Teaching Statement

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The key to teaching mathematics is reaching out to students on a level where they are most receptive. Mathematical ideas were not conceived in a vacuum, and they should not be taught that way. I choose, as often as possible, illustrations and exercises that are related to natural and cultural objects. Such examples highlight both the diversity of sources for mathematical inspiration and the "unreasonable effectiveness of mathematics" (to use Wigner's phrase) in analyzing elements of these sources. In my calculus classes, for instance, I show scenes from the movie *Apollo 13* to demonstrate acceleration (the second derivative) during take-off and re-entry and to emphasize that concepts from calculus are tangible in our everyday lives. Exponential growth and Newton's Law of Cooling are brought to life by examining the process of making yogurt from live culture. The Fundamental Theorem of Calculus has interpretations in fields as diverse as music (fugues and canons), politics (descriptions of the economy in terms of "job growth"), and film (following a map in *Indiana Jones and the Last Crusade*). In more advanced classes, where one wants to emphasize the intrinsic aesthetic of mathematics, prints by Escher and sculptures of ruled surfaces are just two sources of beautiful geometric illustrations. For a differential geometry course, I chose the new textbook *Differential Geometry of Curves and Surfaces* (2010) by Banchoff and Lovett, in large part because all of the major concepts are paired with interactive online applications.

Of course, reaching out does not simply mean bringing multimedia into the classroom. Students must be involved in mathematical conversation. In introductory classes, I regularly devote time to student discussion so that they can develop their understanding through interesting or unusual applications; one resource for these discussions is the "Good Questions Project" carried out at Cornell. In my differential geometry class, the students wrote papers on topics related to the material, and at the end of the semester they presented these projects to each other using various kinds of multimedia. The quality of these projects was superb, and the range of topics was wide, including 3-dimensional hyperbolic geometry, Lie groups, connections on manifolds, general relativity, knot invariants in Chern–Simons theory, and computational geometry. In 2009–2010 I taught an honors calculus course that covered the fundamentals of a usual calculus sequence while also introducing elements of analysis; for this transitional class, I devoted nearly half of the instructional time to student practice on the board, so that I could guide the students as they wrestled with very new ways of dealing with mathematical ideas.

The means of communication have vastly expanded in recent years, and as instructors we should expect to adapt our teaching to the Information Age. To this end, I have incorporated Twitter and Tumblr into my calculus class, both during and outside of the scheduled class periods. The latter serves as a repository for videos and graphics that illuminate or recast material covered in class. The former enables conversations to occur among several students or even the whole class at once, without the restriction of space or my immediate presence. In class discussions, students can project their thoughts and questions to the front of the room so that everyone can respond. Indeed, several students for whom English is a second language have indicated that they find it easier to ask questions in class via Twitter than out loud. Using Twitter encourages concise but clear expression. Twitter also makes it possible to hold online office hours in the evening, when

students are likely to be in the midst of homework. In both situations, I have noticed in general that a different set of students speaks up digitally than verbally, and so I know I am reaching a larger portion of my class.

I am also committed to educational issues related to accessibility and empowerment. From fall 2000 through the summer of 2002, I taught secondary mathematics in Guinea, West Africa, as a Peace Corps Volunteer. During that time, I taught algebra and geometry to over 250 students. I started a math and science club, the *Club Scientifique de Kérouané*, which initially provided a venue for encountering non-traditional topics: we explored subjects like cryptography and fluid properties of the atmosphere. Through collaboration with other teachers at my school, the club became a permanent feature of the school and a means of supporting regular review sessions for students in science and mathematics. I learned about many of the real obstacles to universal primary education, and became more firmly convinced of its importance.

In the summer of 2008, I taught a pre-calculus course for Cornell's Pre-Freshman Summer Program (PSP), a six-week program designed to help talented students, primarily minorities, transition from high school to the university. This course covered all of the usual prerequisite topics for calculus as well as a brief introduction to tangents and derivatives in the special cases of circles and parabolas. My purpose was twofold: to prepare those students who wished to continue taking calculus and to provide a basis for informed scientific discussion among those who did not. Students' feedback during the course indicated that they found the material both challenging and beneficial. Several of them did continue into college-level calculus, even though the students in this particular class would not normally be expected to do so.

Effective teaching requires a balance of several skills: anticipating students' questions, responding to the questions that are actually asked, and challenging the students to ask new questions. In all of my teaching experiences, I have found that the keys to communication are accepting that different people understand the ideas in different ways and supporting them in their growth. As a result, both preparation and flexibility are necessary. By teaching, I experience again and again a renewal of my own interest and excitement about mathematics. My time spent teaching in Peace Corps led me to the decision to pursue graduate studies. Each class I teach provides an opportunity to reconsider ideas and examples that have inspired minds throughout the ages. The greatness of the classroom is that these experiences of "discovery" can be shared and enhanced by the joint efforts of teacher and students.