Abstract for working group

Geometry Working Group
Keith Jones, University of Southampton and Taro Fujita, University of Glasgow

The Royal Society report on the teaching and learning of geometry argues that "the most significant contribution to improvements in geometry teaching will be made by the development of good models of pedagogy, supported by carefully designed activities and resources". This meeting of the Geometry Working Group provides an opportunity to consider approaches to the teaching of geometry developed in China and Japan and to consider what research might have to contribute to developing new pedagogic approaches.

Abstracts for research sessions

The role of the hide/show tool in Cabri in the context of the proving process
Federica Olivero, University of Bristol

This paper draws on a study investigating the use of dynamic geometry software in the context of open geometry problems requiring conjecturing and proving at secondary school level. The possibility of hiding and showing elements in Cabri is a 'new' powerful tool of dynamic geometry software, because according to what is left visible in the figure at stake, the focus can shift to different elements. What students see on the screen influences the construction of conjectures and proofs and the possibility of choosing what elements to leave visible influences the proving process. For example, showing construction lines, together with dragging the figure, helps the students keep in mind the properties of the construction. Hiding some elements may be useful when wanting to focus on some particular configuration. This will be illustrated through examples from students' work and implications for teaching will be drawn.

Relationships with/in primary mathematics: learning and working with primary teachers
Jeremy Hodgen & Mike Askew, King's College London

In this paper we explore two aspects of primary school teachers' emotional relationships with mathematics. Firstly, it is commonly assumed that individuals are either drawn to or avoid mathematics per se: the pleasure/pain dimension. Secondly and more recently attention has been turned to the social aspects of learning mathematics and the 'defended self' that is either drawn to or avoids maths: the shame/pride dimension. Drawing on the case of a primary teacher who became a teacher researcher we examine the interplay of these two dimensions and the implications for teacher education.

Learners' shifting perspectives on randomness
Peter Johnston-Wilder, University of Warwick

In this session, I present the results of probing learners' understanding in situations involving apparently familiar random generators, such as dice, coins and sampling bags. Interviewees were invited to talk about their experiences of making sense of the emerging sequence of outcomes from repeated trials using different generators, some of which were biased. Analysis of interviews with learners revealed distinct ways of viewing the phenomena represented by the interview tasks. Drawing upon the local and global

meanings of randomness identified by Pratt (1998), I find that learners rapidly shift their perspective between the local and the global as they seek to interpret the observed outcomes.

What factors influence conviction in mathematical arguments?
Matthew Inglis and Juan Pablo Mejia-Ramos, University of Warwick

Harel and Sowder (1998) have proposed the so-called "proof schemes" framework for categorising the factors which affect whether or not students find an argument convincing and persuasive. In this session we will engage the audience by asking them to rate their level of conviction in a mathematical argument, before reporting data that looks at how the argument was so-rated by successful undergraduates and research staff. By considering this argument, and our data, we aim to provoke a critical discussion on to what extent certain factors influence conviction in mathematical argumentation, and about what factors students should be encouraged to consider when evaluating arguments.

Probing understanding through example construction: the case of integration
Shafia Abdul Rahman, Open University

Activities that reveal something about learners as they become aware of aspects of mathematical concepts can inform about how learners' understanding is usually structured. In this paper I consider example construction tasks as research probes to reveal learners' awareness of integration. Forty students studying A-level, engineering, mathematics and education have been invited to construct relevant mathematical objects meeting specified constraints, following Watson and Mason (2005). By becoming aware of features of a concept that were not previously at the focus of their attention, learners revealed to themselves aspects of the concept that were not previously salient to them. Getting learners to talk about these aspects not only reveals the dynamics and depth of their awareness but acts to promote and enrich their appreciation of the concept.

The company of words: using concordances to develop language in the maths classroom
Frank Monaghan, Open University

In this session I will describe the use of concordancing software to explore a corpus of mathematics materials. The aim is to show how this could deepen the understanding of the register of mathematics and to develop a more linguistically principled curriculum for EAL learners in particular.

Why do teachers stay?
Jan Winter and Laurinda Brown, University of Bristol

In this session we will present data from a small research project conducted at the University of Bristol. We contacted as many ex-students from our PGCE course, from 7 chosen cohorts, as we could trace. We asked them a range of questions about why they are still teaching (if they are) or why not. This is a development of work we began in 2002 and presented at an OU conference in 2003. We will share some of what we see as the key factors which make teaching attractive and consider how these factors can be maximised and more negative factors reduced. We will be interested to discuss this work with colleagues and hear their perspectives on the issues we raise.

Moving beyond the 'procedures-first or concepts-first' question
Chronoula Voutsina, University of Southampton

Existing research has provided evidence on the positive correlation between procedural and conceptual knowledge as well as marked discrepancies between these two components of arithmetic. The ongoing debate on which of the two types of knowledge develops first has moved the focus away from exploring the interaction of the two types of mathematical knowledge. The paper presents findings from a study that used the micro-developmental method to explore the process of change in 5-6 year old children's successful strategies when tacking a multiple-step arithmetic task. The findings illustrate the bidirectional relations that are formed between the two types of knowledge when children continue to work upon their successful problem solving strategies. The paper argues for the need to provide children with structured activities and teaching that enables them to learn how to use their knowledge of procedures and concepts both to evolve their strategies for solving known problems and to build new strategies for solving new problems.

Researching mathematics classrooms: moving from 'insider' to 'outsider' research methods
Julie-Ann Edwards, University of Southampton

For the first 15 minutes of this session, I intend to describe my own experiences of moving from 'insider research', researching aspects of collaborative group work in my own mathematics classroom, to working as an 'outsider researcher' researching this same area in the classrooms of others. I will briefly outline the problems associated with identifying appropriate sites for this research and the needs of teachers willing to be involved in the research. The final 15 minutes is intended as an open discussion in which some of the experiences and expertise of others, either those having made the same transition or those supporting others to do so successfully, could fruitfully inform both the presenter's work and that of others.

Observing subject knowledge in action: characteristics of lesson observation feedback given to trainees
Andrew Harris, Canterbury Christ Church University

While many research studies have been undertaken in order to consider the nature of the relationships which exist between the subject knowledge of trainee teachers and their teaching output, relatively few studies have considered the lesson observation feedback given to trainee teachers about aspects of their practice which derive from their mathematics subject knowledge. This session will focus on the findings of a small-scale study in which written feedback given to primary trainee teachers by school-based mentors, university mathematics tutors and other university tutors as part of routine lesson observations was investigated through a form of content analysis in conjunction with a small number of interviews. The study highlights a number of aspects of mathematics teaching which feature frequently in written feedback given to trainees while other aspects are rarely mentioned. Further issues are raised about the awareness of some observer groups in relation to contingency-based elements of mathematics teaching provided by primary trainee teachers.

Gender, mathematics and identity: an introduction to and critique of Simon Baron-Cohen's systemiser/empathiser dichotomy

Melissa Rodd, Institute of Education and Margaret Brown, King's College London

Arising from previous work on mathematics undergraduates' identities, we present and critique some of Simon Baron-Cohen's ideas as expressed in his recent book [1]. Baron-Cohen's central claim is that "the female brain is predominantly hard wired for empathy and the male brain is predominantly hard wired for understanding and building systems" (p1). We interrogate the associated notions of 'systemizing' and 'empathizing' and how they relate to participation in and learning of mathematics. In this paper, we refute the generality of Baron-Cohen's claim through analysis of his argument and discussion of his methods. Furthermore, we consider the subtle effects on females' identity, participation and agency with regard to mathematics at all educational stages that his thesis could have.

1. Baron-Cohen, S., The Essential Difference: the truth about the male and female brain. 2003, London: Penguin.

Subtraction of fractions through the eyes and ears of fifth grade modellers
Andreas O. Kyriakides, Open University

The central question addressed in this session concerns the ways in which modelling activities ground the conditions for a group of fifth graders to experience a progression in their awareness of subtraction of fractions. The teacher's narratives along with students' written work and transcripts of audio-taped class discussions constitute the primary data source for analysis. My attention is particularly drawn to a close examination of a teaching episode that appears to serve my research query. The study documents strong evidence that students could refine their fractional reasoning when exposed to a learning environment that sensitises them to detect problematicity through confronting impasses publicly, questioning themselves and peers, conjecturing and welcoming broken expectation.

The long-term effects from the use of CAME (Cognitive Acceleration in Mathematics Education), some effects from the use of the same principles in Y1&2, and the maths teaching of the future
Michael Shayer and Mundher Adhami, Kings College London

In this session we shall summarise the findings reported in a paper accepted by Educational Studies in Mathematics both on Pre-Post-test results of CAME and also long-term gains in GCSE Maths, Science and English. We shall then discuss the skills of teaching for thinking in maths used in the recent RCPCM project (Realising the Cognitive Potential of Children 5 to 7 with a Mathematics Focus, funded by ESRC). The questions will then be raised, Would it be desirable for these skills to become an essential part of school maths teaching?, and if the answer is, Yes, then, How, in a mode different from previous Government PD initiatives, might some exponential process deliver them into every classroom?

Pedagogical sensitivity and procedural thinking: an uneasy relationship?
Elena Nardi, University of East Anglia
(paper written by Irene Biza, Elena Nardi and Thedossios Zachariades

In the proposed session we will report on a small qualitative study in the course of which we examined the relationship between subject-matter knowledge and pedagogical content knowledge of 53 in-service Greek mathematics teachers in the context of their written responses to a question that involved: solving the equation $|x|+|x-1|=0$, examining a flawed

student solution and providing feedback to the student. Here we will focus on a group of scripts characterised by pedagogical sensitivity but constrained mathematically (substantively and metacognitively). Our analysis will demonstrate how insistence on standard procedural methods, inappropriate contextualisation of otherwise commendable pedagogical practices and inadequate reflection on student thinking may impede didactical effectiveness.

Using discursive psychology in research in mathematics classrooms
Richard Barwell, University of Bristol

Discursive psychology has emerged as an anti-cognitivist, anti-realist perspective on cognition. This approach includes both a theorisation of the role of discursive practice in thinking, and a methodological approach to researching psychological problems. Discursive psychology has informed much of my research into the role of multilingualism in the teaching and learning of mathematics. In this seminar, I reflect on what the adoption of this perspective has allowed me to see, as well as what it may have obscured. These reflections will be illustrated by examples from my own work, as well as examples from other published research. I will conclude by considering what discursive psychology could offer research in mathematics education more generally.

Mechanics should be integral to secondary school mathematics
Stuart Rowlands, University of Plymouth

Mechanics has never been the most popular subject in A-level mathematics, either with the students, the teachers or indeed educationalists. The 'innovative' attempts to popularise the subject over the past two decades appear to have failed and it is conceivable that the subject will be dropped from the A-level syllabus within the next two decades. This presentation will argue the importance of mechanics and why it should be integral to secondary school mathematics. Mechanics is the exemplar of mathematical modelling, is the logical point of entry for the enculturation into scientific thinking and provides the means to develop an understanding of the relationship between mathematics, the theoretical objects of science and the way science and mathematics speaks of the world.

A cultural-historical approach to teaching geometry Part 2: the results of field trials
Stuart Rowlands, University of Plymouth

In Part 1 (BSRLM Warwick, 2006), we discussed a curriculum initiative that aims to 'bring to life' the major 'transformative events' in the history of Greek geometry. In particular, the combination of the intellectual act of abstraction and the possibility of formalised, logical proof were discussed. In Part 2 we will discuss the results of field trials and how groups of year 6, year 9 and year 10 students engaged with these two transformative events.

Developing on-line questionnaires for university mathematicians
Zsolt Lavicza, University of Cambridge

In my talk, I will discuss the development of an on-line questionnaire that I am developing for my dissertation research. By employing this questionnaire, I aim to gauge university mathematicians' use of Computer Algebra Systems (CAS) in undergraduate mathematics courses as well as their thinking about the advantages and disadvantages of CAS use in

university-level teaching. The development of the questionnaire is based on an interview study with mathematicians that I conducted in the past year. Thus, I integrate issues emerged from this earlier study and include concerns described in the mathematics education literature. Adding to the complexity of the questionnaire design, I am examining mathematicians in three countries, Hungary, United Kingdom, and United States, which requires me to consider aspects of international comparative research. In my presentation, I will report on the difficulties that I encountered during the design of this questionnaire and highlight issues to which researchers must pay attention when deciding on using on-line questionnaires among their research methods.

Teaching of multivariable functions with Computer Algebra Systems (CAS)
Csaba Sárvári, University of Pécs, Hungary

The use of CAS in teaching has a considerable influence on the employed teaching methods and on the course content. The symbolic and numeric features of CAS and the opportunity of calculating quickly and accurately perturb the traditional equilibrium between conceptual and procedural work. Pragmatic, epistemic and heuristic values of schemes, procedures, and new heuristics in problem-solving methods can be successfully used in classes. Also, multiple representations of mathematical objects and modularisation, produced with help of CAS, make discovery and experimentation possible in the mathematics classroom. In my talk, I will discuss how we use the built-in and user-made procedures as sources of discovering and exploring the course material. I will highlight ways of using modularisation in our teaching practice. In addition, I will provide examples of model building in the teaching of a multivariable calculus course. Furthermore, I will describe the learning environment in which we teach and the methods we use to support students' work with CAS.

Integer instruction: an experimental comparison
Andreas Koukkoufis and Julian Williams, University of Manchester

In this study two versions of Linchevski & Williams' 'dice games' method for integer addition and subtraction were contrasted in an experimental design with a control group. The study was conducted with year 5 students from Greater Manchester. We will first describe the two methods emphasising their differences and the rational for contrasting them. We will then present some statistical analyses of our experimental data, aiming to investigate the effect of each experimental treatment on students' 'integer abilities'. Following the presentation of the analyses, we will discuss our findings regarding their consequences for integer instruction in year 5.

Children's views of mathematics during an early transfer project from primary to secondary school
Carol Murphy, University of Exeter

The Early Transfer Project in Cornwall aims to support children in their transfer from primary to secondary school. Primary children attend their new secondary school for one month in the summer term to help them adjust to their new school setting. This is seen as particularly supportive in helping children adjust to their new teachers, their new surroundings and the secondary curriculum. Questionnaires were used to ascertain the children's views across the different curriculum areas, including mathematics. Eighteen children were interviewed before, during and after the early transfer period in order to

ascertain more closely their attitudes to mathematics and their perceived benefits of the early transfer. This report provides initial analysis of the data and attempts to consider if there is any evidence to suggest that the early transfer can help to overcome some of the difficulties children encounter in transfer as identified by Galton et al (2000).

Structuring students' awareness of generality in whole class discussion
Helen Drury, Open University

The appreciation and expression of generality is central to mathematics. While leading whole class conversations, as a teacher, I aim to remain aware of students' powers to appreciate and express generality. In this session I will focus on a whole class conversation that took place during a game of 'algebra bingo'. I will consider the various different types generalities present (explicit and implicit, mathematical and behavioural…) and examine the extent to which students in the class might be aware of each type of generality.

Primary trainee teachers' knowledge of parallelograms
Taro Fujita, University of Glasgow and Keith Jones, University of Southampton

Considerable research has indicated that amongst the factors which make the most significant contribution to high student achievement in mathematics is secure subject knowledge on the part of the teacher as this underpins an approach to mathematics in which topics are seen as part of a coherent set of related ideas, with clear progression and links to previous and future learning. This paper reports part of the findings from a study of trainee teachers' knowledge of basic geometrical figures, in particular focusing on what knowledge they have of parallelograms and how they use this knowledge to solve geometrical problems. The findings indicate that only a minority of trainee primary teacher have a fully sophisticated knowledge of parallelograms and of how to use the properties of parallelograms to solve relevant problems.