In my classes, I strive to create positive and inclusive learning environments where all students feel welcome to ask questions and to voice their ideas. Creating these environments begins with the tone of the first day of class. Typically, I build community on the first day by hosting a guided discussion about the broader context of the course, where I encourage the students to think and ask questions. I also survey my students about their personal course goals on the first day of classes, and I also continue this meta-dialogue throughout the semester by using tools such as mid-semester feedback. I work to keep these goals in mind when working with individual students.

Adapting to the knowledge and needs of individual students is another important way that I make my teaching inclusive and equitable. Though my emphasis on inquiry-based learning does not change, I adapt my actions, as well as my implementation of IBL. For example, I vary the amount of wait time when asking questions to give my students time and/or space to think about or discuss the question before I engage them. These practices allow more students to speak up in class, and generates more thoughtful discussion.

Furthermore, I try to model behaviors that encourage persistence and growth mindsets in my students, as well as behaviors that counteract inequity in the classroom, such as stereotype threat or racial bias. These behaviors can be subtle, such as giving every student the opportunity to ask and answer questions, or using both verbal and non-verbal positive feedback. However, from my experiences teaching virtually, I have also learned to reach out and intervene before my students are at risk of dropping out or failing. In particular, I use low or no-stakes weekly assignments to track student participation and engagement, and I will take the initiative to reach out to students

that are starting to fall behind. This is especially important in terms of equity, as students from underrepresented groups may struggle with asking for help.

## ————— Pedagogical Development and Leadership

My teaching philosophy is informed not only by my experiences teaching, but also by my continued engagement with pedagogical development and research. Throughout my career, I have participated in various interdisciplinary seminars, workshops, and programs that focus on education and teaching practices, and I have contributed my own insights as well. To highlight two recent examples, I received an FIC Graduate Student Teaching Award in Spring 2020 for giving a talk on using role-play techniques in teaching M 371E. In summer 2020, I also gave a talk for the Inequity in STEM Seminar, on ideas and strategies for teaching inclusively and equitably online, which I later wrote up for an AMS grad student blog post.

## ————— Concluding Remarks

Teaching and communicating mathematics is an important part of my mathematical identity, and I value the impact that I have as an educator. It is for this reason that I am committed to inclusive and equitable teaching. From my teaching experiences, as well as my engagement with pedagogical research, I have found that my emphasis on active and inquiry-based learning, as well as my focus on empathy, equity, and inclusivity, improves the learning experience for all students, regardless of the systemic barriers that exist due to race, gender, socio-economic background, or cultural identity. As an educator, my goal is to break down these barriers, and to use mathematics as a tool to inspire, affirm, and empower my students.