

Michael Tait

Teaching Statement

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When I first became a Teaching Assistant, I found myself hoping at the beginning of each semester for “good students”. It is a joy to teach when students are interested, motivated, and able. However, a presumption when hoping not to have “bad students” is that it is predetermined. As I have grown as an educator, I have realized that one of my priorities in the classroom is to cultivate motivation and scholarship habits in my students that will make them want to succeed. Helping students discover mathematics is a true pleasure, and I am constantly striving to become a better educator. One calculus student summarized that I am “*interested in students success*” [1].

My approaches in the classroom: Over the years, I have found that students understand course material much better when they are actively engaged during lecture. To this end I strive for my lectures to be very interactive, my classes being a mixture of telling the material and the students discovering it for themselves. When I am lecturing I ask leading questions to guide my students to say what I want them to (in many lectures, I will have students answering questions more than once per minute). During the first lecture I tell my students that I expect participation and that my questions are not rhetorical. One student put it this way: “*Always asks questions and expects class to participate, but not in a rude way*” [2]. I give praise when students speak up, engendering a culture where they want to participate and want to supply the correct information. This technique gives “*confidence to his students that dislike math*” [3]. I often ask a question in class and poll the class to see what they think. Then I will have one person for each response explain to the class why they answered the way they did. After this I will poll the class again and see how the answers change. Allowing students to explain their position lets them take ownership of their understanding of the problem. I have recently started incorporating “group quizzes” into my lectures, which I have found gets the students excited to work together.

One skill that I hope to nurture in every student is the ability to attempt and to solve difficult questions. During lectures I will often pose a difficult problem and ask the students what one would need to do to solve it, teaching them to think critically before simply applying a formula. Then I ask leading questions and take suggestions on what to do, “*walking [them] step by step*”, so that we solve the problem as a class [4]. Further, I believe that it is important to incorporate basic proofs as early as precalculus. These should be proofs that do not take many steps. For example, in a precalculus course I might ask, “Let $f(x)$ be an odd function. Prove that $f(0) = 0$.” This teaches students to make logical deductions and to think about what they need to do to solve a problem before starting. One Discrete Math student commented that it gave them “*some of the basic intuition underlying*” the problem [5]. For more advanced students, asking difficult questions often means telling them problems which are close to cutting edge research. I have found that students love hearing that there are problems out there that nobody knows how to solve, and that they often become excited to work on them and no longer worried about not being able to get the right answer. One combinatorics student said this: “*The historical context for the results and their relevance to current research was especially useful for getting an idea for the motivation and history behind theorems...I feel like this course better prepared me to do original work in mathematics*” [6]. This also allows me to use more advanced classes to find and recruit undergraduates with whom to do research.

Once a problem is solved, a student needs to be able to tell me their solution with some level of

mathematical maturity. This is a skill that I was not cognizant of until teaching at the University of San Diego, where the math department made it a mission that all of their students would have good writing skills. Now I realize how important, but often neglected, writing is with calculus and precalculus students. To teach this skill, during lower level classes I often highlight the writing process while solving a problem during lecture.

Finally, students do not all learn the same way, and so I always try to be adaptable in my teaching. My goal is to be flexible enough that I can reach every student. During my first experience as an instructor of record, my students gave me feedback that my lectures were too conceptual and did not have enough concrete examples. Since then I have incorporated more example solutions during lecture, and I have also started making YouTube videos showing basic techniques that the students can watch without using up valuable lecture time. Every semester, I encourage my students to write comments in their evaluations so that I can continue to grow as an educator.

Broader impacts and service through teaching: One of my favorite parts of the job is supervising undergraduate research. In my 2 years at Carnegie Mellon, I have supervised 5 undergraduate research projects. These projects have resulted in 1 paper published in *The Electronic Journal of Combinatorics*, 1 paper to appear in *The Australasian Journal of Combinatorics*, 2 manuscripts which are currently under peer review, and 1 manuscript which is currently being written. In October 2017, 1 of my students presented our work in a talk at the Midwest Graph Theory Conference. Additionally, I have co-supervised undergraduates at other institutions in 2 more projects, resulting in 1 publication in *Discussiones Mathematicae Graph Theory* and 1 paper which is currently under peer review. All of these projects are described in further detail in my CV. I am excited to continue to mentor student research. My [research statement](#) contains several specific problems that would be suitable for work with students along with my opinion on the level of student for which each would be optimal.

Promoting equity through teaching is important to me. To this end, with Jessica De Silva, I organized a conference called *Women and Mathematics at CMU* designed to build support and outreach networks for women in math across the country. This conference was supported by a grant that we won from the Woman and Mathematics Ambassador Program through the Institute for Advanced Study. The conference took place at Carnegie Mellon University on April 14, 2018. I am excited to do continued outreach in the future.

Finally, many of the most rewarding parts of teaching come informally, via the personal relationships that one makes with students. I always let my students know that I am happy to talk to them about academic matters not related to the course, and I often find myself talking to students about what other courses to take, giving my honest opinion on going to graduate school, taking the Putnam exam, talking about their extracurricular activities, and more.

The future: While I think that I have done a good job teaching so far, I know that I can still improve as an educator. I will continue to experiment in the classroom and to find what works, refining my techniques and approaches. In the future, I would also like to explore more systematic and researched approaches to improving my teaching, for example by participating in Project NExT.

Quoted student comments

The remainder of my student evaluations are available at www.math.cmu.edu/~mtait/Teaching.html

- [1] “Overall, very knowledgeable! Great help during office hours as well & interested in students success.”
-Calculus II student at UC San Diego, Summer 2015.
- [2] “Fantastic professor with a great sense of humor. Very relatable because of his young age, and able to give relevant examples to his students. Always asks questions and expects class to participate, but not in a rude way.” -Calculus II students at UC San Diego, Summer 2015.
- [3] “Pretty awesome teacher. Haven’t taken calc in three years, and took his class. Really good at teaching, and giving confidence to his students that dislike math.” -Calculus II student at UC San Diego, Summer 2015.
- [4] “Great at explaining the math problems, walking us step by step” -Calculus I student at UC San Diego, Fall 2011.
- [5] “Mike is a sharp guy. Has a pretty deep understanding of the topics which is really helpful when it comes to providing some of the basic intuition underlying these concepts. I never made it to section because there were at a bad time. Would recommend.” - Discrete Math & Graph Theory student at UC San Diego, Spring 2015.
- [6] “This was perhaps the best math course I have ever taken at CMU. I like how we didn’t just cover the basic easy combinatorics stuff like combinatorial identities and basic enumerative combinatorics. Although this course was much more challenging than a typical 21-301, it was well worth getting to learn about extremal combinatorics, spectral graph theory, and the probabilistic method. The historical context for the results and their relevance to current research was especially useful for getting an idea for the motivation and history behind theorems. Furthermore, this course set me up to be able to better understand current papers in the field, which use a lot of the same stuff we learn in class. I feel like this course better prepared me to do original work in mathematics as well. My only complaint, is we could’ve spent a day maybe to review the graph theory elements. The stuff about cycles, girth, chromatic number, etc made up only a small component of the prerequisite 228 course, and having to relearn that made things just a bit harder. Also, I know the grader is busy and our work is very proof heavy but having grades returned consistently after a week would have also been nice.” - Combinatorics student at Carnegie Mellon, Fall 2018.
- [7] “Mike told us from day one that we were going to struggle, and that that would be ok. I did struggle throughout most of the class– each homework was difficult and time consuming, but at the same time I felt like I was often proving meaningful results. The grading was fair and Mike was extremely accommodating with his office hours. I knew that I could always ask to meet and that he would make time for me, which I greatly appreciated. The exams were difficult, but fair. I never thought that any of the problems were completely out of reach, even though I didn’t solve every one of them. I was very glad that Mike was always transparent about the grade distributions and cutoffs for exams– in many classes you don’t know that your low grade is actually pretty good. My favorite part of the course was just the sheer breadth of topics to which we were able to apply our knowledge. Getting to finally apply probability and linear algebra has made these subjects so much more interesting to me. It’s like I finally got to see the value of all the classes I thought would be dead ends. The class is hard, but Mike told us to trust the system, so I did, and I learned a ton. Thank you, Mike. This class was seriously awesome. I sincerely hope I learn as much in future classes as I did in yours.” - Combinatorics student at Carnegie Mellon, Fall 2018.