THE CANADIAN MATHEMATICS EDUCATION STUDY GROUP

28TH ANNUAL MEETING

28 MAY – JUNE 1ST 2004

UNIVERSITÉ LAVAL

ANNOUNCEMENT AND REGISTRATION FORM

We're happy to welcome you to Université Laval for the 28th Annual Meeting of CMESG which opens at 16:45 on Friday, 28 May and closes at 12:30, Tuesday, June 1st. The meeting of GDM, the Groupe de didacticiens des mathématiques du Québec, on May 27 and 28, will precede our meeting. For the occasion, you are warmly welcomed to attend the GDM plenary conference of Jacques Bélair, scheduled for 13:30 on May 28 with simultaneous translation services from French to English. For more details, please consult the "Preconference Activities" section and the insert included with this program.

Université Laval is located in the western part of Québec city (Ste-Foy). To locate the university and its various components, you can visit www.ulaval.ca. Choose **Plan du campus**. In **Autres cartes,** you will find a map giving the access routes to the University.

CMESG activities will take place in Pavillon Alphonse-Desjardins on Friday, and in Pavillon Adrien-Pouliot thereafter. The Desjardins is easily accessible and is the service center of the university. The Pouliot is part of the Science and Engineering Faculty and is located on avenue de la Médecine.

WELCOME AND REGISTRATION

On Friday, all activities are held in Pavillon Alphonse-Desjardins. Registration starts at 14:30 outside the Hydro-Québec auditorium (on the first floor). Cocktails (at 16:45) and dinner (at 17:45) are at the Cercle Universitaire (our Faculty club) on the fourth floor. The opening session (18:45) and the first plenary (19:30) take place in the Hydro-Québec auditorium.

HOW TO GET THERE:

- **From the Québec International Airport,** a cab ride to the hotel (see below) or to the Pavillon Alphonse-Desjardins should cost approximately $18.
- **By car, from highway 20,** follow the signs for Québec City. Once you have crossed the St-Lawrence River (Pont Pierre-Laporte), aim for boulevard Laurier. The Hôtel Classique is on boulevard Laurier, and so is the university (see the campus map).
- **By car, from highway 40,** take the exit for Du Vallon Sud which takes you on the western side of the campus: take the exit for the university from Du Vallon.

PARKING

Parking is free everywhere (except at the parking meters) on Saturdays, Sundays and after 20h00 on Fridays. Also, the visitor's car park at level 00 of Pavillon Alphonse-Desjardins is free every day after

16h30. At all other times, you can use the parking meters (usually limited to 2 hours) but it is best to go to any of the visitor's car parks where an automated machine will sell you a ticket giving you unlimited parking everywhere on campus for $10 a day or $2.50 an hour. Note: there is a visitor's car park across from Pavillon Pouliot.

LODGING

Unfortunately, it is not possible to use the accommodation usually available on campus. Nearly 300 rooms are up for renovations and a very large congress has monopolized all the rooms available (for the 7th successive year) from May 28. The hotel we have chosen for the group is Hôtel Classique, 2815 boul. Laurier. Rates are $92 plus taxes for a room with one Queen Size bed, and $99 plus taxes for a room with two Queen Size beds. You can book by e-mail (delaney@hotelclassique.com), fax (418) 658-6816 or phone 1-800-463-1885, and the **group number is 489356.** The hotel is not as close as we would have wished (1.5km from Pavillon Adrien-Pouliot) but it should be very comfortable.

We have also booked 20 rooms at Hôtel Universel (the **name of the group is GCEDM, and the number of our group is 203275**). This hotel is closer to the university (Chemin Ste-Foy, to the North) and it is cheaper (junior suite with one Queen size bed, a small living room with a sofa bed and a kitchenette at 72$ plus taxes, and a room with two double beds at 72$ plus taxes). We hope that this hotel will be used by those on a smaller budget. You can book at 1-800-463-4495, by fax at (418) 653-4486 or by e-mail info@hoteluniversel.qc.ca.

If you would like to share a room but do not know who to share with, you can write to Frédéric Gourdeau (fredg@mat.ulaval.ca) who will put interested people in touch with one another.

MEALS

All lunches and dinners will be taken together as a group, mostly on campus. Dinners on Sunday (Le Cavour, Place Royale) and Monday (Manoir Montmorency) will allow us to enjoy some of the sights that Québec can offer. For the Sunday evening meal, ***you must choose your main course on the registration form.*** (Please note that the first course is a shrimp feuilleté with a touch of pastis, followed by a cream of vegetable.)

EMERGENCY

The phone number of Hôtel Classique is 1-800-463-1885, while Hôtel Universel is 1-800-463-4495. The department of mathematics and statistics (regular working hours) is (418) 656-2971. For the duration of the meeting, Bernard Hodgson can be contacted for emergencies on his cell phone at (418) 564-2267.

PRE-CONFERENCE ACTIVITIES : « RENCONTRE DU GDM »

The sequencing of GDM 2004 (May 27 and 28) with the annual meeting of CMESG (May 28 to June 1st) will allow participants from both groups to meet and participate in common activities. In particular, the participants of the CMESG meeting are warmly invited to attend the GDM plenary presentation of Jacques Bélair, scheduled for 13:30 on May 28: " Chaos and complexity, models and metaphors : what lessons for mathematics education?". See the insert for further information. Also, all CMESG members who wish to attend the rest of the GDM activities are kindly invited to register through GDM website (**http://xserve.scedu.umontreal.ca/gdm2004/**). Members registering for both conferences may request a 25$ rebate when they register for the CMESG meeting on Friday afternoon.

Note: Except for the conference given by Jacques Bélair (where simultaneous translation will be provided), the GDM activities will be held in French.

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

Lecture I — ***The teacher's situation and knowledge as enacted in mathematics classroom activity***

Claire Margolinas

For a long time (in France circa 1960 – 1990), researchers in math education have focused mainly on the student's observation and the construction of experimental teaching and not on teacher's situation.

This focus on experimental teaching has led researchers to consider the student's situation as mainly determined by the experimental situation, with no actual interest in classroom interactions. In addition, since teacher's actions in experimental situations (even when the teacher was part of the research team) were not only the result of his own decisions, it would have been difficult to study.

These historical considerations have also a theoretical side: a specific approach is needed in order to study the teacher's situation that is a priori different from one that is suitable for studying the situation of students.

The starting point of my research was to try to analyse teachers' situation with the tools of Theory of Situations (Brousseau, 1997): like any subject, the teacher acts in situation, dealing with its possibilities and constraints. During these interactions he/she uses prior knowledge and also builds new knowledge.

The objective of this presentation is to clarify some of the elements regarding the situation of the teacher. The teacher's situation will be described on different levels of determination. For each level, I will show the existence of a dual tension between upper and lower levels, a tension arising from differences between teachers' intentions to teach and the reality of the in-class realization.

By using examples of observation at different school levels, I will show some types of knowledge at work in the teacher's decisions. The situation of the teacher will be questioned in a larger context in which the intention to teach will not be the sole determinant.

Finally, I will try to show how teacher's knowledge evolved through time, and how it is expressed between teachers during specific observations.

Lecture II — ***Evariste Galois's personality: the psychological context of an unusual fondness for abstract mathematics***

Nicolas Bouleau

Galois's name is today associated with group theory, of which he is considered a founder. By means of theoretical concepts he solved the general question of how to express the roots of an algebraic equation by means of auxiliary equations: this is what is known as the Galois theory.

Nevertheless, a good twenty years after Galois's death, Alexandre Dumas, whose *Mémoires* bear faithful witness to his time, was still completely ignorant of the mathematical activity of Galois, and presented him as a passionate, activist republican.

His childhood, his behaviour with classmates and professors, his aptitude for abstract ideas and natural intimacy with higher mathematics, make Galois an interesting case both for a better understanding of mathematical research and also for the identification of some non-universal psychological features specifically associated with abstract conceptual ability.

Galois was anxious and uncompromising by nature, but he also possessed an exceptional vitality. Despite the numerous defeats encountered during his short life, he always found sufficient energy to undertake and see his projects through.

During this exposition we will meet some fundamental ideas of Lacan on the relationship between paranoia and creativity. It will be an opportunity to improve our knowledge of an author who is not always easy to approach due to his sophisticated use of the French language.

WORKING GROUPS

Working Group A ***Learner-generated examples as space for mathematical learning***
Leaders: Anne Watson, Rina Zazkis & Nathalie Sinclair

The role of examples in teaching and learning mathematics has been widely acknowledged. (How else do we encounter mathematical generalities?) In this WG we shall focus on a specific kind of examples, those generated by learners.

The group will spend time working on some mathematics in order to have a shared experience from which to discuss the nature of participants' example spaces and the role they play in learning.

We use the term 'example' not just to refer to worked examples, but also to illustrations of concepts, to demonstrations of relationships, to representations of classes, and even to models of examination questions. In fact, we use it to refer to all those things which appear in textbooks or on the board from which the learner is supposed to learn a general principle, technique, property, method or theorem. We shall examine the following ideas:

? we can only learn by starting from what we have already 'learnt' (an old idea);
? we can learn by exploring, restructuring and extending our example spaces;
? deliberate use of learners' example spaces is a powerful teaching strategy;
? deliberate use of a learner's own example space is a powerful learning strategy.

These statements are based on a view of learning mathematics as creating mathematical structures consisting of concepts, relationships, techniques etc. - that is, the 'structure' in 'construction'. Classroom videos, textbook analysis and research-based insights are likely to be used to structure discussion.

Working Group B ***Transition to University Mathematics***
Leaders**:** Tom O'Shea & Peter Taylor

Past CMESG working groups have examined a number of issues related to the content and pedagogy of lower-level university mathematics courses. In this year's working group we would like to explore how mathematicians and mathematics educators at the university level have created or might construct courses or mathematical experiences that would address the problem of the "transition to university mathematics." This might consist of innovations within traditional introductory university mathematics courses or the creation of new courses that attempt to paint a non-traditional but in fact much more authentic picture of mathematics. In a sense, the theme of the working group is the general question of what exactly should be the experience of students in their first encounter with a university math department.

Participants are encouraged to bring to the discussion examples of topics, activities, or pedagogy they have used that might foster the transition. Or they may like to identify experiences or projects others have written about or developed that would be suitable to include in proceedings of the workshop.

Working Group C *Integrating applications and modelling in secondary and post secondary mathematics*

Leaders**:** France Caron & Eric Muller

As leaders we plan to support a bilingual Working Group in which a short verbal summary in the other language will be provided when requested. We are proposing a number of questions to focus the initial discussions.

1. Is there a sequence of experiences that can help a student become proficient at mathematical modelling? Is there a minimum set of experiences that a student must have in order to become proficient at working with applications?
2. What are the essential components of a modelling situation? Can these components be introduced individually and in sequence with the student's growth in mathematical knowledge and understanding? How "authentic" should a modelling situation be?
3. How does technology open opportunities for integrating mathematical modelling and applications? What new problems can now be tackled? What new models can now be called upon? How should technology be used to implement these models and still contribute to the learning of mathematics? What is lost in the development of understanding when powerful modelling programs are introduced? What is gained by introducing such programs?
4. Does the use of manipulatives, which are presently introduced in the curriculum to provide concrete experiences in the learning of mathematics, open opportunities for applications and modelling? Can these form building blocks in the student's development and understanding of modelling and applications, or can they become obstacles to this development?
5. What are the dynamics of a mathematics classroom when students are engaged in modelling and applications? Where and how do mathematics teachers gain the knowledge, confidence, and experience to engage their students in such classroom environments?
6. What are some of the attributes of learning materials and activities which have been successfully used for modelling and applications in the mathematics classroom?

Working Group D *Elementary Teacher Education - Defining the crucial experiences*

Leaders**:** Jean Dionne & Ann Kajander

Many of us have at some point participated in working groups which have focused on developing exhaustive lists of desirable features of a good pre- or in-service elementary mathematics education program. Such lists may be a source of intellectual satisfaction, but many of us have also experienced frustrating problems in their application such as much too short classroom contact time, lack of preparation of students, poor attitude towards mathematics, and so on.

In this working group we would like to find ways to cope with this situation. Rather than creating a new 'list' of topics we propose to discuss what the minimum attainable set of possible experiences might be for pre-service teachers in their mathematics and mathematics education courses (also variously referred to as 'pedagogy', or 'curriculum and instruction' courses), and how these experiences might be achieved. As well we hope to discuss ways to motivate in-service teachers to continue their professional development, and what might be provided that would be useful to them. We are interested also in the types of problems that might be useful to create these experiences.

Participants are asked to bring along two personal vignettes of situations working with (or being themselves) a pre-service or in-service teacher in a teacher education environment. One of these stories could be about an experience that achieved a goal and was exciting and rewarding for the teacher(s) involved; one that for some reason was not a success. These stories will be shared to begin shaping our definition of the nature and role of crucial or fundamental experiences.

Working Group E ***A critical look at the language and practice of mathematics education technology***

Leaders**:** André Boileau & Geoff Roulet

> "In a given society, the more people talk about a value or virtue or collective project, the more this is a sign of its absence. They talk about it because the reality is the opposite." (Ellul 1990, p.130 – *The Technological Bluff*)

> "If popular tales depict wide-eyed children using an interactive instructional program as adventurers, exploring a wonderful world and making exciting discoveries, a deconstructive reading allows us to see the disavowed other lurking behind these eager adventurers: to see the child sitting mesmerized and inactive before the computer, only her index finger on the mouse moving occasionally as a stream of images passes in more or less pre-determined sequence before her grazed eyes." (Rose 2000, pp.59-62 – *Hypertexts*)

> "All generalizations are false (including this one)." (Anonymous)

Our working group will address the following questions:

? What is the language associated with the promotion, use and research of technology in mathematics education? Some examples of common terms are: interactive, visualization, simulation, mindtool, intelligence amplifier, learning object, multi-modal, drill-and-practice, microworld, project-based, game, and pedagogical model.

? How does this language relate to actual practice, that is, to the design of the technology and to its use in secondary school level classrooms?

? What are the implications for mathematics teacher education? How do we ensure that prospective teachers are both knowledgeable about and critical of technology in mathematics education?

Our working group will have access to a lab and we will have opportunities for hands-on explorations of various samples of mathematics education technology.

TOPIC GROUPS

Topic Group A ***Feedback***
Leader: Dave Hewitt

The opportunities for students to notice and educate their awareness is partly due to what is available for them to perceive (through any one or many of their senses) – what I call 'material' with which they can work. In this session we will consider different ways a teacher might respond to some mathematics a student does and how that feedback contributes to the quantity and quality of material available for a student to gain further insights into that area of mathematics. This, of course, will be hypothetical, but the main purpose of the session will be for us to connect with the beliefs and theories we hold which inform the way in which we respond to the work students do.

Topic Group B ***Body, Tool, and Symbol : Semiotic Reflections on Cognition***
Leader: Luis Radford

Although 20th century psychology acknowledged the role of language and kinesthetic activity in knowledge formation, and even though elementary mathematical concepts were seen as being bound to them (as in Piaget's influential epistemology), body movement, the use of artefacts, and linguistic activity, in contrast, were not seen as *direct* sources of abstract and complex mathematical conceptualizations.

Nevertheless, recent research has stressed the decisive and prominent role of bodily actions, gestures, language and the use of technological artefacts in students' elaborations of elementary, as well as of abstract mathematical knowledge (Arzarello and Robutti 2001, Robutti 2003, Nemirovsky 2003, Núñez 2000). In this context, there are a number of important research questions that must be addressed. One of them relates to our understanding of the relationship between body, actions carried out through artefacts (objects, technological tools, etc.), and linguistic and symbolic activity. Research on the epistemological relationship between these three chief sources of knowledge formation is of vital importance for a better understanding of human cognition in general, and of mathematical thinking in particular. Using transcript and videotape analyses from a longitudinal classroom-based research program and drawing from Vygotsky's psychology, Husserl phenomenology, and Wartofsky's epistemology, the goal of this thematic group is to present an analysis of the mutual relationship between body, tool, and symbol as a key component of human cognition.

Topic Group C ***Standards for Excellence in Teaching Mathematics***
Leader: Steven Thornton

Mathematics education in Australia has, in recent years, undergone many of the same changes evident in mathematics education throughout the world. Curriculum documents have emphasized mathematics as a creative endeavour, have placed high value on problem-solving and mathematical thinking, and have promoted a technology-rich environment for mathematics learning. Australian-produced teaching resources for mathematics have a high profile, and are well-regarded, both nationally and internationally.

Yet when one looks more closely at the actual practice in mathematics classrooms, such as in the TIMSS 1999 video study, it is often dominated by a rule-based, instrumental approach, in which skills take precedence over understanding, and breadth of content takes precedence over depth. Translating the rhetoric into practice remains a critical issue for Australia's teachers.

The Australian Association of Mathematics Teachers has, during the past three years, undertaken a major project to publish Standards for Excellence in Teaching Mathematics in Australian Schools. These Standards have been developed using teacher focus groups and teacher work samples, to ensure that they have practical validity and are owned by the profession. The Standards identify characteristics of excellent teachers of mathematics in terms of their professional knowledge, their professional attributes and their professional practice.

The extent to which these Standards can impact upon the day-to-day experiences of children in Australian schools is the principal question facing AAMT in the next few years. It is hoped that the Standards will provide both a framework for future professional development, and a vehicle through which teachers from all levels of schooling can improve their practice and gain accreditation as highly accomplished teachers of mathematics.

This presentation will provide details of the Standards and their development, and will open discussion on the key issue of how professional standards of excellence can be translated into enhanced student learning.

Topic Group D ***A Retrospective on the Introduction of Probability and Statistics in the Quebec Elementary Level Curriculum: An Intervener's Point of View***

Leader: Renée Caron

Following a seminar held in Royaumont in 1971, UNESCO published its volume III of *Tendances Nouvelles de L'enseignement de la Mathématique (New Developments in Teaching Mathematics)*. A chapter dedicated to probability and statistics stated the growing importance of these two mathematical components and presented the results of an experiment done among primary and secondary school students.

Following my participation at a CIEAEM meeting held in Bordeaux in 1974, I was invited to co-author a series of articles on the subject for the journal *Instantanés Mathématiques.* While writing these articles I began to conduct experiments with various activities in elementary-grade classrooms, with the collaboration of teachers interested in the subject.

Through experiments ranging from the exploration of combinatorics with children of age 6 to the reflection on survey results with children aged 11-12, I was able to identify certain favourable factors for introducing probability and statistics in the curriculum, as well as some less favourable factors.

As proposed quite timidly in the 1980 syllabus and now according to the *Program of Studies for Quebec Schools*, learning probability and statistics should start as early as the first grade via the process of application. In the context of a new paradigm emphasizing cooperative learning from problem situations, it is appropriate to look again at these experiments and analyse their current relevance.

Topic Group E ***Writing for FLM***

Leader: Laurinda Brown

Writing for *flm* begins with reading *flm*. In **23**(3) there was a collection of short pieces of writing under the heading 'Loved Articles' (p. 29) exploring what those authors value in articles published by the journal. You can access the articles themselves from the *flm* web-pages <http://www.flm.math.ca>. You are invited to sharing your thoughts about a particular article that has stayed with you for some reason. Why does it stand out for you? How have you used it? Or/and … Send a paragraph or two or three to me at flm-editor@bris.ac.uk before the meeting or come to the topic group with your thoughts. What are the ranges of writing that we want to read in *flm* – when we have worked on that we will think about actually writing the article we want to read for *flm*.

NEW PHD SESSIONS

Florence Glanfield ***Mathematics Teacher Understanding as an Emergent Phenomenon***

My student examined the research question "In what ways do mathematics teachers grow in their understanding of mathematical processes within the context of professional conversation?" I used an enactivist view of cognition as a frame for teacher understanding and narrative inquiry as a way to describe the emergence of understanding. Within the professional conversation of four teachers about mathematical processes, I noticed individual understanding, collective understanding, and understanding within the body of mathematics emerging. I used Pirie & Kieren's (1994) theory of dynamical growth of mathematical understanding to interpret emergent individual understanding; Davis & Simmt's (2003) work on collective understanding to interpret emergent collective understanding; and Davis's (1996) work around understanding within the body of mathematics to interpret emergent understanding within the body of mathematics.

Luis Saldanha ***"Is this sample unusual?": an investigation of students exploring connections between sampling distributions and statistical inference***

This study explores the reasoning that emerged among eight high school juniors and seniors as they participated in a classroom teaching experiment addressing stochastic conceptions of sampling and statistical inference. Toward this end, instructional activities engaged students in embedding sampling and inference within the foundational notion of *sampling distributions*—patterns of dispersion that one conceives as emerging in a collection of a sample statistic's values that accumulate from re-sampling.

The study details students' engagement and emergent understandings in the context of instructional activities designed to support them. Analyses highlight these components: the design of instructional activities, classroom conversations and interactions that emerged from students' engagement in activities, students' ideas and understandings that emerged in the process, and the design team's interpretations of students' understandings. Moreover, analyses highlight the synergistic interplay between these components that drove the unfolding of the teaching experiment over the course of 17 lessons in cycles of design, engagement, and interpretation. These cycles gave rise to an emergent instructional trajectory that unfolded in four interrelated phases of instructional engagements:

Phase 1: Orientation to statistical prediction and distributional reasoning;
Phase 2: Move to conceptualize probabilistic situations and quantify unusualness;
Phase 3: Move to conceptualize variability and distribution;
Phase 4: Move to quantify variability and extend conceptions of distribution.

Analyses reveal that students experienced significant difficulties in conceiving the distribution of sample statistics and point to possible reasons for them. Their difficulties centered on composing and coordinating imagined objects with actions into a hierarchical structure in re-sampling scenarios that involve: a population of items, selecting items from the population to accumulate a sample, recording the value of a sample statistic of interest, repeating this process to accumulate a collection of data values, structuring such collections and conceiving patterns within and across them in ways that support making statistical inferences.

Nathalie Sinclair ***The Role of Aesthetics in Mathematical Development and Learning***

Mathematicians assure us that aesthetics play a very important, at times even vital, role in their mathematic activities. But how? And in what relevance could this aesthetic nature of mathematical activity for mathematicians have when it comes to students learning mathematics? In presenting my doctoral thesis, I will use theoretical frames as well as empirical data to describe more precisely how the aesthetic values and judgements play three distinct and necessary roles in the course of work of mathematical nature. Following this, I will discuss some pedagogical strategies that, it seems to me, place these aesthetic values and judgements within reach of students.

Laurent Theis ***The Issues of Learning the Equals Sign for Grade One Students***

While learning numbers and basic arithmetic operations during the first grade, many children don't consider the equals sign as an indicator of an equality relation or as an indicator of equivalence; instead, they consider it as an operator signifying that they should write a response according to the operation that precedes it. This interpretation generates two types of difficulties: these children don't often accept unconventional equalities and they aren't able to correctly complete equations that don't correspond to the "a + b = __" structure.

The principal objective of our doctoral research was to describe the comprehension process of the equals sign by students in the first grade. We taught the meaning of this symbol to three students within the framework of a teaching experiment.

The proposed activities were based on a conceptual analysis of equivalence and equality relations according to the Bergeron and Herscovics model (1988). While enacting the instructional activities, we tried to establish a link between written mathematics and concrete representation.

At the end of our teaching sequence, the three students made progress in their comprehension of the equals sign, with two students making significant progress. Despite this progress, the learning of the equals sign constitutes a powerful cognitive obstacle: We were able to note with all three students to different degrees a tendency to return to the conception of the equals sign as being an operator, principally when faced with new situations. Two of the three children were unable to maintain the same performances in the post-test as they had demonstrated near the end of the teaching sequence.

We were able as well to illuminate the importance of a well developed procedural understanding in order to progress in a significant and lasting manner in the learning of the equals sign: the child having a weak procedural understanding was not successful in constructing a solid comprehension of the equals sign as an operator. It was their diverse strategies for addition that permitted the two other children to make more lasting progress.

Irene Percival ***An investigation into the use of historical and multicultural mathematics in the elementary school classroom***

The use of historical perspectives in the mathematics classroom has long been promoted in the literature, and many current mathematics curricula call for activities to be presented to help students understand the cultural background of the subject. However little or no guidance is provided as to how this can be done, and teachers' limited acquaintance with cultural aspects of mathematics calls the feasibility of this goal into question.

To explore this issue, I worked with ten elementary teachers to help them acquire some knowledge of the multicultural history of mathematics. My classroom-based research focussed on six teachers from this group, documenting the different approaches they took to introduce these ideas to their students, and analysing their reactions to the work, the benefits they observed and the problems they encountered. While the results suggest that all teachers *can* teach mathematics in ways which help students become aware of the subject's cultural background, it was apparent that only those teachers who have a particular interest in this area *will* do so.

Peter Gunnar Liljedahl ***The Aha! Experience: mathematical contexts, pedagogical implications***

> *In that moment when the connection is made, in that synaptic spasm of completion when the thought drives through the red fuse, is our keenest pleasure.*
>
> - Harris (2000, p. 132)

The AHA! experience is a term that captures the essence of the experience of illumination. In the context of 'doing' mathematics it is the *EXPERIENCE* of having an idea come to mind with "characteristics of brevity, suddenness, and immediate certainty" (Poincaré, 1952, p.54). In the studies presented here I examine this extra-logical process in pursuit of the answers to three questions:

1. *What is the essence of the AHA! experience?*
2. *What is the effect of an AHA! experience on a learner?*
3. *Can the AHA! experience be controlled, and if so can it be invoked?*

The data for this pursuit comes from three distinct sources; the anecdotal reflections of 76 undergraduate students, the anecdotal reflections of 25 prominent mathematicians, and the mathematics journals of 72 preservice teachers. The results indicate that, although the AHA! experience is precipitated by the sudden coming to mind of an idea, what actually sets the AHA! experience apart from other mathematical experiences is the affective components of the experience, and only the affective component. That is, what serves to make the experiences extraordinary is the affective response invoked by the experience of an untimely and unanticipated presentation of an idea or solution, not the mystery of the process, and not the idea itself. Hence, the AHA! experience has a positive and, sometimes profound, transformative effect on a learner's beliefs and attitudes about mathematics as well as their beliefs and attitudes about their ability to do mathematics. The results also indicate that a measure of control can be exercised over the AHA! experience through the manipulation of a problem solving environment. As such, the results provide a pedagogical approach to problem solving that can be used in the classroom. Furthermore, the methodological contribution of a new form of journaling for the tracking of students' problem solving processes is presented.

Harris, T. (2000). *Hannibal*. New York: Dell.
Poincaré, H. (1952). *Science and Method*. New York: Dover.

PANEL

Is there anything distinctive about Canadian mathematics education?

Organizer: Malgorzata Dubiel

Members of the panel will attempt to address the following questions: Is there anything distinctive, "Canadian", about mathematics education in Canada? What are the issues and problems facing mathematical education in Canada? How does our situation compare to what is happening in other countries? What did we achieve during the last 50 (25?) years? How having two languages and several provinces impacts the issues in mathematics education in Canada? Is there a sufficient exchange of experiences between Quebec and the rest of Canada to really benefit from each other experiences?

CMESG 2004 - Schedule

Friday 28 May	**Saturday** 29 May	**Sunday** 30 May	**Monday** 31 May	**Tuesday** 1 June
9:00-9:30	Working Groups 9:00-10:30	Working Groups 9:00-10:30	Working Groups 9:00-10:30	New PhDs 9:00-9:30
9:30-11:00				Panel 9:30-11:00
11:00-11:30	Working Groups 11:00-12:15	Working Groups 11:00-12:15	Working Groups 11:00-12:15	Coffee Break 11 :00 – 11 :30
11:30-12:00				Closing Session 11:30-12:30
12:00-12:30	Lunch 12:15-13:45	Lunch 12:15-13:45	Lunch 12:15-13:45	
12:30-13:30				12:30-13:30
GDM Plenary (Jacques Bélair) All CMESG members are welcome! 13:30-14:30	Small groups 13:45-14:30	Plenary 2 (Nicolas Bouleau) 13:45-14:45	Small groups 13:45-14:30	13:30-14:00
				14:00-14:30
Registration from 14:30-16 :30 Friends of FLM 15 :30-16 :20	Discussion of Plenary 1 14:30-15:30	Ad hoc sessions 14:45-15:15	Discussion of Plenary 2 14:30-15:30	14:30-15:00
				15:00-15:30
	Coffee Break 15:30-16:00	Excursion Departure at about 15:30	Coffee Break 15:30-16:00	15:30-16:00
	Topic groups 16:00-18:00		Ad hoc sessions 16:00-16:30	16:00-16:30
Cocktails Joint GDM – CMESG 16:45 – 17:45			AGM 16:30-18:00	16:30-18:00
Supper 17:45 -18:45	New PhDs 18:00-18:30		Supper at Manoir Montmorency Departure at about 18:00	18:00-18:30
CMESG Opening 18:45-19:30	BBQ 18:30-20:00	Supper (at the site of excursion) 18:30-21:00		18:30-19:00
Plenary 1 (Claire Margolinas) 19:30-20:30				19:00-20:00
Reception 20h30 - …				20:00-…

Please note : There is no time built into the schedule to get from one event to the next. Please plan accordingly.

Colloque GDM 2004, Université Laval, May 27 and 28
Tackling complexity: a new goal for mathematics education?

As the new math curriculum is progressively being defined and deployed in Quebec, with complexity as one of the recurrent underlying themes, this meeting comes as an opportunity to share experience and reflect upon the development of a sense of complexity, at any level of math education, as much among teachers and students as among researchers.

The joint organization of GDM 2004 (May 27 and 28) with the annual meeting of CMESG (May 28 to June 1) will allow participants from both groups to meet and participate in common activities.

In particular, the participants of the CMESG meeting are warmly welcome to attend the GDM plenary session of Jacques Bélair, scheduled for 13:30 on May 28:

CHAOS AND COMPLEXITY, MODELS AND METAPHORS:
WHAT LESSONS FOR THE TEACHING OF MATHEMATICS?

By Jacques Bélair

Département de mathématiques et de statistique, Centre de recherches mathématiques and Faculté des études supérieures (Université de Montréal) and Centre for Nonlinear Dynamics in Physiology and Medicine (McGill University)

After Catastrophe Theory in the 1970s and Chaos theory in the 1980s, Complexity theory appeared in the 1990s as a conceptual framework suitable for a new interpretation of the dynamics of many phenomena, such as social systems. This interest has not waned, as shown by the December 2003 special issue of the journal *Pour la Science,* which puts forward Complexity as "The Science of the Twenty-first Century".

Beyond alphabetical coincidence, a certain number of common features connect these three theories. Among others, they appeared in a context supporting a move towards interdisciplinary approaches, they are based on qualitative properties, and especially, they developed in a mathematical context of modeling physical and, to a certain extent, biological systems. However, some important systemic differences are evident in the elaboration of physical models on the one hand, and biological models on the other hand: in some ways the latter seem to be as much metaphors as mathematical models.

We will present, in this context, and with the aid of examples, those elements of Complexity theory which appear to us to be the most structurally fundamental, their consequences for the organisation of the teaching of mathematics, and the degree to which new approaches to teaching (Compentency based approaches, cross-curricular competencies, multidisciplinarity) adhere to them.

And all CMESG members who would wish to participate also in the rest of the GDM activities are kindly invited to register and consider submitting a proposal at http://xserve.scedu.umontreal.ca/gdm2004

Note: Except for the session given by Jacques Bélair (where translation will be provided), the GDM activities will be held in French.