



## CANADIAN MATHEMATICS EDUCATION STUDY GROUP

37<sup>TH</sup> ANNUAL MEETING

MAY 24 TO MAY 28, 2013

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### ANNOUNCEMENT AND PROGRAM

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We're happy to welcome you to Brock University for the 37<sup>th</sup> Annual Meeting of CMESG, which opens at 16:45 on Friday May 24 and closes at 12:30 on Tuesday May 28.

**Brock University** is located in St. Catharines, one of the cities that makes up the Niagara Region in Southern Ontario. To locate the university and its various components, you can visit [www.brocku.ca](http://www.brocku.ca) and/or see the color-coded campus map attached at the end of this document.

#### WELCOME AND REGISTRATION

Registration on Friday starts at 14:30 across from room 202 in the Academic South building (#21 on the map – see last page of this document) until 18:45. BBQ Dinner (at 17:00) is at Alphonse's Trough (#13 on the map). The opening session (18:45) and the first plenary (19:30) will be in room 202 in the Academic South building. The reception (20:30) will take place in the Fireplace Lounge in Earp Residence (#11 on the map).

You will also be able to register from 8:00 to 9:00 on Saturday May 25 in the Walker Complex Atrium, which is located in the Academic South building (#21 on the map).

#### HOW TO GET THERE

**Driving. From the East or North:** Highway 401 West to Highway 427; Highway 427 to QEW West/Niagara; QEW West/Niagara to Highway 406 South; Highway 406 South to St. David's Road West; to Brock University. **From the South:** Highway 401 East to Highway 403 East; Highway 403 East to Lincoln Alexander Parkway East; to QEW Niagara; QEW Niagara to Highway 406 South; Highway 406 South to St. David's Road West; to Brock University.

**By train.** There are many connections to Union Station in Toronto. From Union Station, there is regular (about once every hour) Go Transit bus and/or train service to St. Catharines (takes about 2 hours). Check <http://www.go transit.com> for schedule (NiagaraFalls/Toronto line, number 12). From the railway station in St. Catharines, take a taxi to Brock (about 8 km).

**Flying. Pearson International Airport, Toronto:** Niagara Air Bus\*: shuttle to Brock, round trip, regular price \$121; conference price \$90.75; car chauffeur to Brock, each way, regular price \$193; conference price \$154.40

***Billy Bishop Airport, Toronto Island:*** Niagara Air Bus\*: car chauffeur to Brock, each way, regular price \$212; conference price \$ 169.60

***Hamilton Airport, Hamilton:*** Niagara Air Bus\*: car chauffeur to Brock, each way, regular price \$135; conference price \$108

***Buffalo Niagara International Airport, Buffalo New York USA:*** Niagara Air Bus\*: shuttle to Brock, round trip, regular price \$143; conference price \$107.25; car chauffeur to Brock, each way, regular price \$154; conference price \$124

**\*Niagara Air Bus:** Conference discount code is 038–go to [www.niagaraairbus.com](http://www.niagaraairbus.com). At the start of the booking page, you will need to insert this code where you see Conference/ Promo code - and your discount will automatically be calculated as long as the code is entered. We have obtained a shuttle rate discount of 25% for Toronto Pearson and Buffalo International. We have also obtained a 20% discount on all car chauffeur services for Hamilton, Billy Bishop Toronto Island, Toronto Pearson, Buffalo, and Niagara Falls New York International Airports. The discounts are valid from *May 18th through June 1st*. If you have questions regarding their bookings, call the reservations line at 905-374-8111, or email inquiries to [airsales@niagaraairbus.com](mailto:airsales@niagaraairbus.com).

## **PARKING**

Parking for persons staying in Earp Residence (#11 on the map) is adjacent to the residence building in "Residence Parking Lot M". Parking is included in the price of your room. When you arrive at Brock you can get to Lot M off of Glenridge Avenue.

Parking for persons staying in townhouse-style accommodation (#12 on the map) is available in Lot S, which is adjacent to the townhouse residences.

Parking is provided at no charge for guests staying at the hotel.

Persons travelling to Brock by car each day should park in "Visitors Parking Lot D." The flat fee is \$6.00 per day (including evenings and week-ends), payable on entry in cash.

## **ACCOMMODATION**

Brock University has standard student accommodation (single bedrooms) and townhouse-style accommodation (for up to 5 people) for visitors and participants of the conference. General information about the rooms is available at <http://www.brocku.ca/conference-services/groups/conferences/accommodations>.

### ***Standard Single Bedroom***

CMESG delegates will be staying in Earp Residence (#11 on the map), which has standard single bedrooms. An elevator is located in the residence lobby for convenient access to all floors. Regular rooms are available for \$61.65 per night (plus HST). This includes a buffet breakfast that will be served in the Decew Residence Dining Hall (located in building #9 on the map),

close to Earp Residence. Each room shares a full bathroom with one other room. Upon booking, you may indicate the name of another delegate with whom you agreed to share the bathroom.

### ***Townhouse-Style Accommodation***

Village Townhomes (#12 on the map) are located near the Walker Complex (Athletic Facility). These units have four bedrooms, one of which contains two single beds. Each unit has one four-piece washroom and one two-piece washroom. There is also a kitchen/dining/living room area. The kitchen has a refrigerator and stove, but is not equipped with cooking utensils. These units are available for \$174.00 per night (plus HST). This does *not* include a breakfast. A buffet breakfast served in the Decew Residence Dining Hall (located in building #9 on the map) could be purchased at \$10.15 per person (plus HST). Please see the website for recommendations of things to bring: <http://www.brocku.ca/conference-services/groups/conferences/accommodations>. If you decide to book this accommodation with other delegates and wish to share the costs, please contact Chantal Buteau ([cbuteau@brocku.ca](mailto:cbuteau@brocku.ca)) to indicate to her the name of all delegates in the townhouse and your cost sharing agreement.

### ***Booking your Brock Accommodation (Standard Single Bedrooms or Townhouse Accommodation)***

The deadline to reserve a residence accommodation at the special rates listed above is ***April 30***. Reservations are to be completed along with your CMESG conference registration. Your room is also available at the conference rate if you want to arrive before the conference or stay afterwards. Indicate the details of your stay on the conference registration form.

After April 30, the rates increase to \$65.65 (for a standard single bedroom) and \$179.00 (for townhouse accommodation), and accommodation booking needs to be done directly through Brock Conference Services (905-688-5550 x4443).

### **CHECK-IN (RESIDENCES)**

You must check-in at the Conference Services front desk on the ground floor of Vallee Residence (#10 on campus map — immediately to the west of Earp Residence). The check-in desk is open 24 hours a day. Check-in on arrival is at 15:00. Check-out is at 11:00.

### **HOTEL**

We have booked a block of rooms at the Four Points by Sheraton Hotel, which is only a 15-minute walk from our conference venue on campus. The cost is \$139 per night (plus taxes) for a standard suite with two double beds and single or double occupancy. Additional adult guests are \$10/night. You can make reservations by calling 1-877-848-3782 before *April 22*. To receive the preferred rate, you must reserve a minimum of two nights and identify yourself as a CMESG/GCEDM conference delegate. If you wish to have free internet access in your room, make sure you request this when you register as well.

## MEALS

All lunches and dinners will be taken together as a group, mostly on campus. Dinners on Saturday (on your own) and Monday (at the Welland Canal) will allow us to enjoy some of the sights that the Niagara region can offer.

## EXCURSIONS

St. Catharines is a beautiful city known for its friendliness, charm, and pride; characteristics that come from its identity as The Garden City. Located within the Niagara Region, St. Catharines is close to many beautiful and historical sites including Niagara Falls, the Niagara Wine Country, the Welland Canal, and two major forts from the War of 1812. The excursion on Monday May 27 will offer the opportunity to visit Niagara Falls, Niagara-on-the-Lake, or the hiking trails of the Niagara Region. In addition, participants will have the opportunity to explore St. Catharines and the surrounding Niagara Region at their own convenience on the evening of Saturday May 25. For more information, please visit <http://www.tourismstcatharines.ca> or <http://www.niagarafallstourism.com>.

## EMERGENCY

In any case of emergency throughout the meeting, you can contact Joyce Mgombelo (289-686-3221) or Chantal Buteau (905-964-5707). The university also has a security service available at all times at 905-688-5550 x3200. During regular working hours, you may also contact The Department of Mathematics ((905) 688-5550 x3300) and/or the Faculty of Education ((905) 688-5550 x5087).

## PRE-CONFERENCE ACTIVITIES

We will be hosting on Friday May 24 from 9:30am to 4:30pm a pre-conference, entitled *Mathematics Education Research and Mathematics Teaching: Illusions, Reality, and Opportunities*. It will feature a keynote address by John Mason, a presentation focused on teacher education, and a discussion panel with four panelists addressing the topic at the four education levels, i.e., the elementary, secondary, college, and university levels. The registration fee is \$20, which includes lunch and coffee break. Advance registration is required. A detailed program will be sent through the CMESG mailing list at the end of the month. For any question or registration for the event, please contact Joyce Mgombelo at [Joyce.Mgombelo@brocku.ca](mailto:Joyce.Mgombelo@brocku.ca).

## FEES

The conference fee (\$210 if registration is received by April 30 and full payment by May 7, \$240 thereafter) covers the cost of the reception on Friday, lunches on Saturday, Sunday and Monday, dinners on Friday, Sunday and Monday, coffee breaks, the excursion, and other local 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).

*Please note: "Ad Hoc" and "Gallery Walk" presenters are required to pay the academic program fee.*

## **MEMBERSHIP AND REGISTRATION FORMS**

The membership renewal, conference registration, and accompanying persons' registration forms are available online (except for the payment) on the CMESG website: <http://www.cmesg.ca>. If you encounter issues using the online registration form, please contact Chantal Buteau: [cbuteau@brocku.ca](mailto:cbuteau@brocku.ca).

## **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 website: <http://www.cmesg.ca>.

## **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.

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## ABOUT THE CONFERENCE

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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 **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](mailto:esimmt@ualberta.ca)

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: Rosa Leikin***

*University of Heifa, Israel*

***On the relationships between mathematical knowledge, creativity and talent***

During the last decade educators and researchers raised their attention to the role of mathematics education in the development of students' mathematical creativity and the place of mathematical creativity in school mathematics. Whereas mathematical creativity is clearly expressed in the work of research mathematicians, in school mathematics the notion of mathematical creativity is rather vague.

This observation drives special attention to the relationships between mathematical creativity, mathematical knowledge, high achievements in school mathematics and mathematical talent. During the lecture I will discuss these relationships using examples from multidimensional examination of mathematical giftedness that focuses on students cognitive and neurocognitive characteristics.

I will demonstrate strong mutual relationship between mathematical expertise and mathematical creativity in high school students. At the same time I will argue that excellence in school mathematics; mathematical creativity and mathematical giftedness are different traits. Emphasis will be made to the ability of students to generate insight-based solutions for mathematical problems and solve problems using multiple solution strategies. The particularities are reflected both in behavioral characteristics and in brain electrophysiological activity associated with solving mathematical problems. Educational implications of the research findings will be discussed.

***Lecture II: Bill Ralph***

*Brock University, Canada*

***Are We Teaching Roman Numerals In A Digital Age?***

Mathematics has evolved from pressing reeds into clay to speaking an integral into a cell phone and having it display the correct answer, as a student recently demonstrated in one of my classes. We all laughed at the cell phone calculation but the question they left hanging in the air was why are you teaching us to do what our phones can do instantly? In this talk, I'll look at some modern research areas and think about the relevance of our current teaching to these new developments in mathematics and computing. We'll consider some mathematical frontiers such as the use of

simulation in various sciences; learning objects programmed by students to teach and explore mathematics; the analysis of large data sets in finance; and new ways of analysing and creating fine art. I believe we have a responsibility as mathematics educators to provide leadership in identifying and promoting significant new trends within the rich intellectual culture surrounding mathematics. By paying close attention to these new developments, we can hopefully avoid repeating the mistakes of the people who refused to give up Roman numerals when a better system was right in front of them. For more information about my work, please see my financial website at <http://www.portfoliomath.com> and my art website at <http://www.billralph.com>.

### ELDER TALK

<i>Eric Muller</i>	<i>Through a CMESG Looking Glass</i>
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*When you say "hill," the Queen interrupted, "you could show  
 you hills, in comparison with which you'd call that a valley."  
 "No, I shouldn't," said Alice, "a hill can't be a valley, you  
 know. That would be nonsense—"*

*Alice Through the Looking Glass* by Lewis Carroll

I will explore a few themes that, to me, are of central importance to the future of mathematics education in Canada. It is my hope that at least one of these will resonate with your interest.

## WORKING GROUPS

### *Working Group A*

*Leaders: George Gadanidis and  
Phillipe Richard*

### *MOOCs and Online Mathematics Teaching and Learning*

MOOCs (Massive Online Open Courses) are a recent development building on an emerging trend for educational institutions (such as MIT, Harvard and Stanford) and others (such as the Fields Institute's mathematics for teachers courses and the Khan Academy) to make course content freely available on the Web. We want to better understand the MOOC phenomenon and its implication for mathematics teaching and learning.

Our initial plan, to be adapted with participant input, is to explore the following questions:

- **What is a MOOC in mathematics education?** What are some examples to give us a first-hand sense of MOOCs and help us develop a working definition?
- **What are the pedagogical and didactical issues in a MOOC?** What is the particular nature of teaching and learning of mathematics in a MOOC? What is the particular nature of mathematics within a MOOC? How does a MOOC take advantage of the affordances of new media (such as multimodality, multilinearity, performance, etc.)? What is relevant for mathematical education in the current research on MOOCs?
- **Where/how do other tools and approaches fit in?** What about our previous/ongoing focus on such tools and approaches as learning objects/applets, dynamic geometry, algebra environments, tutorial systems, and closed online courses?
- **Where do we go from here?** What is the future of MOOCs in online mathematics teaching and learning? What might be the effect for students, instructors and institutions? What questions should guide our research of this phenomenon?

As MOOCs are a recent phenomenon, research is just emerging. The following introductory readings are available at <http://www.researchideas.ca/moocs>:

Cormier, D. (2010). What is a MOOC? Youtube.

Cormier, D. & Siemens, G. (2010). Through the Open Door: Open Courses as Research, Learning, and Engagement. *Educause Review*, July/August, 31-39.

Kop, R., Fournier, H. & Mak, S.F. (2011). A pedagogy of abundance or a pedagogy to support human beings: Participant support in Massive Open Online Courses. *NRC Publications Archive*, 12(7), 74-93.

Vardi, M.Y. (2012). Will MOOCs destroy academia? *Communications of the ACM*, 55(11),5.

**Working Group B**

*Leaders: Ann Kajander, Dominic Manuel, and Bharath Sriraman*

***Exploring creativity: From the mathematics classroom to the mathematicians' mind***

Learners of mathematics do not typically experience mathematics as a creative subject, yet research mathematicians often describe their field as a highly creative endeavour (Burton, 2004). The term creativity unfortunately has come to imply eminent acts/products/achievements, yet research suggests that creative thinking is an everyday occurrence (Craft, 2002). In this working group we seek to capture the essence of mathematical creativity as seen through the eyes of mathematicians and described by current research, and express it in ways that might also be applicable to learners of mathematics including, but not restricted to, students described as highly able. Questions for consideration might include: What is mathematical creativity? Does it differ from other kinds of creativity? How can we observe it in learners? Is creativity necessary for mathematics research? How can creativity be enhanced in classroom mathematics learning? Are some students more mathematically creative than others?

A possible goal of part of our working time might include the construction of a series of classroom tasks for potential publication in a professional journal article for teachers. Such tasks could be illustrative to teachers who wish to provide learning environments to students, which enhance the kinds of creative mathematical abilities described by mathematicians.

**References:**

- Burton, L. (2004). *Mathematicians as Enquirers: Learning about Learning Mathematics*. Dordrecht, The Netherlands : Kluwer Academic Publishers.
- Craft, A. (2002). *Creativity and Early Years Education*. London: Continuum Publications.

**Suggested Readings:**

- Liljedahl, P. (2013). Illumination- An affective experience. *ZDM- The International Journal on Mathematics Education*. In press. Springer Online  
<http://link.springer.com/article/10.1007%2Fs11858-012-0473-3>
- Sinclair , N., de Freitas, E., and Ferrara , F. (2013). Virtual encounters: the murky and furtive world of mathematical inventiveness. *ZDM- The International Journal on Mathematics Education*. In press. Springer Online  
<http://link.springer.com/article/10.1007%2Fs11858-012-0465-3>
- Sriraman, B. (2009). The characteristics of mathematical creativity. *ZDM- The International Journal on Mathematics Education*, 41(1&2), 13-27.  
<http://link.springer.com/article/10.1007%2Fs11858-008-0114-z>

***Working Group C***

*Leaders: Doug Franks, Kathleen Pineau, and Walter Whiteley*

***Mathematics of Planet Earth 2013: Education and Communication***

2013 has been acclaimed as the year for “Mathematics of Planet Earth” – MPE2013. Initiated by Dr Christiane Rousseau, Professor of Mathematics at the University of Montreal and Vice-President of the International Mathematical Union, this project has been embraced by over 100 academic organizations, institutions, and societies around the world, including UNESCO.

The MPE2013 website identifies the three-fold mission of the project as:

- Encourage research in identifying and solving fundamental questions about planet earth;
- Encourage educators at all levels to communicate the issues related to planet earth;
- Inform the public about the essential role of the mathematical sciences in facing the challenges to our planet.

Our working group will focus on the last two points: mathematics education for understanding and effective communication of potentially complex issues. The focus will be primarily secondary and tertiary, but mathematics educators at all levels are invited to participate.

The MPE2013 Project includes a broad spectrum of “Planet Earth” topics in which mathematics plays an important role. The four themes are, A Planet (i) to Discover; (ii) supporting Life; (iii) organized by Humans; and (iv) at Risk. Climate change is a major component of the fourth theme, and is clearly a matter of great contemporary concern. At the 2011 CMESG meeting in St. John’s, a working group led by Barwell, Craven, and Lidstone extensively addressed the topic, “Mathematics Teaching and Climate Change,” and we encourage all potential participants to read the Working Group’s report in the 2011 Proceedings. In the current working group, we plan to broaden the focus to include the mathematical education and effective communication of more – or even all – of the MPE2013 themes.

Variability, uncertainty, modeling and risk are central mathematical concepts at the core of the investigations. How these are presented has a major impact on what is communicated and what decisions are made. Examining both the scientific literature and what appears in blogs and public discussion, graphic displays and visually presented simulations are how people choose to present their ‘information’. One theme for the working group will be probing such displays, to ask ‘where’s the math’ and ‘what’s the math’ in different choices of graphic presentations. These types of questions are a central issue of mathematics education. Given the importance of ‘rhetorical communication’ on the vital debates involving Planet Earth, we will consider ‘graphical rhetoric’. How do we put mathematical arguments into these displays and how do people extract mathematical reasoning from such graphic displays? As an example, consider the ‘math’ in the video:

[http://www.ted.com/talks/hans\\_rosling\\_shows\\_the\\_best\\_stats\\_you\\_ve\\_ever\\_seen.html](http://www.ted.com/talks/hans_rosling_shows_the_best_stats_you_ve_ever_seen.html).

Tentatively, the working group will be guided by the following questions:

1. Where is the mathematics in key issues of Planet Earth that we can address as mathematics educators?
2. How can this mathematics be addressed in secondary and tertiary curricula and in teacher education? And How is this mathematics now addressed in these curricula?
3. How can this mathematics be conveyed to “the wider public” in such a way as to offer a clearer understanding of Planet Earth issues, and thus support positive action?

As part of the process, we invite prospective participants to bring examples of their own curriculum-related work in mathematics and mathematics education on these themes.

We recommend reviewing the following references in preparation for the Working Group:

Barwell, R., Craven, S., & Lidstone, D. (2011). Mathematics teaching and climate change (pp. 25-36). In P. Liljedahl, S. Oesterle, & D. Allan (eds.), Proceedings of the 2011 Annual Meeting of the Canadian Mathematics Education Study Group, June 10-14, 2011. Retrieved from <http://cmesg.ca/>

The MPE2013 website, <http://mpe2013.org/about-mpe2013/>

The blog announcement of MPE2013 in the Canadian House of Commons (be sure to scroll down the page to see other links to MPE2013):

<http://nghoussoub.com/2012/12/14/mr-speaker-i-rise-today-to-salute-the-mathematics-of-planet-earth-initiative/>

Other resources on graphic communication will be relevant to our discussions, including:

Howard Wainer: Visual Revelations: Graphical Tales of Fate and Deception, Psychology Press 2000.

Howard Wainer: Picturing the Uncertain World: How to Understand, Communicate, and Control Uncertainty through Graphical Display, Princeton University Press, 2009.

Edward Tufte: The Visual Display of Quantitative Information, 2nd edition, Graphics Press 2001.

***Working Group D***

*Leaders: Izabella Oliveira and  
Lorraine Baron*

***Multiplicative thinking in 9- to 15-year olds***

We “understand something if we see how it is related or connected to other things we know” (Hiebert et al., 1997, p. 4).

From an early age, children apply multiplicative thinking while solving mathematical tasks or problems, for example, when they are called upon to find one-half of an object or quantity. Despite this, multiplicative thinking (Vergnaud, 1983) and its related ideas, including division, fractions and proportions, are not formally introduced until late primary or early intermediate grades.

Students’ conceptual understanding of multiplication is developed throughout their schooling. These ideas, first explored through arithmetic, will be adapted by students during their algebraic learning. If one of the goals during late primary grades is “to develop students’ algebraic thinking, building a foundation of understanding and skills while they are young so that they can be successful in their later, more formal study of algebra” (Burns, et al., 2002, p. xii). Empson, Levi and Carpenter (2011) argue too “that relational thinking is a critical precursor – perhaps the most critical – to learning algebra with understanding, because if children understand the arithmetic that they learn, then they are better prepared to solve problems and generate new ideas in the domain of algebra (p. 426)”.

Then, in general, this working group seeks to reflect upon the following:

- Discuss the development of multiplicative understanding from grades 4 to 9
  - How might multiplicative thinking evolve through schooling given the particular strategies taught within the system?
  - What are the particular difficulties or misunderstandings experienced by students during their learning journey from primary to middle grades?
- How are multiplicative and proportional thinking ideas learned in elementary grades linked to algebraic understanding in middle and secondary school?
- Which methods or teaching strategies are important to support student learning during this journey?

References:

Burns, M., Wickett, M., & Kharas, K. (2002). *Lessons for algebraic thinking: Grades 3-5*. Sausalito, CA: Math Solutions.

Empson, S. B., Levi, L., & Carpenter, T. P. (2011). The algebraic nature of fractions: Developing relational thinking in elementary school. In J. Cai & E. Knuth (Eds.), *Early Algebraization* (pp. 409-428). Berlin, Germany: Springer Berlin Heidelberg.

Hiebert, J., Carpenter, T. P., Fennema, E., Fuson, K. C., Wearne, D., Murray, H., . . . Human, P. (1997). *Making sense: Teaching and learning mathematics with understanding*. Portsmouth, NH: Heinemann.

Vergnaud, G. (1983). *Multiplicative structures. Acquisition of mathematics concepts and processes*. Orlando: Academic Press.

***Working Group E***

*Leaders: Brent Davis, Kathy Kubota-Zarivnij*

***Mathematics Curriculum Re-Conceptualization***

Mathematics curriculum revision has become a more-or-less constant project for ministries of education, often framed in terms of adding to, deleting from, or re-situating topics in the K-12 trajectory. What are other possibilities? What does curriculum comprise and what might mathematics curriculum reform or re-conceptualization entail? The intention of this working group is to envision a model of mathematics curriculum design that is informed by contemporary “reconceptualist curriculum” literature and that embodies what is currently known about mathematics knowledge, learning, and teaching. In this working group, we will be aiming to:

- articulate a set of principles that orient efforts toward mathematics curriculum design, and
- exemplify these principles using one or two mathematical case examples.

More specifically, we will endeavor to look toward other possibilities by delving into questions, issues, parameters and possible subject matter content that precede curriculum development. Specific topics of examination may include:

a) embodying the structure of the mathematics discipline in the format of the mathematics curriculum (consider the following contrast: when knowledge is construed in Euclidean terms as, e.g., a building, attentions veer toward firm foundations, discrete skills, and proven strategies; in contrast, when knowledge is construed fractally as, e.g., a decentralized network, attentions turn to hub-concepts, self-similarities, and complex modeling).

b) rethinking the mathematics content basics/hubs – with the centuries-old decision to place arithmetic at the core of mathematics instruction and to gear schooling toward preparing learners for the industrialized world, it makes sense that  $+$ ,  $-$ ,  $\times$ , and  $\div$  would be selected as the “basics.” Might it be time to consider other “essentials,” such as exponentiation and spatial fluency?

c) exploring strategies for curriculum design that are participatory and that draw on (and perhaps contribute to) evidence bases (following, e.g., on the examples of Japan, Israel, and elsewhere). How might students, teachers, educational researchers, mathematicians, and others be involved in ways that move beyond opinion-based contributions?

To make this task manageable, discussions will be focused on elementary and middle-school (grade K–8) levels.

#### Readings:

Math Skills Map – The partnership for 21st century skills. Available at [http://www.p21.org/storage/documents/P21\\_Math\\_Map.pdf](http://www.p21.org/storage/documents/P21_Math_Map.pdf)

Reid, W.A. (1998) “Reconceptualist” and “dominant” perspectives in curriculum theory: what do they have to say to each other? *Journal of Curriculum and Supervision*, 13(3), 287–296.

Sztajn, P., Confrey, J., Holt Wilson, P., & Edgington, C. (2012) Learning trajectory based instruction: toward a theory of teaching. *Educational Researcher*, 41(5), 147–156.

## TOPIC SESSIONS

<b><i>Topic Session A</i></b>	
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*Ann Arden, Richard Hoshino,  
and Kathleen Pineau*

	<b><i>Planning for CMEF 2014</i></b>
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The next Canadian Math Education Forum will take place in Ottawa in late spring or early summer 2014. The three co-organizers are Richard Hoshino (Quest University), Ann Arden (Ottawa-Carleton DSB and University of Ottawa) and Kathleen Pineau (École de technologie supérieure). At this session, Richard, Ann and Kathleen will present their ideas for the theme and the structure of the meeting and will welcome comments and further ideas from others.

<b><i>Topic Session B</i></b>	
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*Egan Chernoff*

	<b><i>Social media and mathematics education: whenever the twain shall meet?</i></b>
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In this topic session, an overview of the current state of social media for mathematics education will be presented (in four parts). First, the different types of social media being used for mathematics education will be highlighted and detailed (e.g., social networks, blogs, microblogs, social bookmarking, media sharing, aggregators and discussion forms). Second, for each of the different types of social media, I will detail “who” (e.g., individuals and organizations) is using “what” (e.g., Facebook, Google+, Twitter, Tumblr, Delicious, StumbleUpon, YouTube, Instagram, Pinterest, RSS, LinkedIn, Academia, Listserves and others). Third, I will discuss my use of (and varying attempts to manage) social media over the past four plus years. With a better picture of the social media for mathematics education landscape, I, lastly, will discuss when social media and mathematics education will truly coexist. In the time that remains, I look forward to mediating an open forum and answering any questions that may arise from the presentation.

*Topic Session C*  
*Caroline Lajoie*

***Role play in a mathematics method course : a tool for  
mathematics teacher education or a tool for research on  
mathematics teacher education ?***

In one of our mathematics method courses at UQAM, students, through role play, become active actors in different teaching situations (involving teacher/pupil(s) interactions) instead of simply imagining or analyzing such situations. Developed at first as a pedagogical approach in the course «didactique de l'arithmétique au primaire», role play now provides us (also) an approach to research on mathematics teacher education.

This topic group will be devoted to role play. With the help of a few examples, I will be able to highlight some of our intentions at UQAM regarding mathematics teacher education at the primary level. Also, participants will be invited to explore with me the potential and the limits of this approach for mathematics teacher education as well as for research on mathematics teacher education.

## NEW PHD SESSIONS

*Nathalie Anwandter Cuellar*

*The new status of magnitudes in the curricula of mathematics in France and its impact on teaching practices.*

The epistemological upheavals caused by the evolution of the field of mathematics produced a series of changes in the school curricula in France, one of particular interest being in the teaching of magnitudes. We wanted to analyse the place and role of magnitudes in the 2005 restructure of the curricula and to see the impact of these changes on the teaching conditions and the restrictions teachers must face when teaching magnitudes. In order to do this, we conducted a study, based on the Anthropological Theory of the Didactic developed by Yves Chevallard. We examined teaching practices by looking at the interrelationships between magnitudes, the functional and numeric for case of proportionality, and the internal functioning of magnitudes for the notion of area. Our results show how the new status of magnitudes in official documents creates difficulties for teachers to integrate the new curricula knowledge for an adequate teaching of magnitudes.

*Priscilla Bengo*

*Mathematics coaching to improve teaching practice: the experiences of mathematics teachers and coaches*

The study explores the relationship between teachers' specific emotions, teacher learning and teacher coaching in secondary mathematics classrooms. Using a case study approach, it shows that: a) mathematics reforms produce negative and positive emotions; b) emotions are a result of not knowing how to implement the mathematics reforms, beliefs about teaching and learning mathematics, the nature of coaching, gains in student achievement and engagement and positive in-school factors; c) coaching may not help teachers build their professional self-understanding when it fails to address their self-image issues; d) teacher learning can occur even when teacher beliefs are inconsistent with reform initiatives; and e) even when teacher learning results from coaching, reform strategies are modified by teachers. Coaches experienced positive and negative emotions based on how well the reforms were implemented by teachers. As a result, they require support during reforms. The directions for future research are described.

This study strived to understand how mathematical modelling is perceived by novice, intermediate and expert modellers, through comparing and contrasting their understanding and habits of modelling. The study adopted a qualitative methodology based on observations, interviews and surveys of 78 participants. This included 14 experts who are professors, 11 intermediates consisting of graduate students and post-doctoral fellows, and 53 novices who were undergraduates. The study incorporated interviews of the professors and the post-graduate participants, while questionnaires were utilized to understand the perspective of the undergraduate students. The study revealed a spectrum of approaches and attitudes from novice to expert, including how they define modelling, their autonomy, their initial approach to the problem, their use of collaboration versus individual research, perseverance, their willingness to discuss emotion and their activeness in dealing with barriers. The results of this study, including those mentioned above, have implications for the teaching of effective mathematical modelling.

In this presentation I examine some of the representations of mathematics and mathematicians in the short film All is Number which was produced in the Caribbean by the University of the West Indies, aired on regional television stations and was intended for Secondary School and non-specialist audiences. My methodology is based on critical approaches to visual material and culture. I consider the film All is Number to be situated with/in the heteroglossia of broader cultural phenomena, viz. the 'popularisation' of educational consumption, and more specifically, the popularization of mathematics. Through excerpts I illustrate how the film constructs an idea of mathematical authority and mathematics that is simultaneously sensitive to concerns in the mathematics education literature about the representation of mathematical practitioners and mathematics, yet insensitive to its own practices of Othering. I argue however that the polyphonic representation of mathematics in the film All is Number might function as an anomalous place of learning despite presenting a view of mathematics as universal and culture-free. I consider some of the implications of these representations in the film for mathematics education in the Caribbean region in particular the need for ethically responsible inter and transdisciplinary dialogues.

*Martha J. Koch*

***Implications of the multiple-use of large-scale assessments for the process of validation: A case study of the multiple-use of a Grade 9 mathematics assessment***

Using questionnaire data, document analysis, school-level case studies and interviews with test development personnel, I examine the multiple-use of the Education Quality and Accountability Office (EQAO) Grade 9 Assessment of Mathematics which is administered in Ontario, Canada. I focus on two of the uses of this assessment: the use as part of Ontario's accountability program and the use by teachers as part of students' grades. Evidence of interactions between these uses is provided and the limitations of applying Kane's (2006) argument-based model of validation are discussed. I demonstrate how the analytic concept of a boundary object can contribute to the validation of the multiple-use of this assessment. In closing, I suggest a number of ways of rethinking the process of validation for large-scale assessments to better address the frequently occurring practice of multiple-use.

*Martina Metz*

***Interacting With Implicit Knowing in Mathematics***

This study explores notion of "empathic second person coach" and Eugene Gendlin's notions of "felt meaning" and "implicit understanding" in the context of learning mathematics. Felt meaning provides a vague or holistic sense of a situation that points to implicit understanding; by attending to indicators of its presence, it was possible to broaden the scope of what was deemed relevant in particular contexts, including previously subconscious understandings that influenced learning in unseen (and often surprising) ways. Once named (even broadly), implicit understanding co-evolved with language in the development of mathematical understanding. By attending to external indicators of felt meaning, it was possible to interact with others' implicit understanding in ways that helped bring it closer to consciousness and into conversation. Conversely, prematurely insisting on clarity and logic shut down awareness of the implicit.

*Tina Rapke*

*Creating, Understanding and Teaching Mathematics:  
Complementary Processes*

My doctoral research, part of a fully joint PhD in mathematics and mathematics education, explored the relationships among understanding, creating and teaching mathematics. My dissertation includes two pairs of complementary mathematics and education papers. The papers are complementary in the sense that the education papers drew on the experiences of creating the mathematics that appeared in the mathematics papers and in doing so, provided insight into how the mathematical concepts, theorems and proofs were constructed. The education papers not only provide insight into one mathematician's creating of mathematics, but mine the experiences and insights for their pedagogical implications. In this presentation, we will consider definitions in graph theory (specifically in oriented colourings and injective oriented colourings) and discuss creating, understanding and teaching mathematical definitions.

*Miranda Rioux*

*Evolution of prospective teachers training projects in contact  
with probabilistic situations*

This communication unveils the results of our doctoral study, which stands at the crossroads of research in mathematics education and teacher training. It was conducted among 58 undergraduate students in special education at Université du Québec à Rimouski. Two general objectives were formulated: the first aims at describing student training projects while the second addresses the development of a sequence of situations to help enrich their initial projects. It was highlighted that although most students want to develop knowledge of techniques and teaching methods, the sensitivity to complexity shown in some projects does not allow to reduce students' expectations regarding their training to the building of a repertoire of teaching techniques deemed effective.