



BSRLM Day Conference
University of Cambridge, 28 February, 2009

A. Open Forum

The Society's Open Forum will take place at the day conference. Further details will be announced.

B. Conference Sessions

Alshwaikh, Jehad (30 mins)
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Diagrams as interaction: The interpersonal (meta)function of geometrical diagrams

Diagrams are part of mathematics. However, the main stream among mathematicians is prejudiced against the use of diagrams in public. In my PhD study, I consider diagrams as a semiotic mode of representation and communication which enable us to construct mathematical meaning. I suggest a descriptive 'trifunctional' framework that can be used as a tool to analyse the kinds of meanings afforded by diagrams in mathematical discourse. In this presentation, only the interpersonal function of the diagrammatic mode is considered with illustrations. In specific, I consider notations, labels and the neat-rough diagrams as realisations of that function. Concluding remarks about the suggested framework and its possible uses are presented at the end of the presentation.

Ashby, Ben and Johnston-Wilder, Peter (30 mins)
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Exploring children's attitudes towards mathematics

This session aims to highlight current attitudes towards mathematics in primary school classrooms. Data was gathered using observations and focus groups during a series of visits to year three numeracy lessons in a local primary school. Three main themes that could influence children's attitudes towards mathematics were identified: 1) The apparent lack of real-world applications of mathematics; 2) Self-belief, anxiety and mathematical ability; and 3) Difficulties with the language of mathematics. In addition, the importance of conducting a separate reflection period will be discussed. The session will consist of a presentation about the project and a summary of the findings, followed by a discussion about the implications and future directions of the research.

Back, Jenni and the RECME team (30 mins)
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Reflecting on practice in Early Years settings: developing teachers' understandings of children's early mathematics

This paper presents findings of the (Researching Effective CPD in Mathematics Education (RECME) project which was set up in order to investigate, amongst other things, the interrelated factors that contribute to 'effective' CPD for teachers of mathematics. The focus in this presentation is on a CPD initiative that involved a network of teachers and early years practitioners. The Early Years Foundation Stage (EYFS) covers the care and education of children from birth to seven years old and the place of mathematics in these settings has historically been problematic (Gifford 2005); (Griffiths 1994; Moyles 1994); we suggest this makes this initiative particularly interesting. During meetings, which involved practitioners from a variety of settings, participants carefully considered children's mathematical work, especially their spontaneous mathematical graphics (Worthington and Carruthers 2003). This focus led the practitioners on to consider the ways in which they might support the children's mathematical development in the Early Years Foundation Stage settings. We suggest that the professional development of the participants occurred through this collaborative work on thinking about and discussing children's mathematics.

Brown, Margaret, Hodgen, Jeremy, Kuchemann, Dietmar and Coe, Robert (1 hour)
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Year 8 students' knowledge of fractions

As part of the work of the ESRC funded ICCAMS project, we have been interviewing small groups of Year 8 students about their knowledge of fractions. In our session, we want to talk about two

phenomena that we have found of particular interest. One is the tendency for students to work with decimal fractions rather than common fractions, for example when asked to find fractions that lie between $1/4$ and $1/2$. The second concerns students' use of models, in particular diagrams, to support their thinking about fractions; while many students can make effective use of models that have been structured for them (eg, to identify equivalent fractions from drawings of a 'pie' divided into 3 equal parts and a similar pie divided into 6 equal parts), we found that some students struggled to create effective diagrams for themselves (eg, to compare $1/2$ and $3/6$). In the session we will also compare some of our written-test data on fractions with the CSMS data from the 1970s, and consider possible implications for teaching.

Clarke, John (30 mins)

CASS School of Education, University of East London

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Research into pedagogical 'belief statements' held by pre-ITE students on a Mathematics Enhancement Course

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 (from IP 28(3)).

Clarke, Nichola (30 mins)

Department of Education, University of Oxford

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Analysing the argumentation of KS4 students with low prior attainment in mathematics

The session will begin with a presentation of some episodes of transcripts of argumentation. The discussions transcribed come from some groups of Year 11 students with low prior attainment in maths ("bottom sets") working together and with their teacher on maths problems in their classroom. I will use these episodes to illustrate some issues that arise in analysis of argumentation, in particular, the identification of arguments from argumentations in natural language settings, my choice and development of existing frameworks for the particular tasks posed by these classroom contexts, and my rationale for a "bricolage" approach.

Clausen-May, Tandi (30 mins)

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Assessing the digital mathematics curriculum

Ridgeway et al (2004) note an 'emerging gap between classroom practices and the assessment system'. This gap threatens to undermine the effective development of ICT in the teaching and learning of mathematics. An examination of currently available on-screen assessments indicates that stand-alone instructional programs, designed to teach a specific set of skills or topics, are relatively well supported by tests composed of constrained item-types which can be computer administered and marked. On the other hand, tool software such as dynamic geometry or computer algebra packages may be neglected in the classroom because their use does not form a focus construct within the current assessment system. In this paper some of the constraints on test development that have led to this situation are explored, and ways in which tool software usage might be incorporated into an effective mathematics assessment are considered.

Ridgeway, J., McCusker, S. and Pead, D. (2004) 'Literature Review of E-Assessment' (Futurelab Series Report 10). Bristol: Futurelab [online]. Available:

http://www.futurelab.org.uk/resources/documents/lit_reviews/Assessment_Review.pdf

Craig, Ayshea (30 mins)

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Comparing Strategic Thinking Research in Mathematics Education and Psychology

In this session, I present an argument for the importance of re-examining theoretical assumptions in strategic thinking research in mathematics education. By contrasting research into strategic thinking in mathematics education with that in cognitive and developmental psychology, three areas are identified where important details of the model of strategic thinking are left unexplored in education research while being dealt with more thoroughly in the psychological literature. The areas identified are: the positing of innate processes; the nature of memory; and the relation between conscious and unconscious mental processes. The status and reliability of introspective reports on mental processes are discussed as an illustration of the potential of research in psychology to further inform mathematics education.

De Geest, Els and the **RECME** team (1 hour)

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Energising teachers by evoking Passion in Continuous Professional Development for mathematics teachers: Findings from the Researching Effective CPD in Mathematics Education (RECME) Project

This session reports on one of the findings of the Researching Effective CPD in Mathematics Education (RECME) Project, funded by the NCETM. We found how being involved in CPD could evoke a passion experience resulting in teachers feeling energised to keep going and working on developing professionally and to overcome obstacles. The research questions we probed were: what is passion and passion-energy, how is it related to CPD in mathematics education and how can it get triggered/be planned for. Theoretical perspectives that informed and supported our analysis framework came from Perry (1968/1999), Csikszentmihalyi (1997) and Bollas (1997). In this seminar we will share our findings and discuss possible implications.

Dooley, Thérèse (30 mins)

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Primary pupils in whole-class mathematical conversation

Although plenary sessions are common to mathematics lessons, they are often characterised by traditional approaches that endorse the position of mathematics as a kind of received knowledge and the teacher as sole validator of students' input. Research, however, shows that whole-class discussion can be fertile ground for construction of new mathematical ideas by students (Cobb, Wood, Yackel and McNeal 1992, O'Connor 2001). In particular, a shift from the Initiation-Response-Evaluation exchange structure (Mehan 1979) towards a more open classroom conversation is required. In this paper, an account will be given of a lesson in which children aged 9 – 10 years calculated the sum of integers from 1 – 100. Particular attention will be paid to the teacher moves that facilitated engagement of students with each other's contributions.

Edwards, Julie-Ann (30 mins)

University of Southampton

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Mathematical reasoning in collaborative peer groups: the social role in socio-constructivism

This session will explore transcripts of pupils' peer talk while undertaking open-ended tasks in a socio-constructivist setting. I present episodes of mathematical reasoning from pupils between 12 and 15 years old which demonstrate how social aspects among these established working groups serve to provide the necessary support to enable all members of the group to access the mathematical knowledge being constructed. Various forms of mutual support will be demonstrated, including a 'chain of thought' continued sequentially by members of the group, friendly 'name-calling' to alleviate moments of difficulty, constructive argument, talking aloud (and over one another) as a means of keeping ideas 'in the open', and allowing each other 'space' to reach mutual understanding.

Hennessy, Sara, **Dawes**, Mark, **Bowker**, Anne and **Deaney**, Rosemary (1 hour)

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Supporting professional development for ICT use in mathematics using the T-MEDIA multimedia resource and toolkit

The T-MEDIA research project (funded by ESRC) produced an interactive CD-ROM containing a video-based case study of teaching and learning with technology (Autograph, spreadsheet and online games using data projector and laptops) in one secondary mathematics classroom. Designed as a tool for teacher-led, collaborative professional development, the resource aims to stimulate debate rather than present a model of best practice. It is hosted on the NCETM portal and freely available to all. In the follow-up project we will outline, groups of teachers in 3 schools discussed the pedagogical approaches portrayed, planned a lesson in response, observed each other and reflected together on the outcomes and implications for practice. We present the outcomes of these trials and our development of a 'toolkit' (commissioned by NCETM) that might guide other departments' use of the resource for professional development. There will be an opportunity for participants in this workshop to explore the multimedia resource themselves using laptop computers.

Hirst, Christine and the **RECME** team (30 mins)

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Investigating the influence of the NCETM portal on extending networks and the professional development of teachers of mathematics

One of the aims of the Researching Effective CPD in Mathematics Education (RECME) project was to investigate the influence of the NCETM portal on the professional development of teachers of mathematics. To gain an understanding of how the portal was being used, data was collected through in-depth interviews with a group of teachers who participated in the CPD initiatives that were part of the project. This session outlines the findings of this investigation by first considering the teachers' use of

the NCETM portal through Blogs, Communities, Courses and Events, Mathemapedia, News, Personal Learning Space (PLS), Research, Resources and the Self-Evaluation Tool (SET). Analysis of the data showed that Communities and Courses and Events sections were the most useful. By focusing on how the teachers were making use of these we began to see how they were not just enabling online communication but they were also being used to engage with different mathematics teaching and learning communities and to develop networks both online and face-to-face. This session explores how the teachers were using the portal to extend their teaching networks, to share practice and knowledge, to engage with new ideas, seeing different perspectives and getting support from other teachers, and how this related to their professional development.

Jared, Libby (1 hour)

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Working co-operatively within a web-based environment: exploring the interactions of a group of young people as they work on mathematical problems

My recent research has centred around Ask NRICH, the web board conference section of the NRICH mathematics website (www.nrich.maths.org.uk) and the interactions between young people as they pursue serious mathematical study away from the secondary school classroom. Making frequent visits to the Ask NRICH section as a non-participant observer of the members' daily activities, led to a study of over two thousand messages, live and archived. Making an interpretative analysis of the texts has revealed how these young people support each other in coming to understand complex mathematical concepts. This session will focus on the written dialogue on one mathematical problem that, over a four-month period, appeared as the subject of three different threads. By separating out the thirty-seven posts for the eleven individuals involved, it is possible to visualize a small group of young people working together in a way that is neither readily available nor common within the school environment. Rather, I propose, it is akin to the collegiate way that professional mathematicians might behave as they undertake their daily work.

Jones, Ian (30 mins)

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Designing for pupil engagement with the equals sign

I describe a computer-based task designed to foster engagement with arithmetic equality statements of the forms $a+b=c$, $a+b=b+a$, and $c=a+b$. I report on six trials with pairs of 9 and 10 year old pupils, highlighting how they talked about distinctive statement forms and used these distinctions to discuss strategies when working towards the task goals. These findings stand in contrast to how pupils typically view and talk about equality statements as reported in the literature.

Joubert, Marie and the RECME team (30 mins)

marie.joubert@bristol.ac.uk

Characterising Professional Development for Teachers of Mathematics

One of the aims of the Researching Effective CPD in Mathematics Education (RECME) project was to characterise CPD for teachers of mathematics. This paper presents an outline of the findings related to this aim, describing the landscape of professional development within thirty sample initiatives in terms of:

- 1 the different organisational structures of CPD initiatives
- 2 the ways in which CPD initiatives attend to interrelated aspects of mathematical knowledge for teaching: mathematics, students' concepts in mathematics and ways of teaching mathematics
- 3 approaches to trying out new ideas in the classroom and embedding change found in the CPD initiatives

Noyes, Andy (1 hour)

School of Education, University of Nottingham

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Investigating the impact of social factors and schools on AS/2 mathematics completion

Here I report progress on one aspect of the ESRC funded Geographies of Mathematical Attainment and Participation (GMAP) project. Following a brief introduction to the project I will present statistical analyses of National Pupil Database data on participation in AS/2 mathematics, focusing on the 2005(GCSE)/2007(A level) cohort. Secondly I will demonstrate how multi-level modelling has been used to explore between-school differences in completion of level 3 mathematics. Thirdly (if time allows) I will discuss how we are exploring the use of Geographic Information System software to explore *who* does *what* mathematics *where*.

Osmon, Peter (30 mins)
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An alternative maths curriculum. A-level: a university entrance qualification

Issues that have emerged at meetings with groups of academics with a particular interest in the maths knowledge of students when they arrive at university are reported. In discussions so far there has been remarkable agreement on what the issues are. Some are contained within A-level and appear tractable, including the view that "less could be more". Others are inherited from GCSE and earlier learning and amount to deep rooted concerns about the maths children learn and their attitude to it.

Panorkou, Nicole (30 mins)
Institute of Education, University of London
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Mapping experience of dimension: characterising dimensional thinking

As part of my PhD study, I explored how individuals experience and think about dimension. Dimension is experienced in different ways across a variety of settings, namely in everyday experience, in formal definitions, in school curriculum and in dynamic learning settings. Through an analysis of the literature, followed by a phenomenographic study aiming to map and to interpret experiences of dimension across these settings, I present a characterisation of dimensional thinking, which can inform future research and pedagogic practice.

Peters, Mike (30 mins)
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Validation of my Semantic Model for the Learning of Mathematics

The semantic model for the learning of mathematics which I proposed at the Southampton BSRLM day conference (Peters 2008) was based on work with learners using the Chelsea Diagnostic Test for Algebra. In order to validate some of the findings, a series of questions were devised (extending a question posed by Laurillard 2002 to undergraduate students) based on Newton's Third Law of Motion. Two scenarios were presented, a box on a table and a box in mid-air, where the learners had to analyse and explain the outcome. The same questions were presented to mathematics tutors. The subjects were interviewed and their responses transcribed. It was found that the student learners were unable, with certainty, to apply Newton's Third Law to the box in mid-air whereas the tutors, as expected, did not have any difficulty. These findings were then explained in terms of my semantic model.

Pijls, Monique and Dekker, Rijkje (1 hour)
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Students discussing their mathematical ideas: the role of the teacher

This Dutch research project investigates the question how to evoke mathematical discussions between students in secondary education. With mathematical discussions we mean discussions in which students **show** each other their mathematical (thinking) work, **explain** it to each other, **justify** it and **reconstruct** their (thinking) work, described as *key activities* in the process model of Dekker & Elshout-Mohr (1998). We explicitly have engaged the teacher as an expert in developing a learning environment in which students are having mathematical discussions with one another. The presentation will provide an overview of our findings as well as the analysis of student – teacher and student – student interactions.

Roberts, Nicky (30 mins)
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A 'Mobile Aware' or 'Mobile Beware' Mathematics Classroom?

Many secondary school pupils have mobile phones in their bags or pockets while sitting in their maths classrooms. Does this present an opportunity or a threat to the teaching and learning of mathematics? Is the mobile phone an appropriate personally-owned tool for using graphic and/or scientific calculators, browser-based mathematics content, social networking for communities of young mathematicians or any other available mathematics related applications? The presentation will open with a brief description of the project design and related evaluation research for an "M-Learning proof of concept" project currently being investigated. This project involves six Grade 10 (pupils of age 16) Mathematics classes and their teachers in six schools across three provinces in South Africa. An sms-based (or texting-based) model and a browser-based model using specifically designed Mathematics platforms for use on any mobile phone, are being piloted and will be contrasted. The project involves collaboration from the South African national Department of Education, private sector technology vendors (Nokia and MSN) and various mathematics education content (WebAlt) and online tutoring (Mereka Institute) agencies. The project is currently underway, and the presenter is project managing its evaluation research component. Like most technical "proof of concept" initiatives, this particular project and its contrasting M-learning models is unlikely to be a panacea for personal information and communication technology (ICT) access in mathematics classrooms. The presenter will invite some

discussion on the questions this particular project raises for both mathematics teachers and researchers interested in the learning of mathematics.

Rowland, Tim, **Ruthven**, Ken, **Petrou**, Marilena, **Goulding**, Maria, **Watson**, Anne, **Stylianides**, Andreas, and **Adler**, Jill (1 hour)

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Conceptions of Mathematical Knowledge in Teaching: the Nuffield seminar series, Part 1

Over the last two years, BSRLM members from several universities have contributed to a Nuffield-supported national seminar series on Mathematical Knowledge in Teaching

<http://www.maths-ed.org.uk/mkit/> that has met on six occasions.

The final report of the series is now available:

<http://www.mathsed.org.uk/mkit/MKiTfinalreport1008.pdf>

and an edited book is in preparation. The seminars have examined current scholarship and research bearing on how teachers' subject-related knowledge underpins successful mathematics teaching, and on how such knowledge can be assessed and developed. In this session, several speakers involved in the series will present snapshots of the theoretical and practical perspectives examined, and highlight areas where the need for further research was identified.

Rowland, Tim, **Ruthven**, Ken, **Ryan**, Julie, **Corcoran**, Dolores and **Turner**, Fay (1 hour)

Faculty of Education, University of Cambridge

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Developing Mathematical Knowledge in Teaching: the Nuffield seminar series, Part 2

Over the last two years, BSRLM members from several universities have contributed to a Nuffield-supported national seminar series on Mathematical Knowledge in Teaching

<http://www.maths-ed.org.uk/mkit/> that has met on six occasions.

The final report of the series is now available:

<http://www.mathsed.org.uk/mkit/MKiTfinalreport1008.pdf>

and an edited book is in preparation. The seminars have examined current scholarship and research bearing on how teachers' subject-related knowledge underpins successful mathematics teaching, and on how such knowledge can be assessed and developed. In this session, several speakers involved in the series will present snapshots of the theoretical and practical perspectives examined, and highlight areas where the need for further research was identified.

Ryan, Julie (30 mins)

Manchester Metropolitan University

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Mathematical argument in discussion: changing your mind

We begin with the position that significant learning in mathematics takes place through learners interacting with others in discussion – in a mathematical dialogue. The dialogue involves argument in which differences of view are exchanged and explored rationally with a view to persuading with coherent reasoning. We call this argument in discussion. We have written previously about our work in developing a dialogic pedagogy and present here further analysis of children's arguments in discussion and what prompted them to change their mind or not. We discuss the need to slow the pace of the classroom so that the focus is on argumentation and change of mind as opposed to learning specific mathematical content or methods.

Smith, Cathy and **Piggott**, Jennifer (30 mins)

Homerton College, Cambridge and NRICH, University of Cambridge

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enRICHing Mathematics: Progress in Building a Learning Community

The "SHINE" maths project ran for 3 years in two socio-economically deprived London boroughs, recruiting secondary school students with good mathematical prior attainment to meet at out-of-school workshops over the course of a year. Cohorts of 40+ students worked collaboratively on open maths tasks, with discussion guided by NRICH leaders and participating school teachers. The aims were to enrich students' experience of mathematics, further their mathematical understanding and raise aspirations to study maths. This session will describe the project and outline two aspects of the evaluation: how the students described what they had learnt, and how we analysed progress in informal collaborative classwork. Students found SHINE maths enjoyable, different and more challenging than school maths, and became confident to solve new problems. Their teachers observed improvement in problem-solving behaviours. The model of a maths-talk learning community offered ways to categorise changing classroom behaviours, and helped to identify what were effective practices of classroom management.

Turner, Fay (1 hour)

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Using the Knowledge Quartet to identify development in the ability of beginning teachers to respond to the unexpected

In this session, participants will be given a brief introduction to the Knowledge Quartet framework (KQ) as a tool for identifying and developing mathematical content knowledge of teachers through observation of their practice - depth of introduction will depend on the prior knowledge of participants. Video clips will be used to provide an opportunity to use the 'contingency' dimension of the KQ to identify instances of teachers responding to the unexpected. A brief account will then be given of findings, from a four-year study, relating to the development of beginning teachers' ability to respond to the unexpected using the lens of the KQ.

Worthington, Maulfry and Carruthers, Elizabeth (1 hour)

Free University, Amsterdam and Redcliffe Children's Centre, Bristol

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The inter-relationship between an Early Years CPD initiative for mathematics and young children learning mathematics: the power of grassroots learning

Research into early 'written' mathematics has revealed children's ability to use their own marks, symbols and representations (*children's mathematical graphics*) to explore and communicate their mathematical thinking; supporting their understanding and development of the abstract symbolic language of mathematics at a deep level (Carruthers and Worthington 2005, 2006, DCSF 2008). We have explored a number of means to provide effective CPD for Early Years teachers and practitioners to support their understanding of *children's mathematical graphics*, including face-to-face courses and e-learning and a dedicated website, www.childrens-mathematics.net. This session focuses on our recent CPD initiative, local *Children's Mathematics Network* groups; 'grassroots' groups started, 'owned' and developed by teachers and practitioners themselves. In their group meetings group members explore and develop their understanding of *children's mathematical graphics* from their personal, professional perspectives. New research findings (RECME, 2009) reveal the effectiveness of this form of CPD and its impact on children's mathematical learning. The paper explores the philosophy underpinning the success of these teacher/practitioner' groups and its inter-connectedness with *children's mathematical graphics*. The format of the session will be a PowerPoint presentation exploring these themes, exemplified by comments from the teachers' and practitioners' in the CM Network group and by some of the children's own mathematical graphics.

C. Working Groups

Jones, Keith, Lavicza, Zsolt, Hohenwarter, Markus, Lu, Allison, Dawes, Mark, Parish, Alison and Borchers, Michael

University of Southampton, University of Cambridge, Florida State University, Comberton Village College, Stowmarket High School, Queen Mary's Grammar School

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Geometry Working Group: Establishing a professional development network with an open-source dynamic mathematics software – GeoGebra

This working group session provides an opportunity to work with participants in an NCETM-funded project that is working on establishing a professional development network with open-source mathematical software – GeoGebra – in England. In addition, we would like to invite to this session colleagues who are interested in professional development issues in technology-equipped classroom environments. The GeoGebra project has involved nine experienced teachers reviewing, modifying, and implementing existing teaching materials in their classrooms and developing ways of providing professional development and support for other teachers across England. The participating teachers not only contributed to the development of professional development materials but also led workshops for other teachers. Project meetings and workshops were videotaped and participants were interviewed during the past year. Participating teachers were also involved in the analysis of data and the refinement of workshop materials and teaching approaches. The working group session provides the opportunity to find out some results of the project and to discuss potential future work around this topic. We hope that the working group further contributes to nurturing a community of teachers and researchers in England who are interested in developing and using open-source technology in schools and in teacher education.

Watson, Anne

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Trigonometry

Trigonometry has for many years been seen as a critical hurdle for those who wish to achieve at GCSE. There are different views about whether this is justified or not. To understand trigonometry involves orchestrating many concepts which in themselves are known to be hard to understand: angles, ratios and functions are some of these. This topic area is therefore a good one to trigger discussion about how

students learn to coordinate earlier concepts, or how through such coordination they might understand these concepts better, and how teaching might make this process more meaningful. In this first meeting of this working group we shall develop a map of critical issues around these ideas and plan a programme of work, reading and discussion.