TEACHING STATEMENT

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Teaching is more than a profession to me—teaching is my way of life. Or, to borrow the words of the great Teacha, also known as KRS-One, teaching isn't something I do—teaching is something I live.

I have enjoyed great teachers my entire life, from pre-K through today, the greatest teachers of all being my parents (my mom taught high school math, my dad taught law). Growing up around such great role models, I always dreamed of teaching. That dream grew with me, from my first teaching experience in third grade, when I tutored a classmate in his times tables, through tenth grade when I volunteered to read with children in that same third-grade classroom, until nine years ago, when I entered the teaching profession.

After spending most of the 2008-9 school year teaching pre-algebra and remedial Fundamentals of Math to ninth graders in my hometown of Columbus, Ohio, I moved south to earn a teaching certificate through the Mississippi Teacher Corps and spent the next three years teaching high school math and physics. As one of just two math teachers at the high school in the small, rural town of Potts Camp, Mississippi (population 505), I taught every math class from geometry through AP Calculus. My workday never ended; I planned constantly to prep for my four-five different courses per day. I learned that teaching is hard. Still, I loved it, and I believe I also made a positive difference for many of my students.

After three years teaching high school, I started grad school at the University of Iowa, where I have worked as a tutor, TA, and instructor every semester since. Twice I served as instructor of record, once for College Algebra and once for Elementary Functions (precalculus with trigonometry); one year I worked as TA for the first-year graduate sequence in topology, which covers point-set topology, homotopy theory, and smooth manifolds; and for three semesters, I TA'ed Iowa's Mathematica-based vector calculus course for engineers.

I want to describe how these experiences inform my teaching. Here is an outline:

- §1 highlights my commitment to diversity.
- §2 unpacks a core tenet of my teaching philosophy: "No one is born knowing math."
- §3 outlines my approach to course design, test writing, and grading.
- §4 discusses my experience with and interest in active learning.
- §5 emphasizes the value of engagement outside the classroom, in office hours and beyond.

1. Commitment to diversity

Early in my teaching career, I discovered in granular human detail that, while the United States of America promises its citizens access to education, this access is distributed in a way that is grossly unequal. It is, or ought to be, a national disgrace. Before moving to Mississippi, I learned that geography, poverty, and race stand as barriers to equal access in K-12 education. In my classroom, I learned that, while the achievement gap may have systemic causes, its effects are individual. Students, above all else, are individuals. My commitment to diversity proclaims that I honor and serve each student in my classroom for the singular human being they are.

A visitor to my classroom in Mississippi might have seen the hallmarks of an achievement gap according to race, family income, or geography, but they would not have seen any sign of an achievement gap according to gender—half of my students, and more than half of my highest achievers, were young women. Unfortunately, the same cannot be said of the classrooms where I have taught and studied at the University of Iowa. In Iowa, as across America, something in our culture is driving women our of STEM fields. We must do better. We must honor and serve our students, male and female, transgender and nonbinary, as the unique and important individuals that they are. One small way that I work to encourage diversity in my classroom is to combat stereotype threat, which I do—at the advice of my sister Jessie, a veteran teacher with a Ph.D. in developmental psychology—by starting my quizzes with the following exercise (sometimes with variations). Although short and simple, such insert at the beginning of a test has an empirically well-established benefit in combating stereotype threat.

Before you begin, write the following (1 point): I am a successful, hardworking college student.

My commitment to diversity follows the initiative of Phil Kutzko and other leaders who, over the last thirty years, have developed a culture of mentorship in the University of Iowa Department of Mathematics that has earned recognition as a **Program that makes a difference**. During this time, Iowa has awarded fully seven percent of all math Ph.D.'s earned nationwide by underrepresented minority studies. The key to this success is a culture of mentorship, practiced both by the faculty and by graduate students. I have contributed to this culture, volunteering several times to serve as a mentor in our first-year buddy program, as well as serving as a mentor in informal capacities, especially with my former students from the first-year graduate sequence in topology.

Please allow me to illustrate my commitment to diversity with a final anecdote. In mid-October this semester, I received an email from a student who had missed the last few weeks of our Calculus 2 class. The student informed me that he had been out because his mother had died. He asked me whether I thought he could catch up in the course. We made an appointment to meet in person.

I knew from an earlier email about the student's absence that he was enrolled in three other courses, and I knew from interacting with him in office hours that this student had not yet mastered the product and chain rules for differentiation and had thus started the course quite far behind. I also know something about grief, having lost my own mother to cancer when I was nine years old. When my student came to my office, we found a relatively private spot to speak in the hallway.

I expressed my condolences and shared about my mother. Then I advised him to drop Calculus 2. I advised him to stay in his other three courses, noting that one of the best ways to deal with grief is to return to a routine. I told him a hard truth—that in order to succeed in Calculus 2, he would first need to improve his Calculus 1 skills, and that there probably wasn't enough time left to do this and make up his other missing work from the class, all while catching up in three more classes, and of course grieving his mother. My student valued the honesty. He firmly shook my hand, and asked if he could contact me again in the future. I said of course. That afternoon he dropped the course.

This anecdote does not have a happily-ever-after ending, but it does provide a window into my life as a teacher. My student, who happens to be hispanic, had asked me to advise him on an academic matter during a difficult period of loss and grief. Of the many aspects of my student's individuality, only three

substantially informed my advice—his math skills, his course schedule, and his state of grief (as I could best understand it based on my own experience). Race matters. Ethnicity is important. But these factors had no bearing on the question my student had asked me, and they had no bearing on the advice I gave.

My commitment to diversity is to serve students of all backgrounds and to honor them for the individuals that they are.

2. "No one is born knowing math"—empathy in instruction and course design.

We are all born without any mathematical knowledge. As obvious as this is, it can be easy for a mathematician to forget over the years, as we use the same notations, concepts, terminology, and conventions again and again. As acquired knowledge becomes second-hand, like an extra appendage, it can begin to feel almost as though this knowledge has been there all along. It was not there all along. Mathematical knowledge is not inherited, but acquired through hard work, and great math teaching requires an attention to clarity and simplicity, which is possible only through the empathetic work of connecting with students who have not yet acquired the knowledge the teacher seeks to impart.

When I prepare to teach a course for the first time, I try to break down the curriculum into a few fundamental concepts and the connections between them, I take time to grapple with these core ideas, and I aim to make them as simple and explicit as possible by choosing the most precise, plain language to describe them. By the time the course begins, I have applied my past teaching experience to organize my instruction around a few central themes, a few key words or slogans. On the first day of class, I tell my students what the course is all about. I name the theme of the course and plant it, like a sapling, at the center of our curricular space. The work of the semester is then to fill in details to help this sapling grow to maturity.

Teaching the same course multiple times presents a different, but similar, challenge—to keep the material fresh, to sustain the spark of enthusiasm. This challenge, too, demands the empathetic work of remembering what it was like not knowing. I take an approach similar to the one described above.

While I try to make the big picture as clear as possible through a consistent, simple theme, I bring a much more flexible approach to the details of instruction. In part, this is because the details of math courses—such as computations and proofs—tend to be more procedural, and thus subject to incremental improvement, than the few big picture concepts at the core. Indeed, many of my best lesson plans over the years have come fresh out of meetings with students during office hours and in other one-on-one venues. A student asks questions, which I answer, and respond with questions of my own. The student responds by narrating their thinking, grapples, asks more questions, and so on. While engaging with the student, I keep mental notes: What details does this student find less intuitive than I expected? What details come more easily? When I plan to deliver a lecture, I aim to make it as plain and engaging as I can—self-contained, unambiguous, visual, straightforward, and hopefully fun! I am most successful in this aim when my students come to office hours. (More on office hours, seminars, and other out-of-classroom interactions in §5.)

3. Course design, test writing, and grading

Before offering specific thoughts about grading and about designing courses and tests, I want to emphasize a centrally important factor in all three activities: teamwork. What characteristics define a well-written test, an appropriate grading scheme, or an exciting but realistic course? The answer to this question is not

absolute, but situational. To some extent, the answer depends on students, but to a greater extent, the answer depends on the institution, the school. In particular, what qualifies as an appropriate distribution of grades in a given course is mainly an institutional question. On the other hand, an institution with an interest in great teaching can serve that interest by delegating a measure of discretion in this matter to its academic departments and instructors.

In general, grading should always be just, and when possible, fair. Promises made must become promises kept, as with minimum cutoffs for final grades. A single rubric should govern the scoring of all students on a given assignment, so that better work—according to the factors being scored—earns a higher score. Injustice in grading provides a distraction from learning and a disincentive from hard work. Thus, scrupulous attention to even treatment in assessment serves the interests of pedagogy. Sometimes, the structure of a test invites an obvious rubric, but sometimes, a pre-conceived rubric would lead to an inappropriate distribution of scores. In the latter case, I grade for accuracy, without scoring, until—usually after about a dozen assignments—I get a sense of the range of student performances, which I then use to formulate a rubric. All students must be scored by the same rubric.

A well-constructed test should have questions which range widely in difficulty, in order to elicit such a range of performances that a reasonable rubric is able to yield an appropriate distribution of grades (although which distribution is appropriate is partly an institutional question). A well-written test should take almost all of the time provided, for many of the students, if possible; but more importantly, it should be short enough that any student who has been working hard and practices reasonable test-taking technique is able to work every problem on the test. On the other hand, grades ought to reflect content knowledge, as much as possible, rather than test-taking technique, and so easier questions should usually be placed earlier in the test. Finally, tests should purge extraneous complications and pitfalls (such as too many fractions on a College Algebra, or maybe even Calculus 1, exam). The point is to test students on their knowledge of the content of the current course, not a previous one.

Regarding course design, my main insight so far is to listen to the wisdom of others with greater experience. My personal tendency is to underestimate the time a given task requires, before the fact, although when the time comes, I tend to do well with taking my time, being careful, engaging with everyone around me to ensure we're all together. Recognizing this tendency allows me to compensate ahead of time, somewhat, for my unrealistically ambitious expectations, although often not quite enough. Still, I recognize this tendency too, and so on. The better way is to seek advice from a veteran teacher.

4. Active learning

The most difficult challenge I faced while teaching in Mississippi was how to get my students to take their own initiative in problem solving. It may have had something to do with No Child Left Behind, but even my very brightest students froze when presented with an open-ended problem. They wanted me to tell them how to start. "Just try something. Go for it and see what happens!" Progress was slow, but worth it. I left Mississippi feeling that, while I had become fairly adept at direct instruction, I knew far too little about leading inquiry-based learning. Coming to Iowa, I wanted to get better, and I resolved to keep my eyes open. I found inspiration in Engineering Math 2, a course in vector calculus pioneered by Dr. Keith Stroyan, built around an interactive textbook that Dr. Stroyan developed as a Mathematica document.

Each of the three times I have TA'ed this vector calculus course, I have led Mathematica "labs"—hour-long projects in which students answer a series of questions about vector calculus by writing their own

Mathematica code. Some of the labs involve specific questions with somewhat technical language; for these, my role was mainly to make sure students understood the instructions, and to walk around and, when needed, to help them with their coding syntax, and the underlying mathematics. Other labs were more open-ended, and my role was mainly to help with syntax and underlying concepts. These labs provided unique and valuable learning opportunities for my students. In the future, I hope for more opportunities to lead students in active learning.

5. Engagement beyond the classroom

While at Williams College, I learned, as all Ephs do, about then-future President James Garfield's vision of an ideal college classroom: a log in the woods, with Garfield at one end and a great professor, Mark Hopkins, at the other. Indeed, there is no better context for learning than direct personal interactions. The closest I have come to experiencing this ideal as an educator is during office hours and in the math tutorial lab.

The best advice I give my students is to please attend office hours. Office hours provide the best context for learning beyond the curriculum, for reviewing prerequisite material, for building confidence in one's knowledge of the subject-matter, and for building communication skills. As discussed in §2, office hours also provide invaluable feedback that I use as an instructor to adapt my plans for coming lessons. My best semesters of teaching tend to also be my semesters with the most highly attended office hours.

As a graduate student and TA in Iowa, I spend a few hours each week in the math tutorial lab. These hours serve as extra office hours for my students, but they also bring me together with students in a variety of other courses, from College Algebra through Linear Algebra. I value the one-on-one interactions this context affords, especially when I find students who seek not just answers, but understanding. More often, the students I encounter in the math lab seek just the answer, but are open to more substantive learning, as long as it doesn't take too long. In this context, I have worked to adapt my tutoring practices so that I remain efficiently helpful on content, while leaving the actual problem-solving for students to do.

Finally, I want to emphasize the value of research seminars, colloquia, conferences, and other venues in which teachers and students of mathematics communicate with one another, usually about their research. These venues serve the vital interests of the mathematical profession and of mathematical culture. They also provide a great opportunity for learning. Indeed, I have learned at the University of Iowa that the best way to learn new math is to give a talk.

6. Final thoughts

Students study math in college for a variety of reasons. Students in the sciences and social sciences apply the language of mathematics to describe the world around us. Students of engineering apply mathematics in order to build new gadgets and renew our infrastructure. Medical doctors apply mathematics to save lives. Indeed, math is eminently useful.

Yet, math is more than the language of applied science. It is the signature of humankind upon the world of ideas. It lives at the center of the story of civilization. Math is part of what it means to be human. Math is important for culture, for history, for democracy; for philosophy and theology and literature. Leonardo da Vinci earned a doctorate in mathematics. In an age of atrophy in civic discourse, an age of politics impervious to persuasion, I believe that a bit more math is exactly what our culture needs.