

DISCUSSION GROUPS

DG01: MATHEMATICS AND GENDER: SHOULD THE WORLD STILL CARE?

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In 2001, Gilah Leder discussed in her keynote address at PME in Utrecht that

gender equity concerns have attracted considerable research attention by (mathematics) educators in many countries, and that over time the body of work on gender and mathematics education has increasingly reflected a greater diversity of inquiry methods used to examine and unpack critical factors. Research reports presented at PME contain only limited evidence of these trends (p. 1-41).

Our goal for this discussion group is to take up the challenge implicit in Gilah Leder's talk and provide a venue for overt attention to this issue within PME. And while attention to issues of equity has shifted its focus away from gender in some countries, gender remains a salient variable of study as evidenced at ICME 10.

Activities

We will begin with brief introductions and a short reading to stimulate discussion. Depending on the size of the group, we may break into small groups to discuss critical questions such as those posed below or others that emerge from the participants. Small and large group discussions will be synthesized into key ideas for continued discussion, possible joint research, or future action.

What are critical issues in your country related to gender?

What is the interaction of gender with other factors such as socioeconomic status, race, or ethnicity? We have been discussing the need for doing research that integrates issues of gender, race, ethnicity, and social class for a number of years and it is still an extant agenda item.

Which groups (or sub-groups) of boys and/or girls may be advantaged or disadvantaged in their mathematics learning?

Who has influence at the state and/or national level on the mathematics curriculum and/or the assessment program? Is gender a factor here?

What does a researcher do when gender is no longer on the agenda? How does one access resources to support questions of continued importance?

What methodological approaches and theoretical framework(s) would enable us to investigate difficult and unresolved issues concerning gender?

DG02: ABSTRACTION IN MATHEMATICS LEARNING

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At a forum in PME-26 (Boero et al., 2002), three approaches to the study of abstraction in mathematics learning were presented. Papers based on one of these, the RBC (Recognizing, Building-With, Constructing) model, have been presented at PME every year since 2001 (see references below).

At PME-28 last year, another view of abstraction was presented by Mitchelmore & White (2004), who argued for a reconsideration of the role of empirical abstraction in the learning of fundamental mathematical ideas.

Short, informal discussions at PME-28 began to explore the similarities and differences between the empirical abstraction model and the RBC model. The aim of the proposed discussion group is to continue and widen the interaction process, with the aim of refining both models and identifying their respective ranges of application. The ultimate aim is to improve learning through the design of learning environments that enable more students to abstract more mathematics.

It will be assumed that participants are already familiar with empirical abstraction and the RBC model. Each session will then focus on the learning of a particular topic (one elementary, one more advanced). In small groups, participants will explore how the two models could help to interpret student-teacher interactions in sample interview protocols. General discussion will then draw inferences about the robustness of each model.

References

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- Mitchelmore, M. C., & White, P. (2004). Abstraction in mathematics and mathematics learning. *PME-28*, Vol. 3, pp. 329-336.
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DG03: RESEARCH BY TEACHERS, RESEARCH WITH TEACHERS

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This Discussion Group was introduced at PME 28 as the follow-up from the Plenary Panel *Teachers who navigate between their research and their practice* held at PME 27/PME-NA 25 in Hawai'i in 2003. We invite all who are interested in practitioner research, especially teachers who are (or wish to be) researchers in schools as well as university people who would like to do collaborative research with teachers in schools. Teachers who do research in their classrooms deal intimately with the focal interest of our PME 29 conference, namely *Learners and learning environments*. We submit that as teachers study closely what is going on in their classrooms, they may well come to better understand the mathematics and the children's thinking, and this may in turn affect their practice (Novotná, Lebethe, Rosen & Zack, 2003, p. 85-89).

For the discussions we propose to use as points of departure several points which were raised during the sessions of DG 4 at PME 28 and during follow-up informal discussions:

- The continuum from a reflective practitioner to a teacher-researcher.
- Encouraging increased involvement of teachers in researching their own practice; importance of well-defined responsibility and tasks for teachers and researchers who are engaged in joint research.
- Ways to engage pre-service students in reflective practice and research.
- Sharing of models of research methodology used in pre- and in-service teacher education programs, and seeing whether, and if yes how, they might apply to teacher research.

The questions will provide a general framework for the two Discussion Group sessions. The considerations will be based on a particular example and developed in various directions towards a more general perspective.

References

- Novotná, J., Lebethe, A., Rosen, G., & Zack, V. (2003). Navigating between theory and practice. Teachers who navigate between their research and their practice. Plenary Panel. In N. Pateman, B. J. Dougherty, & J. T. Zilliox (Eds.), *PME27 and PME-NA25*, Vol. 1, pp. 69-99.
- Novotná, J., Lebethe, A., Rosen, G., & Zack, V. (2004). Research by teachers, research with teachers. Discussion group 4. In: *PME 28*. Eds. M.J. Høines, A.B. Fuglestad. Bergen University College: Vol. 1, 262.

DG04: THOUGHT AND LANGUAGE IN THE CONTEXT OF MATHEMATICS EDUCATION

Coordinators: Jorge Tarcísio da Rocha Falcão (Universidade Federal de Pernambuco, Department of psychology-Brazil), Steve Lerman (London South Bank University, Department of Education – UK), Cristina Frade (Universidade Federal de Minas Gerais – Centro Pedagógico – Brazil), Luciano Meira (Universidade Federal de Pernambuco, Department of psychology-Brazil).

The group will focus on some approaches concerning the theoretical conceptualization of thought and language. The contributions of some authors will necessarily (but not exclusively) be discussed (see references). We will also try to discuss the nature of mathematical activity in this theoretical context. Aims include:

1. To discuss some theoretical contributions concerning the relationship between thought and language in the context of mathematical activities at school.
2. To examine some empirical data (videorecords) concerning students' mathematical activity.
3. To establish connections between points 1 and 2, in order to improve both research and educational practice in mathematical education.

GUIDING QUESTIONS

- a) Are thought and language different processes? If so, what are their specific characteristics and developmental pathways? To which extent these processes can be (or cannot be) investigated as detached or independent?
- b) What are the relevant consequences of this discussion to mathematical education?
 - b.1.) In which extent is mathematical competence a discursive competence?
 - b.2.) What is the theoretical status of non-explicit pragmatic abilities of illiterate mathematical users (e.g., carpenters dealing with geometrical concepts of area and/or perimeter, third world “children of the streets” dealing with money in real business-context)?

References

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- Vygotski, L.S.(1987) *Thought and language*. Massachussets, The Massachussets Institute of Technology.
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DG05: TOWARDS NEW PERSPECTIVES AND NEW METHODOLOGIES FOR THE USE OF TECHNOLOGY IN MATHEMATICS EDUCATION

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At PME 28 we started the discussion group aiming to initiate a dialogue that moves away from current methods and frameworks to new perspectives and new methodologies for considering the use of technology in mathematical education. Three general questions led the discussion:

1. What perspectives are used to investigate the use of technology in Mathematics Education in different countries?
2. How would new perspectives allow us to re/think the role of users of technology?
3. What new methodologies would enable us to investigate difficult issues concerning teaching and learning situations in microworlds environment?

The first session went as freely as possible for encouraging the participants to speak about their own work, own perspectives and views about Technology: its use and the role of its users. There were about 20 participants who vividly engaged in the discussion while listening to each other's views. We spent most of the session on this discussion, leaving the last five minutes to decide what "we" would be doing about the second session. The "conversation" was very fruitful for all participants as a way of knowing where each of us come from in terms of perspectives and methodologies. This session served as a background to what this discussion group could come to be and what direction it could take.

In the second session, Bibi Lins was asked to present some of the known approaches about Technology and introduced the approach of treating Technology as Text and users as readers from an Anti-Essentialist viewpoint (Lins 2002, Woolgar 1997) to be discussed within the group. The discussion was about four different approaches to Technology: technological determinism, social shaping, actor-network and technology as text.

As it came to be a quite stimulating discussion, the coordinators were strongly asked to carry on the discussion group to the PME 29 and gradually to build up what "we" would like to do and to take from it.

Some of the participants, from Australia, had suggested inviting some school teachers to come along to make it even more interesting and to have the opportunity of sharing the teachers' views about Technology apart from the researchers and mathematics educators'.

INDIGENOUS COMMUNITIES AND MATHEMATICS EDUCATION: RESEARCH ISSUES AND FINDINGS

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This new Discussion Group grew from a paper delivered at PME28 which focused on the issues surrounding research in mathematics education in rural and remote Queensland Indigenous communities. The discussion that followed indicated that researchers in Indigenous mathematics education in other countries are also challenged by the need to develop teaching and learning practices that will better redress the culturally-shared under-performance of Indigenous students when compared with non-Indigenous students' performance. Another major issue to emerge was the ethics of Indigenous research being undertaken by non-Indigenous researchers and the subsequent validity of findings.

The aim of the Discussion Group is to build a community of PME members from around the world who have researched Indigenous mathematics education (or who would like to undertake research in the field but are unsure of the protocols involved) in order to enhance mathematics outcomes and refine research methodologies appropriate for Indigenous communities. The two sessions will provide an opportunity for the coordinators and other researchers to outline their research and the findings that appear to be emerging from these studies. However, the major focus of the sessions will be to examine implicit assumptions that may be unwitting barriers to research outcomes that are beneficial to Indigenous communities. For example: *Do Indigenous people share many researchers' imperatives with regard to the efficacy of high mathematics performance?*

Research in Indigenous mathematics education has complexities that go beyond that of mainstream mathematics education. Smith (1999) argues that much past research has served colonial oppression rather than empowered Indigenous communities. She argues that research, particularly by non-Indigenous researchers, should focus on improving the capacity and life chances of Indigenous peoples. Such research should be community driven, collaboratively planned, executed and analysed – that is, involve real power-sharing between the researcher and the researched. This Discussion Group would like to address questions as to how such as: *Who are the Indigenous? Is this a pejorative label? How can research findings be transformed to practice?* It is hoped that this Discussion Group can collectively plan a way to move forward with respect to further research in Indigenous mathematics education both within and across countries.

Reference

Smith, L.T. (1999). *Decolonising Methodologies: Research and Indigenous Peoples*. Dunedin: University of Otago Press.

DG07: FACILITATING TEACHER CHANGE

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The intention of both pre-service and in-service teacher education as well as that of many interventions in schools is to promote some kind of change in teachers. This change can be an increase in knowledge and skill, but also it can be changes in the (student) teachers' emotional disposition, beliefs or classroom actions. Various case studies suggest that it is possible to influence knowledge, attitudes and/or practices of (student) teachers and many educators have developed their own techniques for changing (student) teachers. This discussion group will consider the nature of such changes and processes for measuring and reporting on such changes.

We can distinguish, for example, the following types of approach to facilitating teacher change:

- Professional development, where the initiative for, and the direction of, change comes from teachers and the educators' task is to facilitate this process.
- A 'therapeutic' approach, where the intention is to facilitate (student) teachers in addressing mathematics anxiety or other attitudes, or their beliefs about the nature of mathematics, the ways people learn mathematics, or the ways mathematics can be taught.
- Structural change, where the aim is to consider the school structures in order to enable more sustained development in the community.

There are several practical problems in facilitating such changes, especially if changes require a radical conceptual change (e.g. in teaching philosophy) or a change in psychologically central parts of the affective domain (e.g. identity). There are also ethical questions about the appropriateness of imposing a change that has not been initiated by the (student) teachers themselves. There are also methodological considerations about ways of measuring and reporting on changes, recognising that self report, especially after some intervention, may be unreliable.

We invite people to share their own experiences of and views about facilitating and researching teacher change.

DG08: EMBODIMENT IN MATHEMATICS: METAPHORS AND GESTURES

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Ornella Robutti, University of Torino, Italy

Janete Bolite Frant, PUC, Sao Paulo, Brazil

The purpose of the Working Session is to continue the study of the role of cognitive processes in mathematical learning, thinking, teaching and communication, deepening our understanding about meaning production in mathematics education by focusing on theories of embodiment, gesture and language. Starting from the framework that considers cognition to be grounded in physical experience, the Working Session will examine how processes such as conceptual metaphor and conceptual blends, drawn from the field of cognitive linguistics, contribute to the construction of mathematical ideas (Lakoff & Núñez, 2000; Fauconnier & Turner, 2002). The session will also take semiotic and psychological views on language and gesture and their roles in teaching, learning and thinking about mathematics (McNeill, 1992, 2000; Goldin-Meadow, 2003).

Depending on the interests of the participants, the Session will consider questions including the following:

- How do gestures relate to speech during social interaction?
- How are gestures meaningful in teaching situations?
- When does gesture reveal thoughts that are not expressed in speech?
- What are the relationships among conceptual metaphors and blends, gesture and language?
- How can cognitive linguistics and semiotics help in understanding mathematics learning and improving mathematics teaching?

The structure will include an introductory review of basic concepts, followed by sharing of data or problems to be jointly analyzed within smaller groups, concluding with a discussion of progress made in understanding and synthesizing the topics of the session.

References

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- Goldin-Meadow, S. (2003). *Hearing gesture: How our hands help us think*. Cambridge, MA: Belknap.
- Lakoff, G. & R. Nunez (2000). *Where mathematics comes from*. NJ: Basic Books.
- McNeill, D. (1992) *Hand and mind: What gestures reveal about thought*. Chicago: Chicago University Press.
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DG09: DEVELOPING ALGEBRA REASONING IN THE EARLY GRADES (K-8): THE EARLY ALGEBRA WORKING GROUP

Coordinators: Elizabeth Warren & Tom Cooper

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The Early Algebra Discussion Group's focus is on investigating and describing what we construe as the possible geneses of algebraic reasoning in young children, and in developing and investigating ways to enhance that reasoning through innovative instruction, applications of appropriate technology and professional development for teachers. The EADG was formed in response to a call form the International Commission on Mathematical Instruction (ICMI) to hold a study conference on "The Future of the Teaching and Learning of Algebra" in December, 2001 in Melbourne. Following that initial conference, the group has conducted working session at PME 27/PME-25 meeting in Hawaii, 2003 and PME28 meeting in Bergen, 2004.

PLANNED ACTIVITIES FOR PME29

We plan to hold two 90 minutes sessions. While research into children's capacity for early algebraic thinking began almost four decades ago, it has, until recently, had little impact on the mainstream research, which in the area of algebraic thinking was largely focused on the introduction of algebra in secondary or middle school.

The first session reviews the research that has occurred in this area in the last 3 years. Researchers in Early Algebraic Reasoning will present a brief summary of their research together with examples of different approaches for fostering algebraic reasoning, the key transitions in developing understanding for both teachers and young children, and the cognitive obstacles that both teachers and young children experience. Participants will be encouraged to engage in discussions about

1. What constitutes algebraic reasoning in the elementary classroom? What do we know about what young students can do algebraically?
2. What do we know about Teacher's Knowledge with regard to early algebraic reasoning?
3. What do we know about how early algebra impacts on student learning in secondary mathematics? What needs further research?

The second session specially focuses on research with respect to patterning. There appears to be very limited literature on patterning per se. But commonly researchers have used patterning ability as an indicator of readiness for other mathematical ideas or as a precursor to reasoning. The following questions will be used to guide the discussion:

1. How does an ability to pattern support mathematical understanding?
2. What research has specifically occurred in patterning per se? What needs further research?

WORKING SESSIONS

WS01: TEACHING AND LEARNING MATHEMATICS IN MULTILINGUAL CLASSROOMS

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Richard Barwell, University of Bristol, UK

Multilingualism is a widespread feature of mathematics classrooms around the world. In particular, for many learners the main language used in their mathematics lessons is a language they are in the process of learning. Research on mathematics education in such classrooms has generally argued that learners' home languages should play a role as learners develop proficiency in the main classroom language. What does this mean for the selection and design of tasks for use in multilingual classrooms? What kinds of tasks are relevant for use in multilingual mathematics classrooms in which learners learn mathematics in a language that is not their home language? Selection and design of tasks for learners to work on is an important activity that all teachers engage in every day. The tasks that learners work on structure their experiences of mathematics and are central in their mathematical development. The aim of this working group is to develop possible criteria for the selection and design of tasks that are appropriate for use in multilingual mathematics classrooms.

ACTIVITIES

The two working sessions will be devoted to sharing, designing, doing, refining and critiquing tasks for use in multilingual mathematics classrooms, as well as developing possible criteria for the selection and design of such tasks. In the first session, we invite participants to work on selected mathematics tasks. We will then invite participants to reflect on the appropriacy of the tasks for learners who learn mathematics in a language that is not their home language.

In the second session, we invite participants to modify selected items or design tasks or activities for a mathematics class from a multilingual context with which they are familiar. We will then reflect on the appropriacy of the tasks for multilingual learners. From these discussions we will develop possible criteria for the selection and design of tasks that are suitable for learners in multilingual mathematics classrooms.

WS02: EXAMINING THESES

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Agder University College

Many members of PME are involved in the supervision of students studying for higher degrees. Additionally they act as examiners of the theses that are usually needed for successful completion. We have had a Discussion Group on the topic 'Examining Theses' for a few years. In these discussions we have heard of situations in various universities and the advice that is given to examiners. We have started to compile a book list of recommended texts and we have aired opinions on what are legitimate comments for an examiner to make. The expectations of students have been particularly interesting.

We now wish to use these two working sessions to (a) discuss, design and write an article for Educational Studies in Mathematics on the topic and (b) produce some guidelines which might help students and new examiners.

