THE CANADIAN MATHEMATICS EDUCATION STUDY GROUP

35TH ANNUAL MEETING

JUNE 10-14, 2011

MEMORIAL UNIVERSITY, ST. JOHN'S CAMPUS

ANNOUNCEMENT AND PROGRAM

Welcome to Memorial University, host of the 35th Annual Meeting of the *Canadian Mathematics Education Study Group* (CMESG). The conference will open for registration between 14:00 and 17:00 Friday, June 10th, and will close at 12:30 on Tuesday June 14th. You may also register between 8:00 and 9:00 on Saturday June 11th.

Memorial University is located in St. John's, NL, considered to be the oldest city in North America. CMESG activities will take place in the Education building (ED), with the one exception of Friday evening, when events will take place at the *Inco Innovation Centre* (IIC). You can visit www.mun.ca for further details about the university; maps of the campus can be found at: www.mun.ca/campus_map/index.php.

THIS CONFERENCE SUPPORTED BY:

AARMS

FEES

The conference fee ($200, if registration is received by May 20th and full payment by May 29th, $225 thereafter) covers the cost of the reception on Friday, lunches on Saturday, Sunday and Monday, the Saturday excursion, the kitchen party Sunday evening, dinner on Monday, multiple coffee breaks, and assists in other conference costs.

The academic program fee is $95 for all participants except full time graduate students, for whom the fee is $45. This fee is waived for all *invited* presenters (plenaries, working groups, topic sessions, New PhDs), as well as for persons accompanying participants if they are not taking part in the academic program activities.

Please note: "ad hoc" and "Gallery Walk" presenters are required to pay the academic program fee.

REGISTRATION

This year for the first time, membership, conference registration and accompanying person's forms will be processed online (with exception of the payment method which remains the same). Links to the forms can be found on the CMESG website at: publish.edu.uwo.ca/cmesg/.

HOW TO GET TO THE ST. JOHN'S CAMPUS OF MEMORIAL UNIVERSITY

From St. John's International Airport (YYT) www.stjohnsairport.com/index/index.cfm to the Campus Residences

By taxi: approximate cost $18 – approximate time, 12 minutes.

By car from St. John's International Airport to Hatcher House, Paton College:

- Take the main road out of the airport and turn left (south) onto Portugal Cove Road. Continue for 2.9 km until you come to Prince Philip Drive.
- Turn Right onto Prince Philip Drive and continue for 2.1 km. Get into the left lane.
- Turn Left onto Livyers Loop. Hatcher House will be on the left.

Please note: rental cars in St. John's need to be reserved well in advance.

From the West

By car:

- Located at the most easterly edge of North America, St. John's, NL makes for a great road-trip destination but time will be needed for the journey. Most car travelers access the province by Marine Atlantic ferries, www.marine-atlantic.ca/ which operate between Nova Scotia and the island of Newfoundland. Take Hwy 1 Eastbound and keep going! Memorial University's St. John's campus is located mainly between Prince Philip Drive and Elizabeth Avenue. For tourist information please visit Newfoundland and Labrador Tourism: www.newfoundlandlabrador.com/.

PARKING

Lot 16A (see campus map) is going to be available to conference participants at no cost during the conference. If you wish to park at the residence there is a temporary permit you must purchase for $4/day at the conference reservations booth in Hatcher House.

ACCOMMODATIONS

Memorial University offers traditional dormitory style accommodations for visitors and conference groups. Paton College, a complex of nine residences constructed in the early 1960's, has single and twin rooms and a shared washrooms on each floor. There is only one residence equipped with an elevator. While the buildings are not modern they are presently undergoing major renovations. Guests are provided with towels, face cloth, soap and a drinking glass in their room on arrival.

Reserve your accommodations before **May 01, 2011**. Requests received after this date will be accepted on an availability basis. Accommodations are provided in university residences with traditional dormitory-style single or twin-bedded rooms.

To request a reservation, please fill out a "Request for Accommodations: Paton College Form" and fax/mail to:

Conference Services
Room 316C, Hatcher House
Memorial University of Newfoundland
St. John's, NL Canada A1B 3P7
Telephone #: 709-864-7657
Fax#: 709-864-6705
Email: conferences@mun.ca

Full payment must be received with application. A full refund will be given if cancellation is received within 7 days prior to arrival date. Within less than 7 days, one night's charges will be deducted from the refund. Visa and MasterCard accepted.

Please note: Credit Card charges will be processed approximately one month PRIOR to arrival.

Check in:

You can check in anytime after 15:00 at Hatcher House but there is flexibility around check-in times. Parking for guests staying in residence can be arranged at time of check in for a fee of $4.00 per day per vehicle.

MEALS

Participants will be able to purchase breakfast in the food court of the Student Centre. Lunches will be taken together as a group at the dining hall. Following the Friday evening keynote at the *Inco Innovation Centre* there will be a reception, which will include refreshments as well as food. On Saturday night, participants will be free to enjoy dinner on their own at one of St. John's excellent restaurants after a guided tour of the many tourist attractions in the St. John's vicinity. On Sunday, supper will be included as part of a group excursion to a local establishment for a traditional Newfoundland kitchen party. Supper on Monday will be taken together on campus at the dining hall. If you require special consideration regarding meals, please contact Margo Kondratieva at mkondra@mun.ca to make specific arrangements.

EXCURSIONS

St. John's offers an enticing combination of old world charm, unique architectural, historic and natural attractions, and is located in close proximity to spectacular coastlines, historic villages and a diverse selection of wildlife. On Saturday late afternoon there will be a guided bus tour of the many attractions located in and around the St. John's area. Buses will pick up everyone outside the residences. Time will be allotted to allow exploration of the many attractions. Participants will be given the option of staying downtown at the completion of the tour to visit any of the fine restaurants and pubs of the city. During their stay, participants are encouraged to enjoy the vibrant nightlife of St. John's, home of the street with the most bars/pubs per square foot of any city in North America. The city has an incredible music scene and there seems to be something for everyone. On Sunday evening, supper will be held at a downtown location where participants will be offered traditional Newfoundland food and entertainment in a kind of 'Newfoundland kitchen party.' Transportation will be provided from campus.

In Case of Emergency

For emergencies, contact Mary Stordy at 709 237-2309 or mstordy@mun.ca. You may also contact Margo Kondratieva at mkondra@mun.ca. MUN Security can be reached 24 hours a day at 709-865-8561.

Welcome And Registration

Registration will take place in the foyer of the *Inco Innovation Centre* (IIC) on June 10th between 14:00 and 17:00 and on June 11th between 8:00 and 9:00 in the Education building (Hickman). Please look for signage. The CMESG opening session will begin at 17:00 in the *Inco Innovation Centre* and will be followed by the opening keynote. There will be a reception immediately following the keynote where food and refreshments will be served.

CMESG 2011 At Memorial Conference Blog

As another way to share information on the conference and the conference location, you are welcome to visit the local organizer's **CMESG 2011 at Memorial Blog** located at cmesg.blogspot.com/, which will be updated regularly as the conference date approaches. Information on rental cars, local attractions, the presence or absence of icebergs, and any program changes will be the kind of information posted on this blog.

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 details and an application form please see our web site at publish.edu.uwo.ca/cmesg/.

Math Gallery

All CMESG members are invited to present their work at the ***CMESG Math Gallery***. Please indicate your intended participation on the registration form.

ABOUT THE CONFERENCE

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 to interact around a particular topic. There are two **plenary speaker sessions**, who will each address the whole conference. In contrast with other conferences where questions are often taken at the end of the presentation, a time slot is assigned for the audience, broken into small groups to discuss and prepare questions that will be presented to the speakers in a question period. Two other types of sessions provide more traditional forms of presentation: invited **topic sessions** and the **new PhD sessions**.

Over the course of a meeting (and from meeting to meeting) various discussions and ideas emerge among CMESG members. Our program is designed with time and space for members to come together to work on their emergent ideas. In order to facilitate **Ad Hoc discussions**, there will be a notice board available to request and announce the sessions. Local organizers will assign space for the sessions posted. The nature of the spaces available for ad hoc sessions will reflect the discussion format and the number of sessions proposed. Ad hoc proposers should not expect access to a classroom, computer, projector or power. Hence sessions proposed should be designed with this in mind. There is no reduction in conference fees for presenters in this category. Note— Any person(s) having work prepared in advance to share at the conference should register for the new **CMESG Gallery Walk**.

NEW — You are invited to contribute to our newest program feature, the **CMESG Gallery Walk**. The CMESG Gallery Walk is intended to provide a forum for members to contribute to our meeting and in doing so enhance our awareness of each other's work. We hope this session will increase opportunities for showcasing members' work and building networks among members. We encourage a range of contributions from research posters, to presentations on community initiatives, from mathematics problems, to mathematics art works, anything that can be shared in a gallery format (imagine a poster session or math fair). The session will be broken into two parts allowing every member to participate both as a presenter and as a "walker." One of: a poster board, a piece of the wall, or a table will be provided for each presenter. Presenters will have to supply their own materials and computers (note also, power may not be available). There is no reduction in conference fees for presenters in this category. For more information about this session please contact Elaine Simmt at esimmt@ualberta.ca Note – the CMESG Gallery Walk will not replace the Ad Hoc sessions but instead provide a space on the program for people who come with work prepared in advance to share thus reserving the Ad Hoc spaces for discussions.

Finally, there is a session that many of us highly value: **meals**! Sit with those you know, sit with those you are getting to know, sit with someone you don't know – the meals are an integral part of the conferring that makes CMESG such a special conference.

PLENARY LECTURES

Lecture I: Chris K. Palmer ***Pattern Composition: Beyond the Basics***

Shadowfolds

Often pattern making in the visual arts stop at a level similar to a simple melody in music. At its best it is played by an accomplished musician on a fine instrument, e.g. a skilled designer uses high quality materials and an appropriate style to express the design in that medium. Can patterns be composed that are equivalent in complexity and harmonic richness to a sonata or fugue? An answer to this question is proposed through the study of principles of recursion developed by medieval artisans of the Middle East. A variety approaches to explain and apply these principles including diagrams (without abstract symbols), acrylic tile sets, and paper, textile and wood models will demonstrate ways to move beyond the basics of pattern composition with an emphasis on paths to orderly complexity through small steps.

Lecture II: Pessia Tsamir and Dina Tirosh ***The Pair Dialogue Approach in Mathematics Teacher Education***

School of Education, Tel-Aviv University, Israel

In the last decade, we have developed the Pair-Dialogue (PD) approach and implemented it in various professional development programs in mathematics teacher education. The PD approach is a specific form of team-teaching in which we teach cooperatively. We use a blend of solo-pair-performances (thought-provoking dialogue-episodes), and interactions with the audience (segments of "inviting the audience", prospective and participating teachers, to express their views on different ideas that are presented and to "help us out" in resolving the dilemmas that we raise). The dialogues are semi-structured, allowing for both prepared in advance and in-action adaptations to different populations of teachers. The activities have several appearances: individual work (occasionally handed in to us); small group communications and whole class discussions. All in all, the PD approach is based on three major didactical components: (a) continuous, formative assessment of the participants' knowledge needed for teaching mathematics (b) teaching-learning interactions, addressing interesting issues known to be challenging, i.e., error or dilemma-eliciting, and (c) discussions of teachers' related, reflective practices.

The PD approach is implemented with prospective and practicing teachers from preschool to Grade 12. The durations of the professional developments projects have ranged from two months to three years, and they usually engage both the teachers and the children in their classes. During the sessions we carry out different modus operandi of the PD approach: Sometimes, both teacher educators offer correct (or erroneous or a mix of correct and erroneous) ideas. In other cases, one teacher educator acts as a "model learner", presenting students' dilemmas, and the other acts as the knowledgeable guide (the roles are altering occasionally, not to have a "clever, always-right" character and a "puzzled-erring" character. i.e., not to have irrelevant hints that may take away the mathematical essence of the situation). A main gain is that the teachers are confronted, in a gentle manner, with their incorrect responses, and the PD opening serves as a springboard to a thorough discussion of the common errors.

In the presentation we shall describe and demonstrate the implementation of the PD approach in various settings. We shall illustrate different facets of teachers' knowledge needed for teaching mathematics.

WORKING GROUPS

Working Group A ***Mathematics, Teaching and Climate Change***

Leaders: Richard Barwell, Stewart Craven, David Lidstone

Climate change is one of the most pressing issues facing the world today and will continue to be in the coming decades, although few people have more than a vague understanding of what it is, how it works and what might be done to reduce its effects. Mathematics is crucial for describing, understanding and predicting climate change, whether through observation and modelling of the climate system (including the atmosphere, oceans and ice fields), or through monitoring and modifying human behaviour (e.g., emissions, economics, population). The mathematics involved includes measurement, descriptive statistics, probability and mathematical modelling. The key role of mathematics in understanding and responding to climate change suggests a corresponding role for mathematics educators. What might this role be?

The aim of this working group is to explore this question and several related issues.

- Helping students make sense of climate change through a mathematical lens is important, not only to build their understanding of the issue, but also to move them, or at least some of them, toward actively responding to the problem. As mathematics educators or teachers, what kinds of things can we do to build students' understanding of climate change and encourage their active response?
- Public discourse about climate change requires a degree of mathematical literacy in the general public, sufficient to understand various techniques or principles (e.g., averages and modelling) and interpret various forms of information (e.g., tables of data, graphs and charts). What implications might this situation have for mathematics education?

During the working sessions, we plan to work on the following activities:

- Educating ourselves about the mathematics of climate change
- Exploring mathematics tasks, materials and resources that connect mathematics with climate change

Working Group B ***Meaningful Procedural Knowledge in Mathematics Learning***

Leaders: Wes Maciejewski, Joyce Mgombelo, Annie Savard

Mathematics learning is about both *knowing* and *doing*. As educators, we acknowledge the importance of understanding the fundamental concepts that underpin mathematics, yet the assessments of our students' understanding of mathematics are often procedure based. If being able to do mathematics follows strictly from an understanding of mathematics, then procedural tests would be an accurate assessment of a student's understanding. Of course, this is not the case. The relationship between procedural and conceptual knowledge is far more complex and dynamic – it might be possible that one can be obtained, to some degree, in isolation of the other. Recognizing the importance of both procedural and conceptual knowledge, how can each of these be best instilled in our students?

Much recent work in mathematics education has focused on the teaching and learning of concepts. Less emphasis is placed on procedures, since it is often assumed that procedural ability

will naturally arise and that procedural knowledge does not involve deep mathematical understanding, and is less interesting from a research perspective, as conceptual knowledge.

This working group will focus on procedural knowledge in mathematics learning. The participants will explore questions along the lines of

- What is procedural knowledge?
- How do procedural and conceptual knowledge relate? Are these types of knowledge distinct? In terms of learning, does one follow the other?
- How is procedural knowledge best learned?
- Is procedural knowledge rote? Can procedures be learned in a non-rote, meaningful way?
- Is there depth to procedural knowledge?

Participants are encouraged to bring resources and activities related to these questions or other issues that will be useful for the working group discussion.

Hiebert, J. (Ed.). (1986). Conceptual and Procedural Knowledge: The Case of Mathematics. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Mayer, R. (2002). Rote Versus Meaningful Learning. *Theory Into Practice, 41(4),* 226-232.

Skemp, R. R. (1976). Relational Understanding and Instrumental Understanding. *Mathematics Teaching, 77,* 20-26.

Star, J.R. (2005). Reconceptualizing Procedural Knowledge. *Journal for Research in Mathematics Education, 36*(5), 404-411.

Star, J.R. (2002). Re-conceptualizing Procedural Knowledge: The Emergence of "Intelligent" Performances Among Equation Solvers. In Mewborn, D., Sztajn, P., White, D., Wiegel, H., Bryant, R., & Nooney, K. (Eds.), *Proceedings of the twenty-fourth annual meeting of the North American chapter of the International Group for the Psychology of Mathematics Education* (pp. 999-1007). Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education.

Working Group C ***Emergent methods for mathematics education research: Using data to develop theory***

Leaders: Souleymane Barry, Olive Chapman, Janelle McFeetors

> *Qualitative researchers approach their studies with a certain paradigm or worldview, a basic set of beliefs or assumptions that guide their inquiries. These assumptions are related to the nature of reality (the ontology issue), the relationship of the researcher to that being researched (the epistemological issue), the role of values in a study (the axiological issue), and the process of research (the methodological issue). (Creswell, 1998, p.74)*

Although qualitative research is common in mathematics education, increased clarity and transparency of its methods is of ongoing concern and interest to mathematics education researchers in order to keep enriching their work and contributions to the field. Adding complexity to the conversation space is the growing focus on constructing theories from within the field of mathematics education (e.g., Kieren, 1997). In this WG, we invite participants to explore *emergent methods* – such as grounded theory (Morse et al., 2009), narrative inquiry (Clandinin, 2007), design experiment (Lesh & Doerr, 2003) – where we take a particular approach to thinking about data: letting the data speak. Representing the interpretive act of listening to research participants in each of these methodological approaches may result in developing theories which seek to make sense of researched phenomena and generate further inquiry. We will consider methodological issues related to: the above Creswell quote; what constitutes sufficient data; how data collection and analysis interact; data management challenges; research being both planned and emergent; strategies for data collection and analysis; and others of interest to WG participants.

Our discussions will draw on the experiences of the WG leaders and participants in order to explore methodological issues and struggle with the role of theorizing which begins with data. Several questions we are considering are: How is theorizing by mathematics educators strengthened by beginning with data? How do we engage in the task of moving from data to build theory? How might research participants' voices be amplified through the developing of theory? Our intent is to spend time working with sample data provided by the WG leaders. We also invite participants to bring samples of their own work to contribute to this process.

Clandinin, D. J. (Ed.). (2007). *Handbook of narrative inquiry: Mapping a methodology*. Thousand Oaks, CA: Sage Publications.

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, CA: Sage Publications.

Kieren, T. E. (1997). Theories for the classroom: Connections between research and practice. *For the Learning of Mathematics, 17*(2), 31-33.

Lesh, R., & Doerr, H. M. (Eds.). (2003). *Beyond constructivism: Models and modeling perspectives on mathematics problem solving, learning, and teaching*. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Morse, J. M., Stern, P. N., Corbin, J., Bowers, B., Charmaz, K. & Clarke, A. E. (2009). *Developing grounded theory: The second generation*. Walnut Creek, CA: Left Coast Press.

Working Group D ***Using simulation to develop students' mathematical competencies - post-secondary and teacher education -***

Leaders: Phillipe Etchecopar, Eric Müller, Jean-Phillipe Villeneuve

Simulation in mathematics education takes many forms, for example, manipulatives and games (both tactile and virtual), learning and exploratory objects, numerical/graphical and geometric interactive activities, interactive exercises, and student self-assessment. Simulation is often a central component of mathematical modelling. The Working Group will explore ways in which simulation can be used to develop students' mathematical competencies at the post secondary level. The choice of mathematics courses whether for majors, co-majors, service or for those in teacher education will be determined by the participants.

After working through a number of simulation experiments, participants will select issues to be studied. Some questions of interest to the co-leaders are

- What is the role of simulation in the development of mathematical competencies at the post secondary level?
- In pre-service and in-service courses, what simulation experiences and reflections are important for teachers of mathematics?
- What competencies are required to successfully transfer experiences acquired in a simulation environment into mathematical competencies?
- How is the role of simulation in mathematics education impacted by the technological culture of post-secondary students? What can be learned from the extensive library of simulations in other disciplines?
- When students develop and program their own simulation activities, what mathematical and other competencies are necessary for them to succeed?

Blomhøj, Morten, and Højgaard Jensen, Tomas, (2007). *What's all the fuss about competencies?*, in Modelling and Applications in Mathematics Education – The 14th ICMI Study, Blum et.al (eds.) Springer, ch. 2.2, 45-56.

Miller, Haynes, R., and Upton, Deborah, S., (2008). *Computer Manipulatives in an Ordinary Differential Equations Course: Development, Implementation, and Assessment*, J. of Science Education and Technology, 17(2), 124-137.

Rieber, Lloyd, P., Noah, David, (2008): *"Games, simulations, and visual metaphors in education: antagonism between enjoyment and learning"*, Educational Media International, 45(2), 77-92.

Working Group E ***Making Art, Doing Mathematics***

Leaders: Eva Knoll, Tara Taylor

The connection between art and mathematics has a long tradition. This dates back to the time when knowledge disciplines were not as clearly segregated (as for example the development of the laws of perspective during the Renaissance). In more recent times, the connection has been maintained both from the perspective of mathematicians who create aesthetically pleasing representations of their ideas, and artists making explicit use of mathematical concepts in their work. In this working group, we expect most participants to come with a primarily mathematics perspective and background. Thus we choose to take the antithetical position, and approach the connection from the point of view of artists. This connection can take a variety of forms. For example, and as members of the Concrete Movement believed, art should:

> *"emerge from its own means and rules, without having to call upon external natural phenomena… By the act of modeling, art works take on a concrete form, they are translated from their mental form into reality; they become objects, with a visual and spiritual use*[1]*" (Albrecht and Koella, 1982).*

In consequence, "released from its attachments to natural phenomena and bound to natural laws, this art gives the feeling and shaping mind, the creative imagination, the greatest possible freedom" (Rotzler, 1989, page 142). In the working group, we will explore and experience this freedom, focusing particularly on the ways in which mathematics can be integrated into the process of creating art. The three main (non-exclusive) ways are: the mathematics can simply be a tool for the creation of art, it can be the subject of the art piece, or it can be the source of inspiration. The focus of the working group is on mathematics as subject or inspiration for the creation of art.

Albrecht, H.J., Koella, R. (1982). *Hans Hinterreiter*. Buchs, Zürich: Waser.

Knoll, E. (1997). Transfert de 2-D en 3-D de l'Opus 84 de Hans Hinterreiter. Unpublished M.Sc. (Aménagement) Thesis, Université de Montréal.

Rotzler, W. (1989). *Constructive Concepts.* New York, NY: Rizzoli.

Working Group F ***Selecting Tasks for Future Teachers in Mathematics Education***

Leaders: Christian Bernèche, Ralph Mason, Marie-Pier Morin

Future elementary teachers often encounter significant conceptual difficulties in mathematics as they enter Teacher Training programmes (Morin, 2008). In order to help these students, one ponders what mathematics training should be provided to develop the knowledge required to effectively teach the subject. In this perspective, what knowledge should be emphasised for mathematics and for teaching? Which tasks should one select in order to better prepare future teachers of mathematics? Among these tasks one may consider *Problem Solving*, which readily brings students to employ concepts that they will later teach, Role Play, which fosters reflective analyses of mathematical concepts, and the teaching and learning of these concepts (Lajoie, 2010), or additionally *Task Analysis* of student samples, which enables future teachers to see a variety of approaches and assessments of difficulties related to the targeted concepts. How do we, as

[1] aus ihren eigenen Mitteln und Gesetzen entsteht, ohne diese aus äusseren Naturersheinungen ableiten oder entlehnen zu müssen.[...] Durch die Formung nehmen die entstehenden Werke konkrete Form an, sie warden aus ihrer rein geistigen Existenz in Tatsache umgesetzt, sie werden zu Gegenstände, zu optischen und geistigen Gebrauchsgegenstände. (Translation to English: Eva Knoll)

mathematics educators, develop our pre-service teachers' […] *understanding required to make explicit or reasonable the connections between students' current understandings (as exemplified with concrete experiences and examples) and the desired outcomes, such as generalization or a new method or procedure* (Kajander, 2010)? Using artefacts and concrete examples, participants in this Working Group are invited to discuss their practices and the different types of tasks they offer future primary teachers.

Kajander, A. (2010). Teachers Constructing Concepts of Mathematics for Teaching and Learning: "It's like the roots beneath the surface, not a bigger garden", *Canadian Journal of Science, Mathematics & Technology Education, 10*(2), 87-102

Kajander, A., et al. (2010). Multiple Visions of Teachers' Understandings of Mathematics, *For the Learning of Mathematics*, *30*(3), 50-56.

Lajoie, C. (2010). Les jeux de rôles : une place de choix dans la formation des maîtres du primaire de l'UQAM. *In* J. Proulx et L. Gattuso (dir.), *Formation des futurs enseignants de mathématiques : Quels modèles, quel équilibre? Discussions et débats entre la relève et l'expérience.* (p. 101-113). Sherbrooke : Éditions du CRP.

Morin, M.-P. (2008). Les connaissances mathématiques et didactiques chez les futurs maîtres du primaire : quatre études de cas. *Canadian Journal or Education, 31*(3), 537-566.

Ponte, J. P., & Chapman, O. (2006). Mathematics teachers' knowledge and practices. In A. Gutierrez & P. Boero (Eds.), *Handbook of research on the psychology of mathematics education: Past, present and future* (pp. 461-494). Roterdham: Sense.

TOPIC SESSIONS

Topic Session A ***Warm Hands Taking Cold Mathematics***

Leader: David Wagner

This reflection on the nature, use and representation of mathematics will be oriented by my desire to identify the most important imperatives for my interactions with mathematics teachers, given my values, which are fundamentally related to non-violent interaction. Thinking of mathematics as a tool, I consider its characteristic nature as static and cold. Questions I will try answering include: How does mathematics come to be taken as rigid? What human needs does this cold and hard tool address? Are there alternative conceptions of mathematics in which it is taken as warm and malleable? How are these different from thinking about a cold tool used by warm, human hands? How do our conceptions of mathematics shape our interaction with the people around us? What alternatives are available to mathematics teachers for representing mathematics? How might a mathematics educator address the needs and desires of mathematics teachers to open up a space for re-evaluating their practice?

Topic Session B ***How to prepare a public lecture? First questions, then execution???***

Leader: Yvan Saint-Aubin

Based on (good and bad) public lectures given by prominent mathematicians and my own experience, I will suggest a few questions that need to be answered before starting the actual process of preparing a public talk. Then I will go through the actual process of preparing for the event: writing the "script", thinking about and preparing the slides, adding visual content or animations, measuring length, planning rehearsal, gauging time of preparation, etc. If that sounds like Hollywood, well, this is what your public is used to!

NEW PHD SESSIONS

Jenny Sealy Badee ***Opportunities to Learn in and through Professional Development: An Analysis of Curriculum Materials***

Though professional development (PD) is seen as key to improving mathematics instruction, little is known in the research literature about what teachers learn in and through PD, nor about what those who conduct the PD might be learning as well. In my dissertation study I address this knowledge gap by analysing a selection of commonly-used PD curriculum materials to ascertain the opportunities they provide for middle school teachers to learn ideas central to improving their instructional practice. Additionally I examine the extent to which the curriculum materials are designed to also support the learning of professional developers. My presentation will highlight my findings on teachers' opportunities to learn specific mathematical content, and the educative features of PD curriculum materials that support the learning of professional developers. Theoretical and practical implications of the study will be discussed.

Lorraine Baron ***Developing and Assessing a Process that Addresses Professional Learning with Practicing Secondary Mathematics Teachers***

Research indicates that reform efforts in mathematics education have had little impact in the classroom. The purpose of this study was to develop a critical process that would be effective for secondary mathematics teachers' professional learning. This critical action research study was designed to assess a process that included three phases of empowerment. The rationale for this study emanates from the failure of technocratic approaches to teacher learning, from the lack of consistency between what teachers believe and what they practice, and from the paucity of studies that challenge teachers' pedagogic discourses through a critical approach to research and practice. It was the researcher's assumption that a research approach that valued practitioners' knowledge and increased their ability to know who they are as professionals would be of value to them.

The sample was composed of seven secondary mathematics teachers that formed a mathematics department in a small school. The primary data collection methods were transcripts from focus groups and journals. Supportive methods included survey data, the researcher's journal, and e-mail conversations. The data were coded and organized according to the research questions. Analysis and interpretation of findings were structured in five categories that addressed the research questions: (a) the benefits of examining beliefs about teaching, learning, and mathematics, (b) the benefits of examining barriers, power relations, and institutional assumptions implicit to teachers' practice, (c) the benefits of the active and collaborative processes of the study, (d) evidence of self-efficacy, and (e) the qualities of facilitating critical action research.

This research revealed that teachers benefited from certain learning processes as practiced by a facilitator who adopted a critical perspective that demonstrated particular attributes. The practices that had an impact included, among others, the exploration and justification of beliefs and practices, the challenging of assumptions by the facilitator, and the active participation of the teachers through collaboration and testing their hypotheses in the classroom.

Implications are offered for research and for practice in the form of a framework for supporting processes and perspectives for teacher development. It is designed with flexibility so that it could be applied in post-secondary or other settings.

Patricia Byers ***An Investigation of Trigonometric Representations as a Source of Student Difficulties***

This Ontario-based, qualitative study examined secondary school and college textbooks' treatment of trigonometric representations in order to identify potential sources of student difficulties in the transition from secondary school to college mathematics. Using a theoretical framework based on representation and views about networks, I constructed networks comprised of trigonometric representations. In this presentation, I describe the development of a general representation network generated using data collected from expert teachers who taught, and textbooks used, in Ontario's secondary school and college educational sectors. Using this representation network, I discuss how similar networks were developed from trigonometric representations found in randomly selected secondary school textbooks used in mathematics pathways leading to college technology studies, and in a college technology mathematics course. The presentation will then focus on the analysis of these networks, which identified numerous issues around the treatment of trigonometry in selected secondary and college textbooks that may contribute to a lack of coherence for the learner. These issues ranged from relationships between Euclidean and Cartesian representations to the treatment of inverse and reciprocal functions. In addition, a number of broader issues were identified; for example, the lack of support for prior learning, and the disparities in notation. It is hoped that the results of this study may inform discussions around the teaching and learning of trigonometry at the secondary and college educational levels to ultimately provide a more seamless transition for students.

Lionel LaCroix ***Learning Mathematics for the Workplace: An Activity Theory Study of Pipe Trades Training***

This study examines a pipe trades pre-apprentice's efforts as he works intensely, with the help of the researcher, to make sense of the fraction patterns on a measuring tape marked in inches. The multi-semiotic analysis of this encounter is framed using both cultural-historical activity theory as popularized by Engeström and Radford's theory of knowledge objectification (TO). From these complementary perspectives, mathematics is considered a culturally situated purposeful activity. Specifically, mathematics learning involves a social and semiotically mediated process of objectification, i.e. a process in which one becomes progressively aware and conversant, through one's own actions and interpretations, of the cultural logic of mathematical objects. This analysis informs the TO by showing, through fine-grained analysis, relevant aspects of its dynamics and by calling attention to a new form of iconicity and a process of semiotic extraction. It also shows various ways in which a learner's subjectification is evident in the process of learning mathematics. The results have a number of practical implications for the teaching of mathematics generally, and mathematics for the workplace in particular, by drawing attention to the social, cultural, historical, and mediated dimensions and dynamics of mathematics learning activity. The findings also illustrate the complexity of learning to measure by identifying a number of processes and conflicts involved and practical ways these are negotiated or resolved.

Lisa Lunney Borden ***Transforming Mathematics Education For Mi'kmaw Students Through* Mawikinutimatimk**

This research project explores how curricula and pedagogy can be transformed to support Mi'kmaw students as they negotiate their position between Aboriginal and school-based concepts

of mathematics. The work was conducted over a nine-month period in two Mi'kmaw schools that are part of a unique jurisdictional agreement with the Government of Canada giving Mi'kmaw communities control over their education system. . In after-school sessions with teachers, support staff, and elders, modeled after a traditional community practice known as *mawikinutimatimk* (coming together to learn together), participants identified four key areas of potential tension for Mi'kmaw students learning mathematics. These areas of tension provide insight into instances of conflicting worldviews, as well as possible pedagogical strategies to support Mi'kmaw learners in a context in which disengagement with mathematics and science is a concern for many teachers.

The first key idea identifies the need to learn from Mi'kmaw language. This involves both learning the language and learning about the way the language works. Most notably, a change in discourse patterns to reflect Mi'kmaw verb-based grammar structures, referred to as "verbification," is exemplified as a strategy that holds promise for supporting Mi'kmaw students learning mathematics. The importance of attending to value differences between Mi'kmaw concepts of mathematics and school-based mathematics is another key area addressed as is the importance of attending to ways of learning and knowing. The final area of tension highlights the significance of making ethnomathematical connections for students. Some challenges and successes are highlighted and pedagogical implications of each area of tension are shared.

Ruth Beatty

Pattern Rules, Patterns and Graphs: Analyzing Grade 6 Students' Learning of Linear Functions Through the Processes of Webbing, Situated Abstractions, and Convergent Conceptual Change

My thesis reports on the design, implementation, and analysis of an innovative instructional approach designed to develop Grade 6 students' understanding of linear relationships by integrating linear growing patterns and graphical representations of linear relationships. The lessons were also designed to introduce students to working with negative numbers by anchoring these within the quadrants of the Cartesian graphing space. Both of these content areas are typically not taught until middle or high school, but I was interested to investigate the kinds of algebraic reasoning that could be supported in younger students. The teaching sequence – seven lessons – was implemented in a classroom of ten Grade 6 students over the course of four months and constitutes the third year of my three-year research study.

During my presentation I will outline the learning sequence, and provide examples of the Grade 6 students' understandings of linear relationships (including the development of solutions for equations of the form ax+b=cx+d) and negative numbers. I will also discuss the two complementary analytical frameworks I used to simultaneously assess both individual student understanding and the collective understanding of the group, and the interactions between the two. One framework was based on Noss & Hoyles' notions of webbing and situated abstractions, which can be defined as the development of successive approximations of formal mathematical knowledge. The other framework came from Roschelle's work on collaborative conceptual change, which allowed for the examination and documentation of mathematical understanding at a whole-class level. Both frameworks emphasize the situated nature of learning, that is, the need to take into account actions and communications in relation to specific situations in order to understand the kind of learning taking place.