THE CANADIAN MATHEMATICS EDUCATION STUDY GROUP

33RD ANNUAL MEETING

JUNE 5-9, 2009

YORK UNIVERSITY

ANNOUNCEMENT AND REGISTRATION FORM

Welcome to York University, host of the 33rd Annual Meeting of the Canadian Mathematics Education Study Group (CMESG). The conference will open with registration at 15:00 on Friday, June 5, and close at 12:30 on Tuesday, June 9.

York University is located in the northwest corner of Toronto. It is bounded by Steeles Avenue to the north and Keele Street to the east.

CMESG activities will take place in the Technology Enhanced Learning (TEL) building located at the south end of campus, at 88 The Pond Road. You can visit www.yorku.ca for further details about the university and maps of the campus at http://www.yorku.ca/yorkweb/maps/keele.htm

HOW TO GET TO YORK UNIVERSITY

From Pearson International Airport:

- By taxi - approximate cost $35 – approximate time, 20 minutes.
- By public transit - The 58A Malton route provides all-day bus service between Lawrence West Station on the University subway line and Pearson Airport. Buses serve Terminal 3 (Arrivals Level), then Jetliner Road and Airport Road, then Terminal 1 (Ground Level). From Lawrence West station, take the subway north to Downsview station and the 196 York U Rocket to the campus. Cost - $2.75 adult cash fare. Approximate time – 1 hour.

From the east or west by car: Take Hwy 401 to Hwy 400. Take Hwy 400 one exit north to Finch Avenue. Take Finch avenue east to Sentinel Road. Turn left on Sentinel and travel 2 lights north to The Pond Road. Turn right. The TEL building is at the northeast corner of Pond and Atkinson. (See information on Parking.)

From the north by car:
Take Hwy 400 to Finch Avenue. Take Finch avenue east to Sentinel Road. Turn left on Sentinel and travel 2 lights north to The Pond Road. Turn right. The TEL building is at the northeast corner of Pond and Atkinson. (See information on Parking.)

By public transit:
Several buses and transit companies are routed through the campus or have express services to York. The center of the campus is a major hub for these buses. Here are a few common ones (for additional options visit the York University website at http://www.yorku.ca and click on: "GET TO YORK maps and directions").

Toronto Transit (TTC) routes to York include:

- Downsview Station (University line) & Sheppard Station (Yonge line):
  - 196 York University Rocket - Express from Downsview Station;
  - 196 B from Sheppard Station via Downsview station during peak times
  - 106 York University - from Downsview station at non-peak times
- Finch Station (Yonge line): Steeles 60C or 60F

GO Transit routes to York include:

- Hwy 407 Express GO Bus Service; Newmarket GO Bus Service; Meadowvale Express GO Bus Service; Bradford GO Train Service:
- A free York shuttle transports passengers to/from the York Common to the York University GO Train Station.

York Region Transit routes include:

- Jane-Concord - Route 20 provides direct connections from the campus to various sites including the Interchange Restaurants & Entertainment Complex, and the Courtyard by Marriott.
- The YRT Viva Orange Line connects areas North and West of the University, including the Interchange complex (and the Courtyard Toronto Vaughan) with York U and the Subway.

Buses drop passengers along the York U Common and on Ian Macdonald Blvd. From the bus stop, walk south to Fine Arts Rd., by walking either through the Fine Arts building or along the path to the south of the Fine Arts building. The TEL building is bounded by Fine Arts Rd. to the north, Atkinson Rd. to the west, and The Pond Road to the south.

PARKING
Parking on the university premises requires payment.
The closest available parking to TEL is in the Student Services Parking Building, located on James Gillies Street near The Pond Road and Keele. The Regular cost is $14 per day. Parking passes with in and out privileges are available at $46.50 (June 5-9) and $70.00 (June 4-10); to request a pass, please email Margaret Sinclair at: msinclair@edu.yorku.ca.

ACCOMMODATION
Unfortunately, due to the prolonged strike, students will not be out of the residences in time for the conference. Rooms have been reserved at the Courtyard Toronto Vaughan, a Marriott hotel located at Hwy 7 and Interchange Way.
We will be arranging for shuttle buses; in the morning buses will leave the hotel at 7:30, 8:00, and 8:30. In the evening there will be three shuttles; times will be arranged to coincide with the evening events. At other times people can use the York Region Route 20 bus, or the Viva Orange bus (approximate travel time 15 minutes), both of which stop close to the hotel, and within the campus (at Ian MacDonald Blvd.)

The hotel offers complimentary parking, free (wired) internet access in guestrooms and free wireless internet in the main lobby. There are a number of restaurants very close by (e.g., Dave and Buster's, Boston Pizza) and a café and lounge in the hotel. Please visit the hotel website at: http://www.marriott.com/hotels/travel/yyzvn-courtyard-toronto-vaughan/ for more information.

The special rate at the Courtyard Toronto Vaughan is $129 plus tax for a Standard Room (1 King Bed and 1 double sofa bed, or 2 Queen beds). Rooms will be on hold **until May 5th**. To get this rate you must identify yourself as a member of the Canadian Mathematics Education Study Group.

To book by phone : Call the hotel's 24 hour toll free number 1-866-239-3202 and ask for the group "Canadian Mathematics Education Study Group" or quote the group code "CME".
To book online: Go to www.courtyardvaughan.com, enter the group code CMECMEA for a standard room with 1 King Bed or CMECMEB for a standard room with 2 queen beds and continue with the reservation process.

HOW TO GET TO THE COURTYARD TORONTO VAUGHAN
From Pearson International Airport:

- By taxi - approximate cost $40 – approximate time, 25 minutes.
- By public transit –take the York Region Route 20 bus from the York University campus.

By car:
Please check the hotel website for directions.

MEALS
All lunches and dinners except dinner on Saturday evening, will be taken together as a group. Please note for breakfast on the weekend: Although there are many places on campus to get food, few are open early on Saturday and most are closed on Sunday. The Second Cup and the Great Canadian Bagel in York Lanes are open on weekends, but not until 9. An option for an early weekend breakfast near campus is the Tim Horton's on Keele, directly across from the main entrance to the university.

EXCURSION
On Saturday afternoon and evening participants will have free time to travel downtown (or perhaps uptown!) to sightsee/shop. Participants will be provided with conference TTC transit passes for the day and itinerary suggestions. Additional information will be posted on the wiki site: http://wiki.math.yorku.ca/index.php/CMESG_York Later that evening, weather permitting, participants will have the opportunity to visit the observatory at York. In June, viewing begins around 9:30.

IN CASE OF EMERGENCY
Faculty of Education – Winters College – (416) 736 5002
Faculty of Education – TEL – (416) 736 5608
Margaret Sinclair – (416) 736 2100, ext. 20344 – msinclair@edu.yorku.ca
Walter Whiteley – (416) 736 2100 ext. 22598 – whiteley@mathstat.yorku.ca
York Security – (416) 650 8000

PRE-CONFERENCE ACTIVITIES :
With support from the Fields Institute, there will be a pre-conference session on Friday June 5 in the Department of Mathematics and Statistics on "Bridging from Mathematics to Mathematics Education". The program will be designed for people from Mathematics Departments interested in more fully participating in the conference conversations with people in Mathematics Education. Participation in the preconference is free (funded by Fields). For more information see: http://wiki.math.yorku.ca/index.php/Math_to_Math_Ed

WELCOME AND REGISTRATION
Registration will take place in the lower level of the TEL (Technology Enhanced Learning) Building on June 5th from 15:00 to 17:30. A barbecue will be held nearby at Michelangelo's (in Atkinson College) starting at 17:30. The CMESG opening session will be held at 19:00 and the first plenary at 19:45 – location TBA. Participants will return to Michelangelo's at 20:45 for the opening reception.

ASSISTANCE TO GRADUATE STUDENTS
CMESG has limited funds available to support full time graduate students who wish to attend our annual meeting and who are not able to do so without additional financial support. For an application form please see our web site at http://cmesg.math.ca.

FOR NEWCOMERS
CMESG is not a typical academic conference, for it is not organized around presentations and audiences. Instead, it is a conference based on *conferring*.

Its main feature is the **working group**. Each working group will meet for three full mornings. You should select one of the four groups, based on the descriptions in this guide and the comments of the leaders on Friday evening. The task of the working group is to interact around a particular topic, with no prerequisite reading or experience and no post-conference obligations. Stay with the working group you select.

There are also two **plenary speakers**, who will each address the whole conference. However, unlike in other conferences, the audience will split into small discussion groups to develop questions for the speaker to address in a follow-up session.

Two other kinds of sessions provide more traditional forms of presentation: during the one-hour **topic session**, select one of two presenters, and during the two half-hour **new PhD sessions**, select one of the two or three presenters.

You will also note three half-hour **ad hoc sessions**: any conference member is welcome to sign up during the conference to lead an ad hoc session, and participants will select from as many options as are scheduled.

There is one last kind of session that many of us consider the most significant: **meals**! Sit with those you know, or sit with those you are getting to know – the meals are an integral part of the conferring that makes CMESG such a special conference.

PLENARY LECTURES

Lecture I Gerda de Vries
University of Alberta

Mathematical Biology: A Case Study in Interdisciplinarity

Mathematical biology is a rapidly growing interdisciplinary field of study, in which mathematical techniques are used to study biological processes. Applications are broad. For example, population biology informs resource management; mathematical epidemiology informs public health policy; mathematical physiology informs medical practice, and so on. Although mathematical biology has been recognized only recently as a field of study, it has a long and rich history. In this talk, I will highlight some particularly noteworthy historical contributions in mathematical biology, dating back to the late 1600s. In those days, scientists were not specialists; instead, scientists were broadly educated, and often worked at the interface of several disciplines. Such interdisciplinary work again is becoming highly valued. I will make connections to current research projects, in cell biology and physiology, focusing on the scientific relevance of these projects. Last but not least, I will describe efforts to bring modern, interdisciplinary applications of mathematics into the class room through the development of pedagogical materials inspired by mathematical biology that are suitable for use in high school.

Lecture II Marcelo Borba
São Paulo State University,
UNESP at Rio Claro, Brazil

Humans-with-media and the production of mathematical knowledge in online environments

In this talk I will discuss different models of online courses based on the notion that media are co-actors in the production of mathematical knowledge. In presenting the models, I will also discuss how different interfaces – chat, forum, videoconference – shape the way we come to know mathematics. I will show examples of online collaboration, inspired by a Freirean dialogical approach, in which inservice teachers construct different solutions to a problem posed to them by the university team proffering the online courses. This presentation will be based on a theoretical perspective that proposes an inter-shaping relationship between humans and technology, in the sense that technology shapes the way we know, and we also shape different technologies in different ways. Technology, including computer technology, should not be conceptualized in opposition to or entirely separate from human beings. Technology is impregnated by the humans who design it and shaped by those who use it. Human beings, in turn, are seen as historically conditioned, shaped by the technology available. The Internet has changed what it means to be human in a similar way that function software has changed how we perceive functions. The examples presented in this talk will illustrate how aspects of the notion of function can be constructed online by collectives of humans-with-media, using function software and a platform that allows for deep interaction in a videoconference interface.

WORKING GROUPS

Working Group A ***Mathematically gifted students***
Leaders: Ed Barbeau, Viktor Freiman, Margo Kondratieva

How do we recognize mathematically gifted students? What are their special needs and how should we meet them? These questions are not new to mathematics educators. But recent research and educational practice prove that they are still current, witness the last two ICME Congresses in 2004 and 2008 with topic study groups on programs and activities for gifted students. International conferences on mathematical creativity and education of gifted students were organized between the two congresses providing yet another opportunity to get deeper into several educational and research issues related to this topic. Finally, the recent ICMI Study 16 on Challenging Mathematics in and beyond the classroom looked closely at enriching the mathematical experience.

During our working group sessions, we will look in depth in these issues focusing on somewhat provocative questions: What are cultural, ideological and political issues that enhance (or inhibit) the identification and nurturing of mathematical giftedness? Who should attend gifted programs: students that look for enriched curriculum or students that are extraordinarily intelligent? How can we determine whether a child is gifted? Are past school grades enough? Do their written instruments help determine this? Is some kind of oral interview appropriate? When can we rely on recommendations from others?

One could take the attitude that most children have an innate intelligence and that the education system can draw on this more than it currently does. So, one might argue that separating out gifted students from non-gifted is divisive and that more challenging and enriched learning environments should be created for all students. Is it better to give students more advanced material or somehow to enrich and broaden material at their own grade level? In fact, is it necessary and desirable to cover a lot of material, or are there means of awakening and developing more creative aspects of mathematical attainment? What is the best material to use?

Another issue is that of cross-fertilization between gifted material and the standard curriculum. One the one hand, can the standard syllabus be modified in a way that makes it more attractive to gifted students while keeping it within the range of all students, perhaps by the use of optional topics and investigations? On the other hand, is it possible to use material for gifted students to a more common purpose? There are even IMO problems, which properly stepped down and presented, can be productively discussed with an ordinary class of secondary students.

Our sessions will address the issues on both the elementary and secondary levels. We are going to discuss some real mathematical issues, but in a way that is inclusive, i.e. people working at different levels have something to contribute. Of particular interest are topics that can be introduced at different grade levels and how they can be treated in the way that is appropriate.

Activities and programs for gifted students:	ICME-10 TSG-4: http://www.icme10.dk/ ICME-11 TSG-6: http://tsg.icme11.org/tsg/show/7
Challenging mathematics in and beyond the classroom:	Barbeau, E. & Taylor, P. (Eds.) (2009). *Challenging mathematics in and beyond the classroom: The 16th ICMI study*. New York: Springer. ICMI Study 16: http://www.amt.edu.au/icmis16.html
NCTM Task Force on Mathematically Promising Students:	http://www.nku.edu/~sheffield/taskforce.html

Working Group B ***Mathematics and the life sciences***
Leaders: Richard Barwell, Hongmei Zhu

Mathematics plays an increasingly important role in many areas of the life sciences – for analysis, for theorising, for representing information. It follows that life scientists benefit from training in mathematical thinking. But what mathematics should they learn? What should the nature of their mathematical education be? And how is education for the life sciences shaped by mathematics?

The aim of this working group is to explore the above questions and several related ones, through working on three specific examples of the use of mathematics in the life sciences. These examples consist of:

- Medical imaging: the construction and analysis of digital images of parts of the human body in order, for example, to identify diseased tissue.
- Epidemiology: the mapping, analysis and prediction of how disease spreads though a population.
- Biological oscillators: concepts, development and analysis of models, such as the beating of the heart, hormone oscillations, and population dynamics.

Part of each day's work will be devoted to looking at one of these examples, introduced by a practitioner of the relevant field. Our work on each example will include input on the general nature of the work, an introduction to a specific technique, and an opportunity to work on some mathematics related to the technique.

The rest of the time will be spent identifying and discussing various questions arising from the above examples. Such questions might include:

- Curriculum issues - how are mathematical applications reflected/ prepared for in the curriculum? Should they be?
- Teacher education issues - what should new teachers know about the use of mathematics in the life sciences? If anything?
- Undergraduate mathematics issues - how well do undergraduate programs connect with the kind of mathematics found in our examples?
- Mathematical thinking - how do these examples reflect/ not reflect current ideas in mathematics education about the nature of mathematical thinking and ways of developing mathematical thinking?
- Teaching and learning - How can teachers design activities to help students understand the value mathematics in the life sciences?
- Mathematics and society - how much do/could/should the general public understand about these kinds of mathematical applications. How can the general public become better informed?

Caron, F. & Muller, E. (2004). L'intégration de l'application et de la modélisation dans les mathématiques au secondaire et au collégial / Integrating applications and modelling in secondary and postsecondary mathematics. In Simmt, E. & Davis, B. (Eds.) *Proceedings of CMESG 2004*, pp. 63-80.

Funkhouser, C., Jafari, H. & Eubank, W. B. (2002). The mathematics of medical imaging in the classroom. *International Journal of Mathematics Education for Science and Technology* 33(4) 481-493.

Working Group C ***Contemporary and Emergent Research Methodologies in Mathematics Education***

Leaders: Lucie deBlois, Gladys Sterenberg

We claim it is not possible to do research in mathematic education isolated from contextual factors. As researchers encounter the complexity of current educational issues in mathematics, multifaceted methodologies emerge. These methodologies reflect the contextual nature of research in mathematics education, that is, they are intertwined with the social, political, and economic issues of the era. We can better understand research in mathematics education when we consider personal and professional issues, the expertise of participants, and the variety of research goals such as implications for classroom practice, the development of knowledge, and engagement in academic conversations. Thus, it is necessary to examine the relationships between research and design and between researchers' perspectives and how these influence their choices of research objects, theoretical frameworks, and methods.

For example, the works of Lieberman (1986), Lave (1991), Erickson (1991), and Bauersfeld (1994) contribute to the development of collaborative research, especially in the area of research with teachers (e.g. Bednarz et al. 2001; Bednarz, 2000; Desgagnés, 1997, 2007). This type of methodology employs specific definitions, questions, and methods with specific conditions, constraints, and contributions with limits. Through literature, mathematical tasks, and dialogue, we invite members of this working group to explore:

- What is the nature of inquiry in mathematics education? What is problematic?
- What theoretical assumptions influence contemporary research methodologies?
- What innovative methodologies are emerging in the literature?
- What kinds of research are possible when considering shifting roles of participants and teachers as co-researchers?
- What is the real work of the researcher? the ideal work? the possible work?

Bourassa, M., Bélair, L., & Chevalier, J. (2007). Les outils de la recherche participative *Éducation et francophonie*, 35(2). http://www.acelf.ca/c/revue/sommaire.php?id=22.

DeBlois, L. (2006). Influence des interprétations des productions des élèves sur les stratégies d'intervention en classe de mathématiques. *Educational Studies in Mathematics*, 62(3), 307-329.

Desgagné, S., & Bednarz, N. (2005). Médiation entre recherche et pratique en éducation: faire de la recherche « avec » plutôt que « sur » les praticiens. *Revue des sciences de l'éducation*, (31)2.

Desgagné, S. (2007). Le défi de coproduction de « savoir » en recherche collaborative, analyse d'une démarche de reconstruction et d'analyse de récits de pratique enseignante, dans M. Anadòn et L. Savoie-Zajc. (dir.) *La recherche participative. Multiples regards*. Québec : PUQ. p. 89-121.

Giddens A. (1987). La constitution de la société. Paris : Presses Universitaires de France.

Kilpatrick, J. (2006). A history of research in mathematics education. In D. A. Grouws' (Ed.), *Handbook of research in mathematics teaching and learning.* Reston, VA: National Council of Teachers of Mathematics.

Lave, J. (1991). Acquisition des savoirs et pratiques de groupe. *Sociologie et sociétés*, 23(1),145-162.

Schönefeld, A. H. (2007). Method. In F. K. Lester Jr. (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 69-107). Charlotte, NC: Information Age, for the National Council of Teachers of Mathematics.

Wenger, E. (1998). Communities of Practice: Learning as a social system. *Systems Thinker*. Retrieved January 28, 2009 from http://www.co-i-l.com/coil/knowledge-garden/cop/lss.shtml.

Working Group D ***Reframing learning (mathematics) as collective action***
Leaders: Caroline Lajoie, Lyndon Martin, Jo Towers

Many aspects of school mathematics and mathematics education research are rooted in assumptions about learning, practice, and knowledge that are proving to be troublesome. These assumptions include beliefs that learning and knowing are (only) individual or personal phenomena that are context-free, contained and innate, and fragmented (i.e., disciplinary/competence specific). A growing body of interdisciplinary research challenges such statements and instead compels us to reframe our accounts of learning in terms of collective, situated, adaptive and interconnected action. This working group will explore this area of emergent thought. On our journey, in an effort to understand collective phenomena and their implications for mathematics classrooms, we will explore contemporary research in mathematics education that offers promising theoretical framings (e.g., Davis & Simmt, 2003; Davis & Sumara, 2006; Martin & Towers, 2009; Martin, Towers, & Pirie, 2006; Stahl, 2006), study and analyse video excerpts of groups of learners engaging with mathematics, and engage in mathematical tasks that might prompt reconsideration of our own experiences of learning and doing mathematics.

Davis, B., & Simmt, E. (2003). Understanding learning systems: Mathematics education and complexity science. *Journal for Research in Mathematics Education*, 34, 137-167.
Davis, B., & Sumara, D. (2006). *Complexity and education: Inquiries into learning, teaching, and research*. Mahwah, NJ: Lawrence Erlbaum Associates.
Martin, L. C., & Towers, J. (2009). Improvisational coactions and the growth of collective mathematical understanding. *Research in Mathematics Education*, 11(1), 1-20.
Martin, L., Towers, J., & Pirie, S. (2006). Collective mathematical understanding as improvisation. *Mathematical Thinking and Learning*, 8(2), 149-183.
Stahl, G.(2006). *Group cognition*. Cambridge, MA: MIT Press

Working Group E ***Studying teaching in practice***
Leaders: Jamie Pyper, Hassane Squalli, Laurent Theis

The study of teacher practice is increasingly taken into account in research in mathematics education. There is increasing evidence of influences on teacher practice (such as context and situation, subject matter knowledge, beliefs, and pedagogical knowledge). From preservice, to inservice, to graduate studies, to research, the effect of teaching practice on learning is known to be essential, (such as the impact on teacher behavior, and possibly student achievement, although to date the direct relationship between teaching and learning has not been shown). The concept of teaching practice is central to research with an interest on the impact of teachers' work.

In this working group, we want to discuss various questions about the study of teacher practice around three dimensions; 1) the foundations of the notion of practice, 2) the reasons for studying teacher practice and 3) possible methodologies to do so.

1) The concept of teacher practice relies on the various perspectives, beliefs, and conceptualizations of "practice". What are the underlying (implicit) principles of the concept of practice? What are some of the different meanings the notion of practice can have in various epistemological perspectives? In what sense is teaching a practice? How is the concept of practice useful for mathematics education?
2) Why should the concept of practice be studied? What can we learn from the study of teacher practice? From the point of view of students' learning? From the point of view of

in-service teacher training? From the point of view of pre-service teacher training? From the point of view of research in mathematics education?

3) Using particular elementary school level and secondary school level examples of teacher practice to explore the methods of analysing mathematics teaching practice, what dimensions should be taken into account? How can we describe teaching practice? Is it possible to refer to teacher practice without referring to a particular teacher's practice? Is it possible to refer to teacher practice without taking into account the content that is taught?

Ball, D. L., & Hill, H. C. (2008). Introductory Overview: Teachers' mathematical knowledge and its relationship to practice. Presented at the *Annual meeting of the American Educational Research Association*, New York, NY.

Feimen-Nemser, S. (1990). Teacher preparation: Structural and conceptual alternatives. In W. R. Houston (Ed.), *Handbook of research on teacher preparation*, 150-170. New York: Macmillan.

Pratt, D. D. (1992). Conceptions of teaching. *Adult Education Quarterly*, 42, 203-220.

Robert A & Rogalski J. (2002). Le système complexe et cohérent des pratiques des enseignants de mathématiques : une double approche. *Revue canadienne de l'enseignement des sciences, des mathématiques et des technologies*, 2.4, 505-528.

Sierpinska, A. & Kilpatrick, J. (Eds.) (1998). *Mathematics education as a research domain: A search for identity*. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Vanderbrouck, V. (2008). *La classe de mathématiques: activités des élèves et pratiques des enseignants*. Paris : Éditions Octares.

Working Group F ***Mathematics as social (in)justice***
Leaders: Yves Saint-Pierre, David Wagner

Mathematics provides individuals and groups with powerful tools. As with any tool, mathematical tools can be used for positive or negative ends.

This working group will explore the (ab)use of mathematics in macrosociety. We focus on macrosociety because working groups at recent CMESG annual meetings have addressed social justice issues in more local settings. In 2005 Sandy Dawson and Arthur Powell led work on "Mathematics, Education, Society and Peace," starting with discussion on the connections between mathematics and ethics and then focusing discussion on the use of mathematics education to contribute towards peace. Then, in 2008 Frédéric Gourdeau, John Grant McLoughlin and David Henderson led a group's work on "Mathematics and Human Alienation."

Our discussion will draw on artifacts that relate to mathematics at play (or should we say "at work"?) outside academic settings. We will consider excerpts from published materials from news media and other publicly active groups (including political, justice-oriented and profit-driven groups), and materials and information released by Statistics Canada. These sources will be complemented by the working group participants' personal experiences of mathematics in society.

Relevant questions may include: How is mathematics used in society? How is it abused? On what bases might we judge the use of mathematics in society? How is mathematics reported or mediated in other ways? What are possible forms for this kind of mediation? How is the form of its mediation influential in public perceptions of mathematics and the agendas it services? How is the (ab)use of mathematics resisted or mitigated, and how might it be? Who has responsibility for addressing the abuse of mathematics and promoting its proper use? Why would these people (or groups) have the authority to address the use of mathematics in society, and how willing is the public to accept this authority?

Participants may want to bring newspaper clippings and other artifacts that relate to mathematics done outside of schools, and to look over the report from the related CMESG working group in 2005. (Proceedings of the related 2008 working group will be released at the 2009 meeting).

Dawson, A.J. and Powell, A. (2005). Mathematics, education, society and peace. In Liljedahl, P. (ed.). *Proceedings of the 2005 Annual Meeting of the Canadian Mathematics Education Study Group*, pp. 21-25. (available at http://publish.edu.uwo.ca/cmesg/pdf/CMESG2005.pdf)

TOPIC SESSIONS

Topic Session A ***The didactic dimension of advanced mathematical concepts: An example with series***

Leader: Alejandro González-Martín

This presentation introduces the three dimensions classically defined and analysed previous to the construction of a didactic engineering: epistemological, didactic, and cognitive. After a brief introduction and some examples with advanced mathematical concepts, we focus on the didactic dimension. We will reflect on some misconceptions and obstacles that traditional postsecondary teaching may produce.

The second part of the presentation shows our results of the analysis of the didactic dimension for the concept of series. We will give some results about the analyses of official syllabi, textbooks and teachers' practise, and will describe some of the limitations that traditional approaches may generate in students.

Topic Session B ***Study of the meaning given to the relationship of equality and the equal sign in the realization of activities on the concept of equality***

Leader: Adolphe Adihou

This presentation is part of a research study that explores the meaning given to the equal sign and the relationship of equality by middle school students. The research seeks understanding on how students use the concept in the numerical, algebraic and problem-solving activities in the middle school (grades 7-8). In other words, how do the students consider the concept of equality? What reasoning do they use in mathematical activities when using the concept of equality? Have the students' representations of this concept changed from elementary school to middle school? During this thematic session, we will identify the relations of reflexivity, symmetry and transitivity (equivalence relation) and the property of regularity of operations that are implicitly used in the various activities and taught in various contexts that refer to the concept of equality. Then we will present some analysis and research results on the meaning accorded to the equal sign, and the strategies and mathematical reasoning used by students in middle school activities relating to the concept of equality.

Topic Session C ***The emergence of disparities in mathematics classrooms***
Leader: Christine Knipping

Teachers and students in mathematics classrooms quickly come to know which students perform well in mathematics and which do not. In our research we investigate the emergence of these disparities from a theoretical perspective based on Basil Bernstein that examines their construction in the context of the social practices of the mathematics classroom rather than students' cognitive dispositions. In my presentation I will discuss classroom episodes that illustrate practices in which teachers provide access for the students to the organising principles of the discourse. These can become practices that are of advantage/ disadvantage for students.

Topic Session D ***Mapping multiple worlds: Imagining school mathematics beyond the grid***
Leader: Susan Gerofsky, Cynthia Nicol, with Zack Triesman

Drawing on our work on mapping and embodiment, indigenous epistemologies and culturally responsive mathematics education, this topic group will explore multiple ways of conceiving and mapping space. We will introduce ideas about smooth and striated space (from Deleuze and Guattari), acoustic-tactile and visual cultures (from McLuhan), and explore ideas about Riemannian "patchwork" spaces. We will explore the challenges of being in and moving among different representations of spaces, including the uniform metric of a grid and the heterogeneous networked spaces of manifolds. We will think together about the inherent violence of "laying a grid" over cultures that operate in a smooth, non-grid space (as most indigenous and even today's networked cultures do), and explore alternatives to a grid-based "monoculture" – for example, learning to live in multiples metaphoric spaces, using a variety of analogies to understand abstract and physical spaces.

NEW PHD SESSIONS

Shabnam Kavousian ***Enquiries into undergraduate students' understanding of combinatorial structures***

Students, especially in post-secondary education, have strongly formed preconceptions. These preconceptions are sometimes in agreement with those of the mathematics community's conceptions and sometimes they are in conflict. Students' preconceptions that are in conflict (misconceptions) with that of the general mathematical community (scientific conception), can create obstacles for their learning. As a part of my dissertation, I examined how students change their concept image, if and when they are faced with a problematic area in their concept image. In this talk I present a methodology that I developed, called mediated successive refinement, to help students reflect on and possibly change an inappropriate concept image. This methodology is based on learner-generated examples, however it takes a more interactive approach, and it encourages students not only to reflect on their own examples, but also to reflect and modify their peers'. Furthermore I identified the different scenarios that can happen when a student's concept image is changing. My study established mediated successive refinement as a methodological tool to provide valuable research data as well as a pedagogical tool to help students improve their concept image and understanding.

Julie Long ***Caring for students and caring for mathematical ideas in an elementary classroom***

By exploring the complexities of an ethic of care in one Grade 6 classroom, this case study, informed by narrative inquiry and phenomenology, re-examines and honours the emotional, intellectual, relational, and moral work that is inherent in teaching both students and mathematics. In this presentation, I will focus on three accounts from Karen Marks's classroom (indifference, mistakes, and conjecturing) that bring forth aspects of care within the teaching and learning of mathematics.

Ami Mamolo ***Glimpses of Infinity: Intuitions, Paradoxes, and Cognitive Leaps***

My dissertation examines university students' emergent conceptions of infinity, as manifested in their engagement with geometric tasks and two paradoxes – Hilbert's Grand Hotel and the Ping-Pong Ball Conundrum. In particular, my research focuses on identifying the cognitive leaps required to overcome epistemological obstacles related to actual infinity, and it offers a refined analysis of the tacit conceptions and philosophies which influence learners' emergent understanding. Further, my research sheds new light on specific features involved in accommodating the idea of actual infinity, such as appreciating 'infinite' as an answer to the question 'how many?' and understanding properties of transfinite arithmetic.

Izabella Oliveira ***Exploring practices in the teaching of proportionality at the middle school level in relation with mathematical activity induced by students solving problems with proportions***

This communication will report the main results of my PhD study. We were looking for a better understanding of the practice of teaching proportionality, while introducing this concept at the middle school levels – in particular, their relationship to students learning. To achieve this goal, we followed two classes in grade 8 (13-14 years old) and their teachers during a complete teaching sequence on the introduction of proportionality. We conducted systematic observations of classroom sessions. This observation was completed by interviews with both teachers, and a written questionnaire concerning solving of different types of proportional and non-proportional problems that were given to students at the beginning and at the end of the teaching sequence. An in-depth analysis of data from classroom observations and interviews revealed several characteristics of teaching practices about proportionality, shedding light on particular choices that make this practice coherent. The analysis of classroom sessions has also identified a variety of professional strategies and tasks used by teachers in order to organize effective action in the classroom. Finally, the characteristics that emerged from the analysis of these two different teaching practices of proportionality, in connection with the analysis of the written questionnaires, enlightened the teacher's role in the students' construction of mathematical knowledge.

Annie Savard ***Developing critical thinking about gambling by teaching probability in elementary school: toward a decision making***

This dissertation studies how learning about probability, which contributes to the development of critical thinking about gambling in children, can influence decision making toward eventual participation in these activities. It therefore focuses on mathematical mobilization of resources with a citizenship approach. Because teenage gambling is prevalent worldwide, it is important to provide them with tools for gambling prevention as early as elementary school. For this study, six learning situations were proposed in a fourth grade classroom. The researcher, who was also the teacher, proposed some extra activities in order to define gambling. Results suggested that mathematical, sociocultural, and personal contexts were the determinants of which perspective the students were situated in.

PLENARY CONVERSATION

A conversation with mathematician and activist Lee Lorch, Emeritus Professor York University

Professor Lee Lorch has over 65 years of experience as a research mathematician and an activist inside and outside the university systems in the US and Canada. For decades Lee has been an activist on issues of inclusion, and non-discrimination for women, visible minorities, and the obligations of professional societies to uphold the highest standards of civil rights and support for all their members. In recognition of his contributions, he is a life-time member of the Association of Women in Mathematics, the National Association of Mathematicians, the Royal Society of Canada, an MAA award for service to the community, The conversation will be moderated by Emeritus Professor Martin Muldoon (York University) who was a Ph.D. student of Lee.

See: http://en.wikipedia.org/wiki/Lee_Lorch