

Teaching Statement – Christopher A. Francisco

My role as a mathematics teacher is to help my students both to learn mathematical concepts and to improve their ability to think independently. Mathematics is a wonderful subject through which to empower students to realize how much they can do by applying knowledge they have accumulated to an unfamiliar situation. Though students may be uncomfortable doing anything but calculating at first, I think students are capable of thinking more deeply about mathematics than we often ask them to do. My first-semester calculus class often culminates with my students talking me through the proof of the evaluation portion of the Fundamental Theorem of Calculus, using a guide I provide. I always have multiple students who took calculus in high school tell me after class that it had bothered them that they did not know why we evaluate definite integrals like we do, and since it was “easy” enough for them to do themselves, someone should have shown it to them before. It is fun to hear that at the end of a semester.

When I teach, I maintain a running dialogue with my students. I almost never talk for two minutes without asking for student input. Most mathematicians agree that it is impossible to learn math without doing it, and I try to ensure that my students are actively engaged during class by picking examples the students find interesting and by asking them to contribute frequently. Even when I introduce a concept that most students have not seen, I find it useful to hear their intuition. When I taught integration to a group of students who had not previously taken calculus, the students tried to estimate the area of a curved region I drew by creatively drawing polygons inside; the leap to the standard rectangle techniques was easy to make. In a more advanced course like linear algebra, I asked for students to volunteer ideas for approaching a proof, occasionally giving them hints. Sometimes, they came up with proofs better than what I intended to present, and the students remembered these arguments better than those I simply explained myself. I promote an atmosphere that encourages students to volunteer without fear of making mistakes, and my students have said in evaluations that they feel comfortable in my class. Additionally, I write complete English sentences on the board as much as possible when I teach. This makes the class feel like a conversation and exploration and less like a course in how to manipulate mathematical symbols.

I recently implemented this philosophy by designing and teaching a graduate course at the University of Missouri on commutative algebra using the computer algebra system Macaulay 2. This was a difficult class to teach because I had a wide range of students; some had never had a graduate algebra class, and others were doing thesis research in algebraic geometry. To handle this mix, I introduced questions that students could understand on a variety of levels. Frequently, I had the students try to discover the statements of theorems I wanted to discuss. For example, I asked the students to use the computer during class to explore the graded Betti numbers of particular monomial ideals. The less experienced students picked out simple numerical patterns in class and made conjectures based on data they gathered. Some more advanced students were able to make more detailed conjectures about the types of syzygies that occurred for these ideals. I think when I stated the theorems afterward, the students had a better understanding of how one might have thought of these results (and perhaps how to prove them).

A primary challenge facing mathematics instructors, particularly in introductory classes, is to help students understand what math is and why we ask them to learn it. Students often come to college thinking that mathematics is largely a computational activity, and they struggle with open-ended, conceptual questions. As with any subject, students understand math better if they see a way to relate it to their own experiences, mathematical or otherwise.

As an effort to address these concerns, I participated in an NSF-funded project in graduate school at Cornell called “Improving Calculus: Developing Concepts Through Good Questions.” With a group of faculty and graduate students, I developed questions and tested them in my classes. We wrote questions that are easy to state quickly in class and both test students’ conceptual understanding and provide a way for them to remember the ideas better. Many questions are multiple-choice; students vote for one of the answers, discuss the choices with their classmates, and then vote again. One difficulty that my students often face is that while they have a vague idea about what a theorem says, they do not really know what the hypotheses are and why they matter. In the case of the Intermediate Value Theorem, some simply memorized that they needed to check for continuity. I addressed this by talking about a basketball game many watched that week in which the team that was behind at halftime won, but the game was never tied. The students understood this possibility quickly, and they were able to explain later in writing why this example did not violate the theorem (and even discussed whether the same thing could happen in soccer); this is a typical question from this initiative.

I used these ideas in more advanced courses as well. When I taught linear algebra, the students were skeptical about the utility of changing coordinates. I told them my address, and they discussed how to explain to someone unfamiliar with the address where I lived. We decided it was simpler to say that I lived a block east of their dorms than to describe how to walk the mile from our classroom on the winding roads around campus. The students understood this easily, and some of the reasons for using different coordinate systems became clearer.

Getting to know my students early each semester has helped me succeed in teaching. I have all my students send me an introductory e-mail so that I know their background. In particular, I ask students to describe both their academic and nonacademic interests. Using this information, I develop examples and homework. When some calculus students struggled to understand relative error, we discussed shooting percentages of basketball players. They knew Michael Jordan had played better when he made 20 of 22 shots than when he made 2 of 4 even though he missed the same number of shots each time. Putting mathematics into a context that was familiar to the students helped them understand what they could not see with the examples in the textbook of computing areas. Discussing subjects students like or that directly relate to them makes them more likely to see why mathematics is important. Many of my business students at Missouri had car payments, so we took specific, realistic examples of principal, interest rates, and durations and figured out how much they were paying in interest. Students were surprised at how much their cars were costing them, and one e-mailed me at the end of the semester saying that because of the class, she was paying off her car loan early.

Throughout my teaching career, my students have given me positive evaluations. As a result of these evaluations and my work in the Good Questions project, I won Cornell University College of Arts and Science's Clark Distinguished Teaching Award in the spring of 2004. I also received the Cornell mathematics department's award for the most outstanding graduate student teaching assistant, and in my first year of formal teaching as a senior at the University of Illinois, I made the "Incomplete List of Teachers Ranked As Excellent by Their Students." A complete list of student comments from my teaching evaluations at the University of Missouri is available on my webpage.

I am most proud of the number of students who have told me that they became interested in mathematics for the first time in my class. I strive to convey my enthusiasm for mathematics to my students and inspire their interest. Several former students from introductory classes have majored in math, and others have told me that they appreciate now that mathematics is not just a dry, computational subject. I hope to continue teaching courses at all levels of mathematics and to help students understand both the utility and beauty of the subject.

Student Comments - Christopher A. Francisco

This is a selection of comments students have written on my teaching evaluations in classes in which I was the sole instructor. I will be happy to provide photocopies of the evaluations and my numerical ratings upon request. Complete student comments from my teaching evaluations at the University of Missouri are available on my webpage at <http://www.math.missouri.edu/~chrisf>.

- "This class sparked my interest in math, not something I expected out of it. Chris is a great guy and a very good teacher."
- "I tried to take this class 3 semesters ago but decided to drop it because I could not understand my teacher. I came into the class dreading it because I heard it was really hard and I'm not that good at Math. Having said that, Chris you are a breath of fresh air. This has been my favorite/best class of the semester, and I thank you for being such a great teacher. You're the best professor I've had since I've been here!"
- "This was a wonderful course which really solidified my understanding of calculus and inspired me to study math at higher levels. Our teacher, Chris, was the best math teacher I have ever had and an entertaining and clear teacher. A wonderful class."
- "I found that Chris addressed his students' independent needs well. He communicated well to students who had never seen calc. before and those who had."
- "I'm really not a math person, but Chris made the class bearable and even interesting. I struggled with some of the material, but he was always patient and willing to help."
- "I think this course has been better than my expectations because of the instructor... Math has always been my least favorite subject, but it has become one of my favorite classes this semester."

- “Very enthusiastic, enjoys his job and conveys that energy onto the class. Easy to understand, gives good examples and is easy to approach. Doesn’t create negative feelings if answers to questions are wrong.”
- “Probably the best teacher I have had so far at Mizzou. He is determined to have the kids learn the material he is presenting.”
- “If you can’t learn calculus from Chris, then you won’t be able to learn it from anyone; he does an awesome job.”
- “Relates material extremely well to the real world—very good at keeping attention—clear directions—reasonable grader—wouldn’t have passed the class with any other instructor—makes complicated subject matter seem reasonable.”
- “Best math teacher I have ever had. Relating examples to real-world situations made learning a lot easier. Always had ample office hours.”
- “Chris Francisco is the best teacher at MU. He is very interesting to talk to and he is always looking out for his students...”
- “You made math enjoyable. The students could tell you enjoyed what you were doing and it made them excited to learn...”
- “Lecture was great. Very informative and helpful. Chris always made an extra effort to help and answer questions. He was very cooperative and a wonderful instructor.”
- “Honestly, best teacher I’ve ever had. Great use of examples.”
- “I thought that the lectures were extremely valuable in this class. The instructor explained the concepts very well.”
- “Great job teaching material. Made a boring topic, to me, seem interesting and fun.”
- “The most absolute best teacher I’ve ever had. Period. Most definitely the best instructor at Mizzou I’ve had. Very organized, respectful, easy to learn from, and most of all, he really cares.”
- “Chris always was very eager and clear in communicating information and explanations... I would be glad to have Chris again for another course.”
- “Lectures were very helpful. Material was presented very clearly. The way HW problems discussed - very effective (helpful, guiding, but not giving it away, making us think).”
- “I really enjoyed the examples Chris presented in class. Instead of using your typical examples, he used items that interested the class such as sports. I think that displayed his love for teaching, because he wanted kids to be interested and realize how math can be applicable to real life.”
- “I used to get A’s in math until Jr. year of H.S. This was the first time in 3 years that I have enjoyed a math class and it is because of Chris. I see him every week and he is so helpful and easy to understand... Chris just uses examples that are relatable to our lives and is always easy to get a hold of and meet with!”
- “Very good job with the lecture; although I’m not receiving an A in the class, you made calc. into a class where I could understand the material although I was afraid to take the course since I failed last time I attempted to. I would definitely recommend you as a TA because I feel as if I understand calc. now...”