Research reports

Dynamic Geometry Software: The Teacher's Role in Facilitating Instrumental Genesis
Nicola Bretscher
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In the UK, teachers' use of dynamic geometry software (DGS) has remained limited. The importance of the teacher's role is often stated in dynamic geometry research but has been seldom elaborated. This study aims to address the apparent deficiency in research. The author conducted the research in the role of a practitioner-researcher with a high ability year 8 class. By analysing teacher/pupil interactions in a DGS context, elements of instrumental genesis are distinguished in pupils' dialogue and written work which suggest strategies that teachers can employ to facilitate this process. Whilst these strategies are specific to a DGS context, they highlight general principles of mathematics teaching. This paper argues that the focus of research needs to shift away from the context, towards teachers and the strategies they employ.

The use of mathematics in ks3/ks4 science classes
Lauren Brodsky
King's College London

In this study I interviewed five science teachers about the use of mathematics in their classes and four maths teachers about their use of mathematics and their view of mathematics in science. I look at the distinction between the maths and science departments and differences that occur in the two settings as described by the teachers. I also look at the factors that contribute to the separation of the disciplines in school and the pressure exerted on teachers by the national curriculum and exams. Finally the teachers describe areas where students have difficulties using mathematics, and how this might relate to the separation of mathematics and science. I then discuss possibilities for further exploration of this separation.

Research into pedagogical 'belief statements' held by pre-ITE students on a Mathematics Enhancement Course.
John Clarke
Cass School of Education, University of East London.

In this paper I will present the results from a small-scale research project undertaken with a group of pre-Initial Teacher Education (ITE) Mathematics Enhancement Course (MEC) students at the University of East London between January and July 2008. The emerging results are in their early stages of development and are a continuation of the results addressed in a paper presented to the British Educational Research Association (BERA) Conference in September 2008 (Clarke 2008). They appear to show some evidence that participation in a MEC, and hence exposure to a variety of teaching approaches, does change "beliefs" concerning the way in which participants think mathematics should be taught.

Assessing numeracy for nursing
Diana Coben & Jeremy Hodgen
King's College London

In this paper we present work in progress on the assessment of numeracy for nursing in two interdisciplinary projects. The background to these studies is that despite widespread recognition that numeracy is a key competence for safe and effective professional practice in nursing, and research studies in various countries which reveal a lack of proficiency within both the student population and amongst registered nurses, there is no international consensus on the nature and scope of numeracy for nursing. The studies are: 'Medication dosage calculation: a benchmark assessment for nursing' and 'Numeracy for nursing'. The first study aims to create a national benchmark for numeracy for nursing in Scotland against which numeracy for nursing may be assessed, initially at point of registration but potentially thereafter at other stages of nurse preparation and in practice. The second study is an exploratory investigation of aspects of teaching, learning and assessment of numeracy for nursing in the undergraduate/Diploma Nursing programme in a large School of Nursing in England.

An Analysis of Three Classroom Episodes

Alf Coles
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This paper examines data from an ongoing study of classrooms and teacher-meetings in one secondary mathematics department in the UK. The study draws on enactivist methodology and linguistic ethnography in its conception and practice. This report is focused around the notion of dialogue (Bakhtin 1981) and the development of patterns of dialogue. I analyse examples of an almost identical form of words used by three different teachers in their lessons, and the different things that happen next, concluding that notions of listening and hearing are needed.

The impact of Masters level study on teachers' professional development

Julie-Ann Edwards
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with Jonathan Eacott, The Clere School, Hampshire

This on-going NCETM-funded[1] longitudinal study is exploring the impact of studying for an MSc in Mathematics Education on the professional life of a group of teachers. Whilst the findings from this research are already anecdotally known, there has been little systematic research in the UK on which to ground these 'teacher stories' of the impact of study at Masters level. We report on the impact on teachers' individual professional development, the impact on their classrooms, their respective pedagogies and on consequent pupil learning, and the impact on the wider life of the school and the local authorities within which they teach.
Children's understandings of algebra 30 years on

Jeremy Hodgen*, Dietmar Küchemann*, Margaret Brown* & Robert Coe**
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In this paper, we outline the design and method of Increasing Student Competence and Confidence in Algebra and Multiplicative Structures (ICCAMS). Phase 1 consists of a large-scale survey of attainment in algebra and multiplicative reasoning, using test items developed during the 1970s for the Concepts in Secondary Mathematics and Science (CSMS) study (Hart 1981). This will enable a comparison of children's current attainment with that of 30 years ago. Phase 2 consists of a collaborative research study with 8 teachers extending the investigation to classroom / group settings and examining how formative assessment can be

used to improve attainment. In June 2008, tests were administered to a sample of 3000 children in each of Years 7, 8 and 9. In addition, attitude questionnaires were administered. A sub-sample of these children will be followed longitudinally and tested in 2009 and 2010. A further cross-sectional sample will be administered in 2009.

Researching Primary Trainees' Choice of Examples: Some early analysis of data
Ray Huntley
University of Gloucestershire

This paper reports on the early findings of a doctoral study exploring primary trainee teachers' choices of mathematical examples and the relationship between this and their mathematical subject knowledge. Through a combination of interview analyses and lesson plans gathered from the final school placement of one cohort of B.Ed trainees, some approaches appear to be commonly held by trainees about the nature and purpose of examples in the planning and teaching process. This paper presents the research design and some early outcomes from the data with a view to developing a second phase of data collection.

Children's understanding of randomness as a model
Peter Johnston-Wilder
University of Warwick

This paper presents two views of randomness from literature on philosophy of science. Each of these is discussed in relation to learning randomness, and they are related to a common restricted understanding of randomness. These views are used to analyse extracts from interviews with secondary school pupils in which the pupils were invited to participate in simple experiments involving randomness, and to discuss situations using the idea of randomness. Finally, the paper presents some conclusions and questions that follow from this discussion.

Does Articulation Matter when Learning Mathematics?
Sue Johnston-Wilder and Clare Lee
University of Warwick, Institute of Education

In this paper, we set out why we feel that it is important for pupils to articulate their mathematical ideas as they come to learn mathematics, whether orally, in writing or through some other representation. We explain the connections we see between thinking, articulating, learning and building a pupil's identity as a competent user of mathematical skills, thinking and reasoning. We believe that articulating mathematical ideas contributes to building what we will call 'mathematical resilience'.

How do teachers of mathematics understand 'effective' CPD?
Marie Joubert[1], Rosamund Sutherland[1], Jenni Back[2], Els De Geest[3], Christine Hirst[4]
University of Bristol[1], Kings College London[2], Oxford University[3], Birmingham University[4]

One of the aims of the Researching Effective CPD in Mathematics Education (RECME) project is to investigate factors contributing to 'effective' CPD. This paper is concerned with understanding the idea of 'effective' in relation to CPD for teachers of mathematics. It draws mainly on questionnaire data from 82 teachers who said their CPD was effective, exploring the responses teachers gave when asked to explain why their CPD was effective. Interview data provides further detail.

The aims of and responses to a history of mathematics videoconferencing project for schools

Ella Kaye
University of Cambridge

Researchers have long suggested a number of benefits to the integration of a historical dimension into mathematics education, yet there is little research into the effectiveness of such an approach. In this paper, I explore some of the issues at stake through a case study of a videoconferencing project on Babylonian mathematics.

The functions and effects of real world contextual framing in A/AS pure mathematics questions: developing an evaluative framework

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This paper reports on ongoing research into real world contextual framing (RWCF) in A/AS mathematics. After a review of research into real world contexts in mathematics, it discusses its possible effects, for example applicability, motivation, teaching modelling skills, and providing a mental scaffolding for mathematical concepts. The paper proposes a framework for evaluating RWCF, based on the notions accessibility, realism and authenticity, and presents some preliminary findings of an analysis using this framework on a sample of RWCF in A/AS pure mathematics questions.

What constitutes a 'hard' question in GCSE Mathematics: A bit of thought is required

Barbara Minards and Stephanie Prestage
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This paper is part of a larger project exploring the take-up of AS and A2 mathematics in a selective grammar school but comprehensive sixth form in the West Midlands. The sub-data presented here is from a survey of GSCE students asked for their reasons for doing or not doing mathematics in sixth form. Surprisingly for the selective intake most of those who were not doing AS level offered the reason that it is too hard. This then prompted an analysis (using Sierpinska, 1996) of the GCSE papers that these students were working towards and a questionnaire to AS students and teachers. The results show that any question requiring more than a memory prompt is considered hard by students and teachers.

Introducing the concept of infinite sum: Preliminary analyses of curriculum content

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In this paper we report the first phase of a study that aims to analyse curriculum content, pedagogical practice and student perceptions of the complex, often counter-intuitive but significant mathematical concept of infinite sum (aka series in Calculus). Sources of student difficulty with the concept identified in previous, not very extensive, research include: certain student perceptions of infinity; limited exposure to visualisation, contextualisation and applications of infinite sums; and, teaching through reduction to an algorithmic approach. Here we report preliminary analyses regarding curriculum content and, in particular, the initial phases of a three-dimensional analysis (cognitive, epistemological, didactical) of mainstream texts used to introduce the concept to undergraduates in the UK.

A Different Maths for the 21st Century: Bubble and Arrow Diagrams show the answers to WHY, WHAT and HOW questions

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This work is part of an investigation of an alternative maths curriculum that emphasises 21st Century applications. It has never been more important to develop children's powers of reasoning and discussion and maths can help. The answers to Why, What and How questions are descriptions- causal, classification, and operational respectively- and they can all be represented as directed graphs. Causal graphs, where the nodes represent occurrences, are not as familiar as classification or algorithm graphs. Besides recording the past- why things (including beliefs) occurred- causal graphs can capture predictions about the future. These graphs can be realised in the classroom as bubble and arrow diagrams and used to develop and communicate answers to all three kinds of question.

HMI Ofsted report for Mathematics 2008 or why teenagers are maths dunces

Stephanie Prestage and Pat Perks
School of Education, University of Birmingham

This paper offers a brief analysis of the HMI mathematics report published on the 19th September 2008 (Ofsted, 2008). We consider alternative discourses for the data used by the authors and for their explicit and implicit messages with the resultant blame laid on teachers. The serious message of this paper is the startling nature of the attribution of blame after more than a decade of prescription and national targets which are regularly inspected.

From modelling the teaching practice to the establishment of relations between the teacher's actions and cognitions

Carlos Miguel Ribeiro
University of Algarve, Portugal

In modelling the teacher practice, we approach some cognitions of the teacher while (s)he is immersed in action. To do this, we elaborate a model, which has been theoretically and practice based, which allows us to display apparent links and relations between the teacher's actions and his/her goals, beliefs and knowledge. In this paper I will present the modelling process in one specific situation where the teacher presents a certain content and, by doing so, I will show what and of what kind of relations occur in those specific situations.

Practitioner Use of Graphing Software to Teach about Algebraic Forms

Kenneth Ruthven, Rosemary Deaney and Sara Hennessy
University of Cambridge, Faculty of Education

From analysis of teacher-nominated examples of successful technology-supported practice in secondary-school mathematics, the use of graphing software to teach about algebraic forms was identified as being an important archetype. Such practice was investigated through case study employing evidence from lesson observation and teacher interview. The practitioner model developed in earlier research (Ruthven and Hennessy, 2002; 2003) provided a framework for synthesising teacher thinking. Further analysis highlighted the crucial part played by teacher prestructuring and shaping of technology-and-task-mediated student

activity. Moreover, this indicated how, in appropriating the technology, teachers modify their classroom practice and develop their craft knowledge.

Choosing more mathematics: happiness through work?
Cathy Smith
Homerton College, Cambridge & IPSE, London Metropolitan University.

This session describes research with A level mathematics students in schools which offer the opportunity to study with the Further Maths Network. Using evidence from observation, interviews and e-mail questionnaires, I examine how the students use the discursive positionings of mathematics and further mathematics students within their work on identity: what Foucault calls their 'practices of the self'. I focus on how they negotiate the contemporary requirement to be happy.

Examining the potential of game-based learning through the eyes of maths trainee teachers
Wee Hoe Tan, Sue Johnston-Wilder and Sean Neill
Institute of Education, University of Warwick

This paper reports the findings from a study of 25 maths trainee teachers which aims to examine their perceptions of the potential of game-based learning. Findings show that trainee teachers realised the potential of game-based learning and they are willing to use it in their teaching. A gap was identified between academics and game developers—the gap between their concepts of engagement. This gap might confuse the production and evaluation of game-based learning.

How secondary teachers structure the subject matter of mathematics
Anne Watson Department of Education
University of Oxford

There are no large studies that focus on how mathematical ideas are structured in those lessons which lead to the successful learning of key mathematical ideas. There are some clues in pan-cultural comparative studies that 'coherence' and 'complexity' are critical features of the way mathematical ideas are treated. In our work with about 40 lesson videos available from various studies we have come to understand that example choice, task design, variation, and certain key mathematical activities play a part in engagement and learning, whatever the teaching style, social context, lesson structure and interaction patterns.

Breaking the anxiety spiral: what can ITT providers do?
Marcus Witt and Jill Mansergh
School of Education, Bath Spa University

There is considerable evidence that many primary teacher trainees come to their PGCE year with significant levels of anxiety about mathematics. Unless these anxieties are addressed, trainees may fail to remedy gaps in their subject knowledge, may fail to learn the required pedagogical skills and may pass their anxieties on to the children they teach. The fact that trainees' attitudes to mathematics change considerably during their PGCE year represents an opportunity for training providers to reduce anxiety levels. This study tracked the attitudes towards mathematics of a cohort of primary teacher trainees throughout their PGCE year and used small group interviews to explore the reasons for the trainees' changing attitudes. The

findings revealed some unexpected factors, which may help providers of ITT to reduce trainees' anxiety about mathematics in the future.

Working group reports

BSRLM Geometry working group: proof and proving in current classroom materials

Keith Jones, Taro Fujita, Nichola Clarke, Yu-Wen Lu
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Research across many countries reports that teaching the key ideas of proof and proving to all students is not an easy task. This paper reports on the session of the BSRLM Geometry Working Group which examined current classroom material from the UK with the intention of uncovering the 'opportunities for proof' in geometry that are provided by such material. To carry out such an analysis three analytical frameworks are compared. Two of the analytical frameworks, while placing proof and proving in a wider context of learners' mathematics, may not fully uncover the detail of proof and proving. The third analytical framework, while permitting a detailed analysis of explicit proof and proving, may not fully account for textbooks that devote most space to discussions of proof and proving and/or contain problems that implicitly provoke proof. This comparison reveals some of the complexity of textbook analysis and suggests that further work is needed on a suitable analytical framework.

Working group on trigonometry: meeting 1

Notes by Anne Watson, Department of Education
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Introduction
For many years trigonometry has been seen as a critical hurdle for those who wish to achieve at GCSE. To understand trigonometry involves orchestrating many concepts which in themselves are known to be hard to understand: angles, rations, functions for example. This area of mathematics is therefore a rich arena for exploring how such understandings can be coordinated; how teaching might make this meaningful; as well as the nature of trigonometry. In this first meeting we developed some areas for future exploration and made a start at identifying existing work that might inform us. The complexities we uncovered made it very clear why many teachers, as well as students, take a short-term view and reach for algorithmic approaches.

- We found main clusterings of initial ideas:
- Prior or concurrent understandings entailed in trigonometry
- Difficulties and needs
- Teaching approaches we knew about that addressed the meaning of trigonometric relationships
- 'Grownup' understandings that might help us understand students' difficulties