Henry Segerman

Teaching Statement

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I believe that mathematical knowledge is only really internalised when we do mathematics ourselves, and that much of pedagogy is essentially about getting students to the state at which they can do it themselves, and thereby teach themselves.

Although I am not currently teaching at the University of Melbourne, I have a continuing interest in pedagogy. I am currently working with the New Orleans Center for Creative Arts (NOCCA), a pre-professional arts training center for secondary school children, which offers intensive instruction in dance, media arts, music, theatre arts, visual arts and creative writing. Previous to 2011, NOCCA was a half-day arts school, but currently has the first class enrolled in a full-day program, involving academics as well as the arts. NOCCA did not have an existing program in mathematics, and we have the opportunity to consider how to best organise and teach such a program starting from scratch. I am writing their curriculum framework for mathematics, and am in close communication with the teachers implementing it. In addition I am available to the students and teachers as a consultant on connections between mathematics and the arts. The curriculum focuses on understanding of mathematical concepts through problem solving, viewing and motivating mathematics both through its applications to the arts and in mathematics as an art form itself.

When I arrived to start my post-doc at the University of Texas at Austin, I had been assigned to teach an introductory proof course in discrete mathematics. The first chapter of the standard text book was on basic logic, covered very drily, with little connection to any actually interesting mathematics. The book dealt with the material in the logical order, but I believe, not the best pedagogical order. Students approaching this for the first time can learn the formalisms, but don't connect them to their own reasoning since there is as yet nothing difficult to reason about. I went to talk to my teaching adviser, Dr. Michael Starbird, who is a leading practitioner of a style of teaching called 'Inquiry Based Learning' (IBL[1]). I adopted this style for my course: In class the students present their own proofs of theorems at the board. The job of the rest of the class is to try to understand the presentations, look for errors and suggest corrections or improvements. The students are teaching each other, and so my role is as a moderator more than a lecturer, making sure that we make productive use of time and helping students with notation and clarity. Ideally the students find proofs themselves, with only minimal input from me.

The IBL approach avoids the problem of starting out with logical formalisms: students already intuitively know how logical arguments work, and need direction in expressing their arguments clearly, rather than going over formalisms that seem irrelevant at the time. The right time to introduce (or better, have them rediscover) the logical underpinnings is when they already have their teeth into a difficult problem. Another advantage of the IBL style is that it brings understanding and doing of mathematics to the core of the course. All too often in a traditional course, the students are only *doing* mathematics when they work on homework, alone, and with little discussion or feedback.

The semester was challenging but broadly successful (both for me and for the students). One student in particular got a failing grade on the first midterm. He kept working hard, and in office hours at some point I told him that he could figure out the problem he was asking about on his own. Ten minutes later he came back having worked out the proof, and realised that he really could think and reason about mathematics on his own, perhaps for the first time in his mathematical career. The commitment to the student discovering the answer on his or her own was key to his experience and growing confidence, and he made a dramatic turn-around and achieved a solid B grade overall.

Discovering and doing are crucial to any mathematical learning experience, although at a certain level it is assumed that students will already know how to construct proofs and will want to see more material. For lower level classes without a proof component IBL would likely not be suitable. However, I think that there are aspects of the approach that can be more broadly applied at lower levels. In particular the emphasis on creative thought fits well with the pedagogy and culture at NOCCA.

[1]For more of my thoughts and experiences with IBL, see http://math.utexas.edu/users/henrys/IBL_experiences.pdf.

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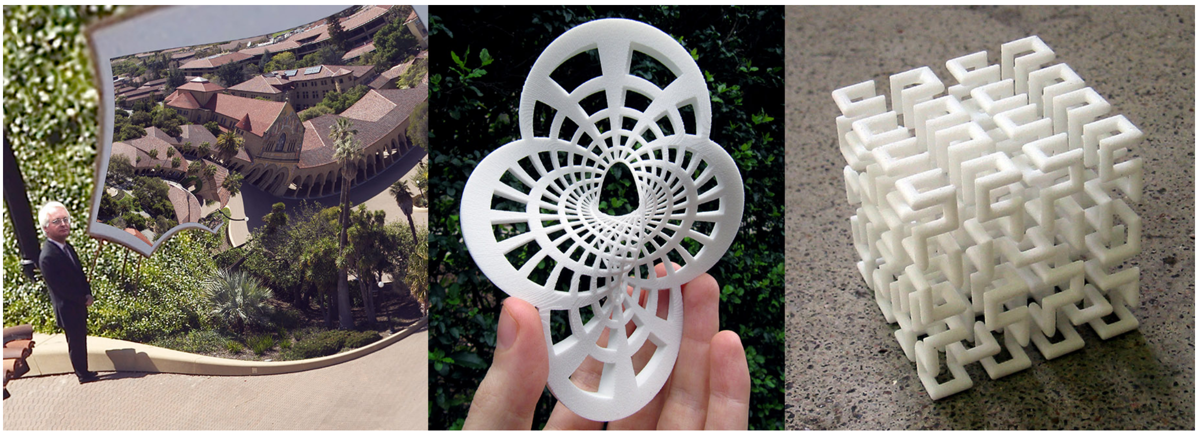
I am interested and involved in encouraging interest in mathematics outside of the classroom. I regularly attend the undergraduate-run Melbourne University Mathematics and Statistics Society talks and I was a regular attendee and occasional host of the University of Texas Undergraduate Math Club, for which I designed multiple club T-shirts. I find undergraduate mathematics clubs an excellent way to get to know students better, and in seeing how different speakers approach a subject or problem in an accessible way I can learn interesting new connections to pass on. I have talked at these mathematics clubs on the mathematics of juggling, as well as at many other venues including the UT Mathematics Department's Saturday Morning Math Group (for an audience of around two hundred high school students from the local area). Most recently, I gave a talk on knot theory to a group of students from Melbourne High School as part of a school visit to Melbourne University.

Over a month during the Summer of 2004 I was a full-time counsellor for the Stanford University Math Camp (SUMaC), an intensive course in higher mathematics for mathematically gifted high-school students from around the world. I was available at essentially all times to answer questions and discuss concepts, both from the classes and broader mathematical ideas. I was also a Teaching Assistant on combinatorial, differential and algebraic topology, so I would meet daily with the students, and acted as an advisor for projects they worked on over the course.

All of these extra-curricular activities are fun for everyone involved. They are important for young people to gain a "general knowledge" of mathematics, and for bringing them into the mathematical community in a way that classes alone may not.

I am a very visual thinker, and whenever possible I prefer to have a visual intuition for or explanation of some otherwise abstract fact. Visual explanations often have a greater 'sticking power', and an image can draw people into a lecture, paper, or mathematical idea. This relates closely to another interest of mine, mathematical art, in that it is often a way to interest the general public in mathematics and show them some of the internal beauty of mathematics, without necessarily requiring the formal mathematical background. I have designed posters for colloquia and covers for books. Paul-Olivier Dehaye (who was a colleague at Stanford) and I created a photographic version of M.C. Escher's "Print Gallery" image, based on the work of Professor Hendrik Lenstra in analysing Escher's work. More recently I have been exploring 3D printing as a way to produce mathematically accurate sculptures.

Even non-mathematicians have a natural appreciation of the beauty of mathematical patterns and objects when presented in a visual way, and this is an excellent way to get both students and the general public interested in mathematics. Once we have them interested, *doing* mathematics (and thereby gaining a deeper appreciation) is only a few steps away.



A photographic version of M.C.Escher's "Print Gallery", a symmetric embedding of a punctured Möbius strip and a step in the construction of a 3-dimensional Hilbert curve.