STUDC

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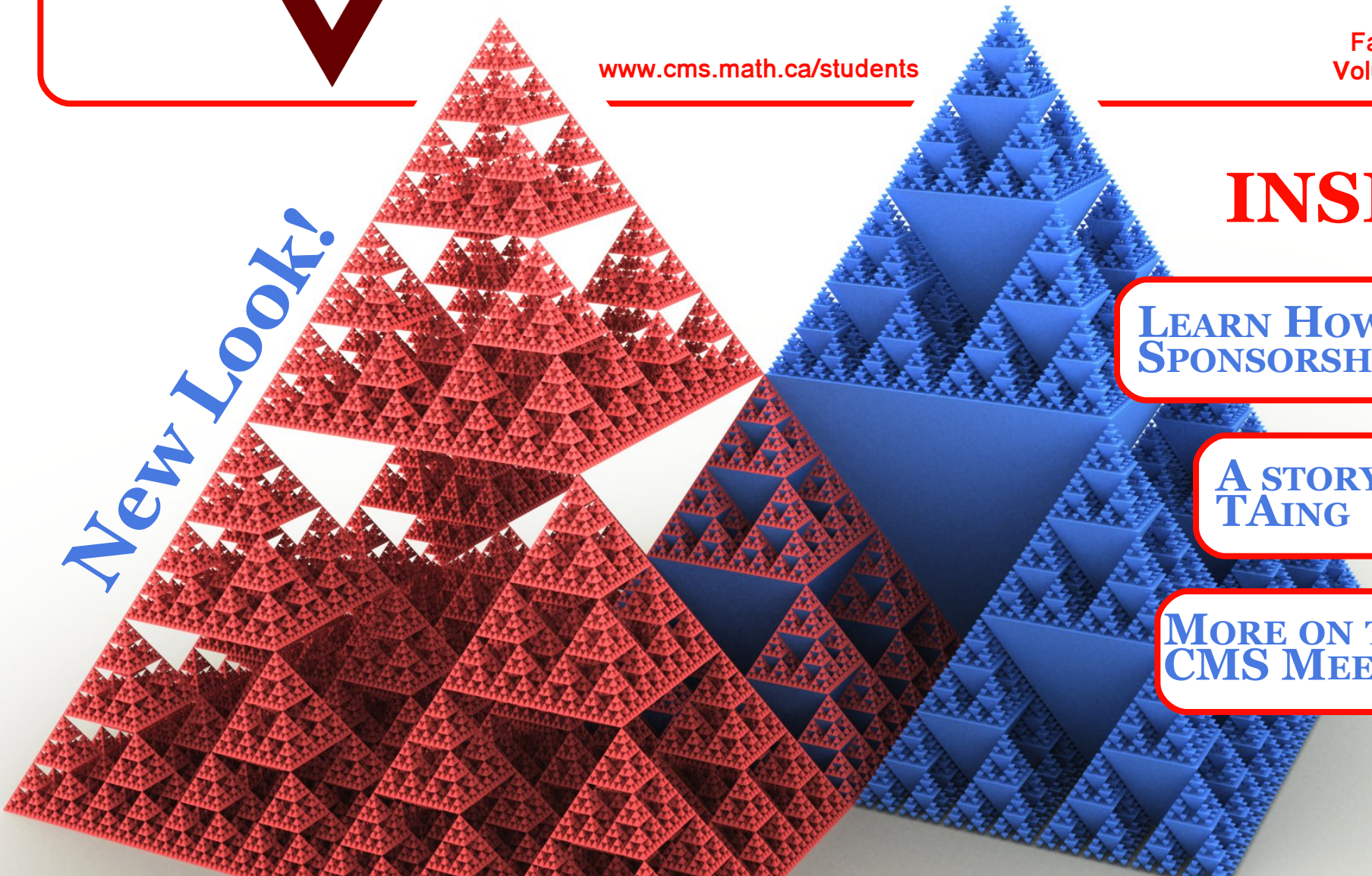

New Look!

INSIDE:

In this issue

Edited by Louis-Xavier Proulx

About Studc

We are a committee of the Canadian Mathematical Society (CMS), composed of undergraduate and graduate students from across Canada. Our goals are to address issues relevant to Canadian mathematics students. We organize social events, poster sessions and panels at the CMS meetings. We also support the Canadian Undergraduate Mathematics Conference (CUMC) and we also provide funding for your student events or local conferences. Keep in touch with our

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Contribute

Would you like to see your article features in the next issue of our newsletter? If so, send your submissions to **student-editor@cms.math.ca**

Deadline: December 1, 2010.
Next release date : January 15, 2011.

Symmetry in Action

Mark Penney
Memorial University

Since the age of Isaac Newton, mathematics and physics have enjoyed a period of mutual growth. We've seen mathematics applied to physical problems, new mathematics developed as a language to express new physical ideas, and even physical results that hint at possible mathematical truths. As an example of the first, we have the use of calculus in classical mechanics. For the second, the development of operator theory and functional analysis as the language of quantum mechanics. The third, the current interplay between string theory and algebraic geometry.

As exciting as these interrelationships are, the most awe-inspiring scenario is when a very general mathematical result radically changes the way we see the world and the way we do physics. Of these, my personal favourite is Noether's First Theorem. It states: "If a system has a continuous symmetry property, then there is a corresponding quantity whose value is conserved in time". On this simple statement hinges the whole machinery of 20th century physics. However, before explaining just how important the theorem is, let us take a moment to elucidate what it says.

On the mathematical side, the theorem is almost trivial; it can be proven in a few short lines. You start with a particular type of integral called an action. If the value of this action is invariant under small changes of its integrand, then a few lines of calculus of variations tells you that there is some quantity that is constant. More technically, if the action functional is invariant under the group action of a one-dimensional Lie group, then one can derive an associated continuity equation. The result is relevant to physics since it is often possible to write action functionals associated to your equations of motion. The first example of this was the Lagrangian formulation of classical mechanics, which replaces Newton's F=ma with an action principle.

With the Lagrangian formulation of classical mechanics the true depth of Noether's theorem becomes apparent. The actions for classical mechanics are invariant under coordinate and time translations and so Noether's theorem then implies that there are two associated conserved quantities. Astonishingly, these turn out to be linear momentum and energy! These may be the two most important conserved quantities in all of classical mechanics. However, conservation of energy was only an empirical law: there was never any mathematical basis for energy to be constant. Through Noether's theorem we see that the experimentally driven assumption of conserved energy is in fact implied by a more fundamental assumption about the structure of the universe, that being the homogeneity of time. Similarly, the conservation of linear momentum comes from the

isotropy of space!

More practically, the theorem is a workhorse for formulating new theories. If, through experimentation, one can deduce that there is some collection of quantities that are conserved, you immediately have restrictions on what the resulting action principle must be. This type of approach was used repeatedly throughout the development of the standard model of particle physics. Proposed action principles would have to output the correct conserved quantities as observed in particle collider experiments.
Through a simple mathematical theorem we've experienced a profound shift in our understanding. Noether showed us that fundamental properties of nature can be encoded in the mathematical symmetries of our models. This is the sort of result that when first encountered, one is "awed and overwhelmed by an almost painful beauty". ■

Using the History of Mathematics to Enrich Lessons

Natasha Richardson
Simon Fraser University

As a mathematics teacher, I am constantly looking for ways to connect my undergraduate coursework with the secondary school curriculum. One connection I have found is through the history of mathematics: including anecdotes from the history of mathematics in lessons is both enriching and engaging for students.

Historical anecdotes lend themselves to storytelling and provide a fresh change to the routine of the classroom. Moreover, they can even help students remember aspects of the lesson. For example, my memory of how to sum consecutive integers is tied to the story of six year old Gauss. His teacher had asked him to sum the integers from 1 to 100, expecting this task to occupy him for an afternoon. Instead Gauss computed the sum in minutes, deriving a formula for summing consecutive integers. To this day, I do not remember the formula, but the method by which Gauss first derived it.

In addition to engaging students through stories, historical anecdotes can help students to understand that mathematics is a changing process and that it has not always been as it is now. All the mathematical tools we are so used to, from notations to concepts, were created for a purpose and students find it surprising that there was a time when the equal sign "=" and "zero" simply did not exist.

As a teacher, I am frequently asked “When are we ever going to use this?” While historical anecdotes cannot answer this question, they can lead to a discussion of the very interesting question, “Why was this needed in the first place?” For example, my students were intrigued that logarithms were created to turn complicated multiplications into simple additions and this story provided a context for the unit.

The history of mathematics is a valuable enrichment tool that can and should go beyond small anecdotes; however, these short stories are a simple way that I can begin to enrich the curriculum and connect my current practice to my undergraduate coursework. ■

HAHA!

Kseniya Garaschuk
University of Victoria

There is a small town in Quebec on the Trans-Canada highway approximately 45 minutes from Riviere du Loup called St. Louis-du-Ha!-Ha! Look it up on Wikipedia and you will discover that back in the day "haha" was French for an unexpected obstacle or an abruptly ending path. Supposedly, early canoe explorers came about such an obstacle in the face of a lake 8 km east of the town that forced them to make an 80 km detour - hence the town's name. Now, the exclamation marks weren't always a part of the name, they were added later on, informally of course (a practical joke? a lost bet?). However, they have gained enough popularity to be adopted by the government and the newly embellished name now appears on everything from road signs to the Canada Post building. Not surprisingly, really, since clearly Haha has nothing on Ha!Ha!. That and another article on the subject got me thinking - why don't we use exclamation marks in mathematical research papers? I know a research paper is a serious piece of work and should not be taken lightly, but neither should a town's name. Considering the amount of time we spend proving our results, I feel that "...which concludes the proof of the theorem!" is much more suitable than "...which concludes the proof of the theorem". I'm excited about it, so why shouldn't I pass my excitement on to the reader? I cannot think of a better way to engage the audience in my research. We waste space and use hyperboles like "interesting", "intriguing", "elegant", "unexpected", etc., but all that we are trying to convey could be so much easier accomplished with just one exclamation mark! Everyone always complains how notoriously boring and tedious writing papers is; maybe that is because we make it so. Maybe, if we allowed ourselves a little bit of leeway, our target audience would not be just reading a paper, they would be also getting to know its author. Now, I realize that some of us might get carried away with it (let's not name names here - you know who you are), but we are mathematicians, so I'm sure we can find a suitable map between the number of exclamation marks and/or other unorthodox elements and the paper's traditional parameters, such as its length, research area, complexity and so on. Of course there will be debates about it, but for now I'm hoping to start a movement. I promise to use at least one exclamation mark in my thesis and I promise to get it past my committee. I hope you all join me to do the same. After all, shouldn't we be passionate enough about our research to want to evoke the same response in our committee?

Conference in review: CUMC 2010, Waterloo ON

Jerrod M. Smith
University of Regina

The 17th annual Canadian Undergraduate Mathematics Conference (CUMC) was held this year at the University of Waterloo from July 6th to 10th. I attended the conference for the first time this summer.

There were over 80 student lectures presented at CUMC from diverse areas of mathematics, statistics and computer science. I attended talks on several fascinating topics including elliptic curves, Hilbert C*-modules, and functional analysis. Other lectures covered the inner-workings of democracy and how to cut up a birthday cake and keep everyone happy! I also presented a talk concerning my summer research in Quantum Information theory, funded by NSERC.

Above and beyond some of the great mathematics at CUMC this year, the conference is a great opportunity to meet other young mathematicians, physicists, and statisticians. I met students from across Canada with similar interests and made many new friends from Ontario, Quebec and B. C.

My advice to any undergraduate student interested in mathematics is to attend the next CUMC to be held at Université Laval in Quebec City. I'm looking forward to next year's conference already! You can find out more at

cms.math.ca/Students/CUMC

The job is yours to win

David Thomson
Carleton University

Notes from the Panel Discussion on Hiring at the 2010 CMS Summer Meeting.

Four years of undergraduate, two years of masters and four years of doctorate education. Ten years of post-secondary education and we are finally presented with the question, "what now?".

There are so-called real jobs in mathematics; between telecommuni-cations firms, the financial district and the many government agencies there are job opportunities for Dr. So-and-so with a PhD in mathematics. There is one crucial type of employer missing from that list: academics. However, academics is often not placed in the category of "real jobs" because it is too near and dear to the collective hearts of mathematicians. If your passion for mathematics is in research or teaching, then academics can provide an optimal environment to pursue whichever avenue best suits you.

At the 2010 CMS summer meeting, the CMS Student committee invited Monica Nevins (Ottawa), Alyssa Sankey (UNB) and Terry Visentin (Winnepeg) to shed some light on the somewhat daunting proposition of applying for an academic position.

In the modern world of mathematics and the current economic climate, a new PhD should not expect to immediately slide into a tenure-track position. Almost invariably, new grads should have a post-doc fellowship for at least one or two years (and as many as five years) before expecting to find a position. A post-doc is the time to leave your host institution and focus on building your research program and publication list without the burdens of committee work. Painfully, in many cases, this involves separating your research program from that of your PhD supervisor.

As a prospective new hire you should have a solid research background including approximately six publications in high-level peer-reviewed journals, a strong PhD thesis and some teaching experience with good teaching evaluations. Even though your teaching experience will be limited, most institutions will require a teaching statement. "Teaching statements are so generic," the panel notes, "We're just looking for something to stand out."

The application should include reference letters from not only your PhD supervisor but also other colleagues who have knowledge of your research, teaching and departmental involvement.

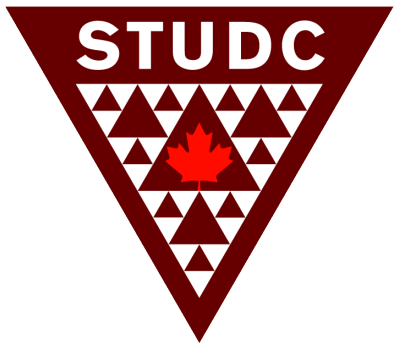
After identifying your top choices, securing amazing reference letters from your supervisors and any other colleagues you have made and applying to all the best institutions to progress your career, hopefully you will be contacted and brought in for an interview. Hiring committees are budget-constrained and they often can only bring in 3 to 5 candidates for a position, so once you are in for an interview, Terry Visentin

notes, "The job is yours to win".

An interview for a position will vary slightly between institutions but a typical interview will last for an entire day and consist of: a teaching talk, a research (colloquium) talk, a meeting with a hiring committee of approximately 5 people, a lunch or dinner with members of the hiring committee and the research group in your area, some additional meetings and informal talks with department members and colleagues and a one-on-one meeting with the Dean.
Like many long-time students, I am not a suit-and-tie guy, but bear in mind that, however prolonged, this is an interview and so standard interview etiquette applies: you should look clean and be respectful at all times. But you should also be yourself. Your talks will be evaluated on clarity and preparedness. Your research talk will be given to a general audience, and so it should appeal to a broad range of mathematicians but still show your capabilities as a researcher. It is important to understand that hiring is a two-way process, so feel free to ask questions of the hiring committee. I am always looking for a colleague. A real go-getter. I ask myself, "Is this person going to make a solid contribution to the department?". Monica Nevins advises, "Keep in mind: you are always being evaluated."

Identifying your top choices of institution is critical for your happiness and long-term success. An important question to ask yourself is, "Am I genuinely interested in going to this university?" You may send applications to every institution in North America; however, you need to convince not only the hiring committee but yourself as well that where you accept an offer is where you would like to be. If you cannot convince the committee, then you will not get the job. If you do not convince yourself, then this is often bad for your both your professional development and also bad for the hiring institution.

Finally, success! All of your hard work paid off and you receive an offer of employment from a new institution. Sign on the dotted line and you are the newest hire in mathematics. But wait a minute! After ten years of being a student, plus post-doc work and a long job search you are probably elated at receiving any offer of real salary. However, there are many factors which should enter into negotiations with the Dean: salary, teaching load, start-up grant and reimbursement of moving expenses are just a sample. Before negotiating, you should contact the union and any contacts you have made in the department and ask them what the normal terms of a contract are for that department. For example, you do not want to be stuck in a contract earning minimum salary and teaching five courses per year. Salary tiers are often displayed on the host university's web page and are an important tool in any negotiations. At any point, don't be discouraged. Let your research and experience speak for itself. Make sure you are well-prepared, and just **be yourself** in front of the hiring committee. It is a long road but the pay-off of being "Professor so-and-so" will be worth all the toil in the end. ■



Accromath: Une revue pour les accros

Louis-Xavier Proulx
Universite de Montreal

À quoi servent les maths? Voici **la** question qui m'est le plus souvent posée lorsque je mentionne que je fais des études universitaires en mathématiques. Cette question, je me la posais également lorsque j'étais au secondaire et malheureusement, certains enseignants, un peu maladroits, me disaient que l'utilité des mathématiques se restreignait à la comptabilité ou faisaient tout simplement fi de répondre. Pourtant, les mathématiques sont utilisés constamment dans de nombreux domaines et permettent de résoudre toute sortes de problèmes différents.

Heureusement depuis 2006, il existe maintenant une revue pour m'aider à répondre à cette fameuse question : Accromαth. Le projet Accromαth a été conçu dans le but d'intéresser et de vulgariser les sciences mathématiques aux élèves du secondaire et du cégep. Du même coup, il permet aux enseignants de parfaire leur culture mathématique et ainsi d'ajouter une nouvelle dynamique à leurs cours.

Chaque exemplaire est divisé en "dossiers" qui se consacrent à un thème lié aux mathématiques. Les dernières publications ont présenté différents pans de l'histoire des mathématiques et ont également traité des dernières percées et applications des maths dans des domaines tels que l'informatique, la biologie et les arts visuels. À chaque édition, une biographie d'un grand mathématicien est présentée en lien avec quelques-uns de ses résultats les plus importants.

En plus de contenir des articles de qualité, Accromαth a rafflé plusieurs prix depuis sa création. Elle a remporté une médaille de bronze en graphisme dans la prestigieuse compétition mondiale des Summit Creative Awards, un "Grand Award", la plus haute distinction dans sa catégorie dans le concours Apex Awards et finalement un Prix Spécial de la Ministre de l'Éducation, du Loisir, et du Sport du Québec pour sa contribution à la didactique des mathématiques.

Accromαth est publiée deux fois par année et la 9e édition devrait parraître très bientôt. Cette revue est produite par l'Institut des sciences mathématiques (ISM) et le Centre de recherches mathématiques (CRM). Vous pouvez vous y abonner gratuitement ou consulter les dernières parutions à l'adresse suivante :

www.accromath.ca

Student Event Sponsorship

Sarah Plosker
University of Guelph

The CMS Student Committee (StudC) sponsors several student events at the regional and local levels each year (with preference given to events at regional conferences). The idea is to encourage student participation and communication. Events that we sponsored this past year are:

The Prairie Network for Research in Mathematics Science (PNRMS) Meeting, University of Manitoba, April 30 – May 2, 2010. A student workshop, which introduced students to research in mathematical sciences, took place on the first day of the meeting. StudC sponsored the pizza lunch for the student day ($250).

The Fields-Carleton Finite Fields Workshop, University of Carleton, July 20-23, 2010. The workshop included talks and some mini-courses from leading figures in finite fields research at both the national and global level, as well as contributed talks by students. StudC sponsored the student social ($250).

Math and CS Problem Solving Seminar, University of Victoria, Sept. 2009 – April 2010. An informal, student organized seminar in the Computer Science and Math departments of UVic. StudC sponsored the seminar. The sponsorship funding went towards refreshments at the talks ($125).

If you are planning a math student event, please consider filling out our sponsorship application form at

cms.math.ca/Students/Involved/

Closing Time

Four Irish guys, two Greeks, one Belorussian, one Uruguayan, one Brazilian and a smattering of Iranians, Americans and Canadians, all mingling talking mathematics and life until the lights came on and it was time to go home.

This was the scene at the Discrete Mathematics Social held with the cooperation of the Fields-Carleton Finite Fields Workshop and the CMS Student Committee.

The night began with discussing the merits of drinking Guinness in Dublin with the director of the Claude Shannon Institute in Dublin, IR, moved to discussing the Hansen/Mullen conjectures with namesake Gary Mullen of Penn State and finished with a wager about Uruguay's chances in the 2014 World Cup.

Thanks to the CMS Student Committee for making it possible.

David Thomson
Carleton University

Mathematical Temperaments

Bradley Dart
Memorial University

In my experience, mathematicians display one of two "mathematical temperaments." Depending on which is favoured, they approach the activity of mathematics in one of two ways: as a problem solver or as a theoretician. Of course, these are not mutually exclusive positions, and both are involved in the practice of mathematics, but one of the two tends to be emphasized in each mathematician I have met. I must admit allegiance to the second category, although I do love attacking problems that allow for creative solutions and lead to new ideas.

Problem solvers take pleasure in figuring out answers to specific questions, and producing novel results. They tend to look at mathematics as a game or a puzzle, to be conquered and figured out. Theoreticians, on the other hand, are concerned with the understanding and development of the ideas in an area of study. Mathematicians with this attitude enjoy the abstract and general nature of mathematics, and like to explore mathematical concepts. The problems and ideas could be motivated by the natural sciences or other areas of mathematics, so this division is not essentially related to pure or applied mathematics. As well, both approaches are equally concerned with the views of mathematics as a science and as an art.

So, which method is more productive? Of course, this depends on what we see the goal of mathematics to be. If we see it as the deduction of results or the solving of numerical and logical puzzles, we should support the first. If we see it as the elucidation of abstract and general ideas having to do with number and relation, we should support the second. However, as is usually the case, the two approaches are complementary: profound ideas are created as a result of specific problems and questions are solved by the invention (or discovery) of profound new ideas.

I think that the first point of view is much more common amongst mathematicians today. This is perhaps a result of ultra-specialization in modern science and academia: mathematicians have to focus on the specific rather than the general. Although this is perhaps an unavoidable and natural result of mathematical progress, I feel that, if taken to the extreme, it will be to the detriment of the field of mathematics.

Without a framework and rich interconnections between different sub-specialties of mathematics, we get a disjoint and ugly system. In my estimation, the aesthetic appeal of a mathematical innovation is usually due to the synthesis of concepts involved and the exquisite interrelationships between seemingly disparate mathematical ideas. I think an analogous statement is true of scientific achievements. Just as we are searching a unified theory of the universe, we should continue to searching for a unified mathematics, continuing to study mathematics as a rich source of interesting and deeply related ideas. ■

What I needed then, what I need now

Tina Rapke
University of Calgary

A series of snap-shots as a post-secondary teaching assistant

When it all began (TAing as an Undergraduate student)

I remember many of my students being my age. This was a time of survival. Fortunately, the tutorials were small and there were very few classroom management issues. I knew the material, but not as well as I know it now. I could not teach it in my sleep. There was not much thought about my teaching practice and how students might learn or struggle. At that time, I wasn't able to see the big picture of mathematics and how the different topics would fit together. My suitcase only contained one or maybe two (if I was lucky) ways of explaining things.

What did I need then? Resources, practice time and confidence. I needed to do all the exercises in the text so that I was familiar with any question I might be asked. I needed the confidence to talk to people about their practice and how they dealt with struggling students. I thought that I needed to be perfect and my abilities would be questioned if I showed any sign of uncertainty. My practice was very private.

Continuing (TAing as a Master's Student)

This was truly a time of growth. My first teaching assignment was to be a sequence of large first year engineering tutorials. This was scary because I had very little experience with the management of large classrooms and the training which was offered was very minimal. Luckily, I talked to more experienced graduate students, who gave me tips on how I might more effectively run my tutorials.

My tutorials at this point were fairly traditional in nature. I would prepare questions that would prepare them for their quizzes and stand in front of the class and deliver. During the first tutorial, students were told that I was there to help them and that their success was important. I also explained that any student who spoke at the same time as I would be asked to leave. Humor and sarcasm were tools which proved to be effective in controlling the room.

What I needed then: colleagues and a non-judgmental environment where it was OK to admit fault ask any questions.

The later years (TAing as a Doctoral student)

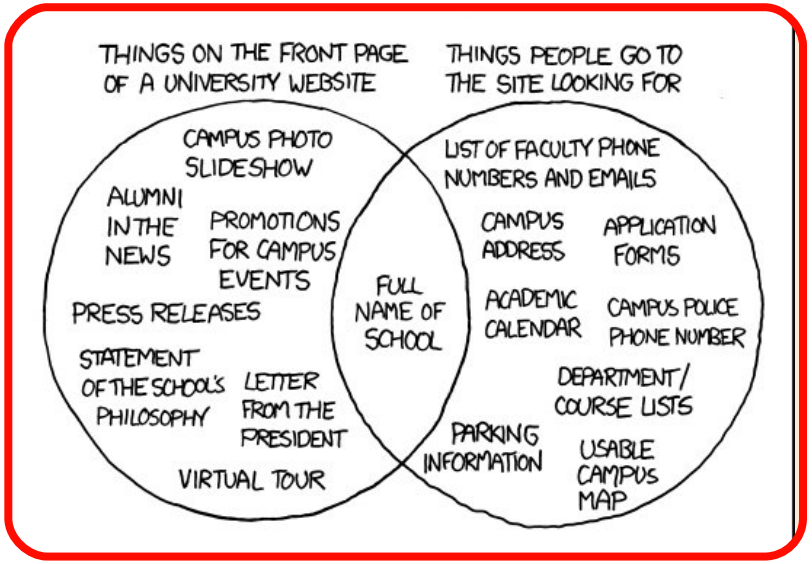
I had gained a true appreciation/fascination for teaching and learning mathematics. I started asking myself about what was really going on with the math concepts that I was teaching. I would start asking my students the same types of questions. My tutorials now became much more interactive. Mathematics was no longer a spectator sport. I would place questions on the board and give time for them to work them out for themselves. In the past few years, things started to

really change when I started to ask the question "What is really going on here?" not only pertaining to mathematical concepts but classroom dynamics. There was something special going on in my tutorials. There was a sense of community.

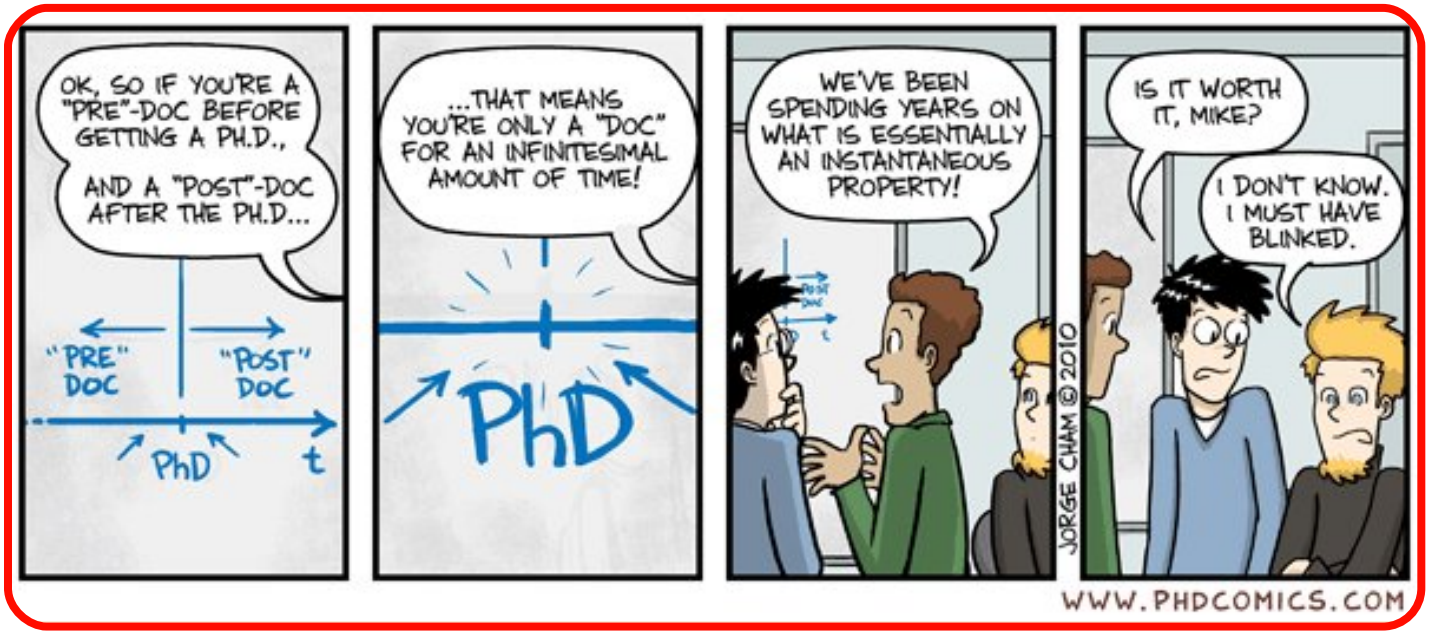
What do I need now? I need to be in contact with good math teachers. I need to be reminded that students are individuals that come to us with different histories that I need to support and respect. Looking back, I believe I've been a good TA because I really do care about my students' success and they know it. I strive to create a welcoming and supportive environment where students can grow as mathematicians. They have the confidence to offer solutions and strategies.

COMICS

University Website xkcd.com/773



"Piled Higher and Deeper" by Jorge Cham



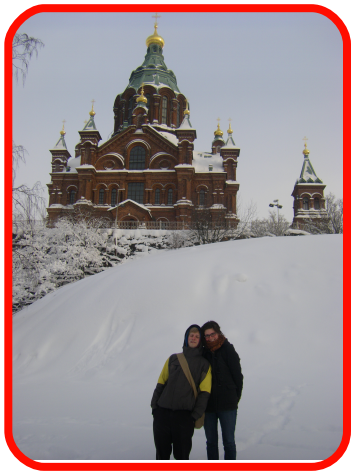
The Way Things Could Be

Jody Reimer
University of Manitoba

Having stayed close to home to attend university at the University of Manitoba, my view of pedagogical methods in the field of mathematics was unknowingly narrow. While on a recent exchange in Finland, however, I had the chance to meet many international students and to discuss, amongst other things, our academic backgrounds. There are a couple of differences I found fascinating while discussing with a friend, Jonas Rogger, who just completed his undergraduate degree at the Universität Bern, Switzerland. Apparently there is not only one way to study math, though some things stay the same no matter where you are!

The formats of the written exams differ from ours quite significantly, in that they are only one hour and not the typical two or three hours. They also may write several in a row, so, for example, you may have two hours to complete two separate exams, but you receive all the questions at the beginning. To me, personally, one hour seems quite brief, as there are many simple problems which could easily take longer than that to work through, but perhaps this forces the questions to be more concise in their testing.

Jonas frequently mentioned oral exams as a common method of testing. To me, this seemed bizarre for a subject such as math, which is notorious for requiring time to resolve. However, he said that oral exams take the focus off of long, complicated solutions with room for minute errors and instead test a solid understanding of concepts and definitions. An examiner generally begins with easier questions such as, "What is the definition of a continuous function? Can you give an example of a non-continuous function? What is the difference?" and then perhaps gets more difficult with something like, "In what theorems do you need the property of continuity and why?" This process is intended to force students to really think about the concepts and not just memorize the methods. I wonder though how much thinking I could do under the pressure of scrutinizing gazes from respected professors. Imagine the stress!



Regardless of pedagogical differences, though, when discussing the atmosphere in the math faculty at the University of Bern, we realized some things are universal. We both agreed that, in addition to there being a high degree of coffee consumption, there is intensive learning going on. It is a field that you have to love to stay in. Whether being tested through tiring four hour exams or perhaps equally grueling thirty minute oral ones, in Bern, as at any Canadian University, the people that complain are usually not in math very long!

Upcoming CMS Meeting

Sarah Plosker
University of Guelph

Present a poster at the AARMS-CMS Student Poster Session and compete for prizes! Go to cms.math.ca/Events/Winter10/Students for more info.

The 2010 CMS Winter Meeting will be held December 4 - 6, 2010 at the University of British Columbia. CMS meetings are not just for professors – there are lots of reasons you as a student should attend.

As a student, there are so many ways of participating at the meeting. You may wish to talk in the Contributed Papers session or at a topic-specific session. There will also be a Student Poster Session organized by the CMS Student Committee.

Additionally, there will be a Student Panel Discussion intended to answer a broad range of questions students might have on a particular topic. Past sessions include The Hiring Process (Summer 2010), Publishing Process (Winter 2009), and Scholarship: How to apply and win (Summer 2009). Finally, there will be a Student Social, which is intended to bring students together to have some fun. Typically we go as a group to a pub for free beer and pub grub, but at our last social we went 10 pin bowling! How can you say no to free food and entertainment?

The meeting allows students a chance to network with professors at universities other than their own. If you are an undergrad or master's student and wanting to meet a potential supervisor for your next degree, or if you are a PhD student looking for potential job opportunities, this is the perfect conference to attend.

Partial funding is available through CMS, check the meeting website at cms.math.ca/Events/winter10. Other funding sources include your university's graduate studies travel awards, your math department, your student union, and your advisor. You may have better chances at obtaining funding if you are presenting.

Although December sounds far away, it's fast approaching. Typically online registration closes one month prior to the event, and if you are thinking of going you should look for seat sales on airfare well in advance. So, start thinking about it now! ■