Teaching Statement

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Abstract

A central theme of my teaching is facilitating communication. While it is possible for a student to sit alone in a dorm room and learn calculus, for most undergraduates this is not the most effective way to learn. By facilitating communication, I mean, one, providing tools which foster interaction; two, designing exercises which force students to write and speak mathematics; and three, encouraging the formation of academic cohorts. I believe that giving students the tools to excel at reading, writing and speaking mathematics benefits not only students themselves, but society at large.

1 Three Examples

1.1 Weblogs in Mathematics Education

In Fall 2005, while teaching Introduction to Number Theory at the University of British Columbia, I was looking for ways to encourage my students to interact with each other. UBC is largely a commuter campus, and the average student in Intro to Number Theory has had only one prior proof-based course. This situation often leaves students struggling on their own with rather advanced material. To address this problem I set up a weblog[1]. Students can access the blog from any web browser, where they can post and respond to messages, ask questions and organize study groups. This blog not only fosters interaction among students, but also gives students the means to take an active role in their own learning.

I have continued using (and refining) this blog in subsequent courses. At the beginning of each course a certain amount of 'activation energy' is necessary to get the blog moving. Initially, it is I, as professor, who responds to most of the students' posts, but once the blog reaches 'critical mass' my interaction wanes significantly. By the end of the semester I am no more than a moderator. So far, the students have used the blog mostly to organize study groups (see Figure 1) — this is the mode of interaction most needed by students served by UBC. However, the potential of such blogs is greater than simply supporting students in organizing study groups. Different campuses have different issues, but weblogs' low overhead, ease of use, and flexibility makes them an easy and useful addition to most learning environments. I am committed to using and exploiting all such media in support of my courses.

1.2 Mathematics + Haikus = 'Mathkus'

Students often have difficulty expressing mathematical concepts in words. Transforming mathematical ideas from symbols into English helps distill the concepts being taught. Following the "Writing to Learn" model, I regularly assign essays to encourage students to see past the abstraction to the underlying concepts. (For instance, I have my Calculus II students write an essay on what the

[1]This blog (which I'm currently using for my Calculus I class) is located at http://drsinclair.blogspot.com/. Many schools have analogous (and more sophisticated) resources at their disposal (Blackboard, Moodle, WeBWork, etc.). Since I did not have access to these resources I opted to use a free internet service.

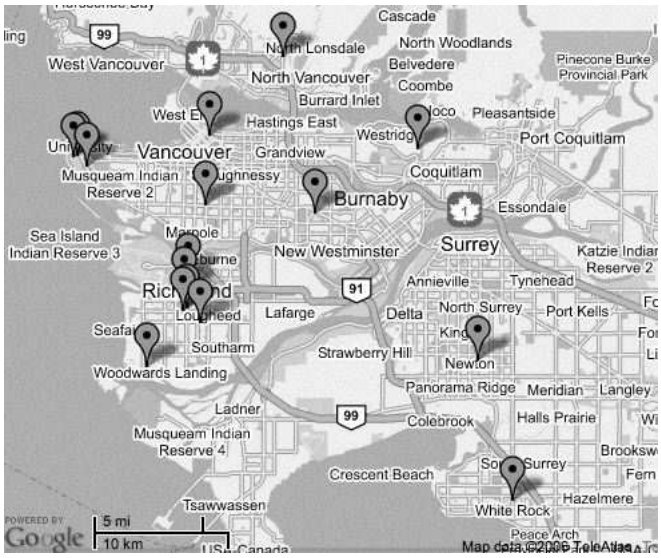

Figure 1: *Locations of student-initiated study groups for my Summer 2006 calculus class in the Vancouver metro area. All study groups were organized by students via the blog and were held in public locations — many on a recurring basis.* [n.b. *The leftmost cluster of markers is the University of British Columbia*]

Fundamental Theorem of Calculus *really* says, and why it is one of the most important scientific discoveries of the last millennium).

I also ask my calculus students to write 'mathkus.' A haiku is a Japanese poem consisting of three lines: the first and third lines must have five syllables and the second line must have seven syllables. Students get credit for writing a haiku about a mathematical concept on the syllabus — a 'mathku.' The theory is that students must know a concept fairly well in order to massage it into a highly structured poem. Here are some examples (provided by my students, of course):

What occurs near x	*The derivative*	*To change sign you must:*
Not what's happening at x	*Is slope of a tangent line*	*Pass on through the x-axis*
Will be your limit	*Limits always used*	*Or jump over it*

1.3 The Emerging Scholars Program and Beyond

While at the University of Texas at Austin I was fortunate to be chosen to be an instructor in Uri Treisman's Emerging Scholars Program (ESP). This program pairs a small group of students with an ESP instructor for six hours a week in addition to their usual three hours of calculus lecture. During the ESP workshops, the students work together on challenging problems designed by the ESP instructor. By working in groups for such long hours, the students develop academic peer groups which support them during the volatile transition to university life. Many of these peer groups persist beyond ESP — well-documented as leading to long-term success. For example, I was recently contacted by a former ESP student, Rodrigo Trevino, now a fourth year mathematics major, who is taking four graduate math classes this semester and preparing a publication based on work done in an REU.

Certainly, much of the success of the Emerging Scholars program can be attributed to the significant investment of instructor interaction at a critical time in students' academic careers. At a large university like the University of Texas, it is impossible to invest this much time in every incoming calculus student — ESP is extremely selective. However, although in smaller departments teaching resources might be a barrier to the adoption of this program, the **idea** of investing time

and resources at a critical period in a student's development is surely worth further exploration. For instance, I would be interested in applying some of Treisman's ideas to mathematics majors during their first year of proof-based classes. A simple implementation of such a program might be realized in a one hour workshop twice a week, run by older undergraduates (or graduate students, if available). Individual workshops might be dedicated to presentations of mathematical topics beyond the standard curriculum, or to peer help sessions. By organizing and attending these workshops, students would be driven to communicate their ideas with their peers and this communication would lead to their developing cohorts in the undergraduate mathematical community.

2 Practical Information

For the last five years (and a total of 7 courses) I have been the Instructor of Record for the classes I've taught: Precalculus, Emerging Scholars Workshops, Calculus and Introduction to Number Theory. Overall, I have taught a total of 12 courses at two different universities, the University of Texas at Austin and the University of British Columbia. For the most part, these classes have been at the level of calculus and below, though I have taught more advanced proof-based courses and would be comfortable teaching any material at the undergraduate level. To be sure, I am more familiar with some subjects than others, but I like learning new mathematics and I have found that teaching is consistently the best way for me to learn new material. At the graduate level I would be most comfortable teaching in the subjects of algebra, analysis, number theory and random matrix theory.

I have taught in both large classrooms with 100+ students, and in smaller classroom settings. For example, I once ran a discussion section with only seven students for a program aimed at retention of at-risk students (none on the students dropped out during the duration of the program!). While at the University of Texas, I led sessions in a number of specialized programs besides just the Emerging Scholars Program: minority retention programs, programs designed to develop study skills, and programs focused on fostering academic cohorts. In leading these programs I supported a level of student-instructor interaction not commonly seen at most large universities. As such, I see my teaching experiences as preparatory for teaching in both large universities and at smaller liberal arts universities.

The following table summarizes my overall instructor rating from 267 students collected over 11 semesters of teaching at both the University of Texas and the University of British Columbia:

very unsatisfactory	unsatisfactory	satisfactory	very good	excellent
.5%	.5%	8%	29%	62%

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