RUTGERS

Learning from proofs

A one-day conference on the teaching and learning of mathematical proof

10:00am	Opening - Coffee
10:15am	Matthew Inglis (Loughborough University) *The Personality of Mathematical Proofs*
11:05am	Short Break
11:10am	Tim Fukawa-Connelly (Drexel University) *Why lectures in advanced mathematics often fail*
12:00pm	Lunch
1:05pm	Adrian Simpson (Durham University) *The Anatomy of a Proof: or, how 3 marks on an exam can be dashed hard to come by!*
1:55pm	Short Break
2:00pm	Lara Alcock (Loughborough University) *Investigating and improving undergraduates' mathematical reading*
2:50pm	Coffee
3:05pm	Doron Zeilberger (Rutgers University) *Proofs are dead, long live algorithms*
3:55pm	Short Break
4:00pm	Hyman Bass (University of Michigan) *Proving: Good practices, disabilities, and therapies*
4:50pm	Closing - Coffee

Friday February 14, 2014. 10:00 a.m. - 5:00 p.m.
The Hill Center for the Mathematical Sciences
Rutgers – The State University of New Jersey

The Personality of Mathematical Proofs
Matthew Inglis (Loughborough University)

What do mathematicians mean when they use terms such as 'deep', 'elegant', and 'beautiful'? By applying methods developed by social psychologists, I suggest that mathematical proofs can meaningfully be said to have `personalities' that vary on four dimensions. I pay particular attention to mathematical beauty and show that, contrary to the classical view, beauty and simplicity are almost entirely unrelated in mathematics.

Why lectures in advanced mathematics often fail
Tim Fukawa-Connelly (Drexel University)

This case study investigates the effectiveness of a lecture in advanced mathematics. We video recorded a lecture delivered by an experienced professor. Using video recall, we then interviewed the professor to determine the content he intended to convey and we analyzed his lecture to see if and how this content was conveyed. We also interviewed six students to see what they understood from this lecture. The students did not comprehend much of the content that the professor intended to cover in his lecture. We propose three reasons for why students failed to grasp much of the content that the professor intended to convey.

The Anatomy of a Proof: or, how 3 marks on an exam can be dashed hard to come by!
Adrian Simpson (Durham University)

The talk will explore how proof is assessed in (UK) undergraduate degrees and look in detail at the analysis of one proof given as a model solution which may help understand how to analyze mathematical arguments more generally.

Investigating and improving undergraduates' mathematical reading
Lara Alcock (Loughborough University)

This talk will begin by presenting results from a study in which we used eye-movement data to compare the mathematical reading of undergraduate students with that of professional mathematicians; this study showed that mathematicians and students focus their attention on different aspects of mathematical text and process it in different orders. The talk will then report a sequence of three studies in which self-explanation training was adapted for mathematical reading. These studies show that self-explanation training improves the quality of students' explanations, changes their reading behaviors, and improves their comprehension of mathematical proofs.

Proofs are dead, long live algorithms

Doron Zeilberger (Rutgers University)

The notion of mathematical proofs, bequeathed to us by Euclid, did some good, of course, but it also did lots of harm, by turning away mathematically talented people from mathematics and science, because they felt oppressed by its pedantic rigidity.

At any rate, even if it was a good idea at one time, that time has passed! Very soon proofs will lose their dominion, and a more open-minded attitude to mathematics, inspired by our silicon brethren will take place, that would emphasize algorithms and experimentation rather than formal proofs.

And this is good news for educators. It is much more fun to teach, and learn, algorithm, rather than to teach and try to learn (most often unsuccessfully) this artificial and rigid art form called "(rigorous) mathematical proof".

So why not start right now, and teach algorithms (and concepts!) rather than proofs!

Hyman Bass (University of Michigan)

Proving: Good practices, disabilities, and therapies

Knowledge generation in many disciplines follows roughly the following kind of trajectory:

Exploration → discovery → conjecture → seeking/finding warrants → certification.

Of course this linear image is an oversimplification, and, in fact there is often a lot of feedback, and even fractal-like structure. And the details of this process are of course discipline-specific. What most distinguishes mathematics is the nature of its warrants: (deductive) proof. While mathematical proving is a powerful and complex practice it is neither intuitive nor natural – *it must be learned*. And proving, being a *complex practice* rather than a body of knowledge, must be learned developmentally, over time. Yet we often isolate the learning of proving to a ritualized version in a geometry course, or to a single 'bridge course" that serves as a kind of border crossing into a restricted land of mathematical doing and thinking.

I will discuss some proving related skills that I have observed, in teaching a proving-intensive course, to be particularly challenging, even for mathematically proficient students: making mathematical connections, reasoning from definitions, and "disarming" intuition. In each case, I shall describe some task designs intended to intervene on these challenges.