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Research presentations

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"It doesn't have to be like this": Women mathematics teachers' experiences of professional learning

Despite the range of possibilities for mathematics teacher professional learning and the reported success of individual initiatives, the overall picture in England appears to be one of restricted access to opportunity together with a lack of appropriate support for individuals. This study explores women mathematics teachers' experiences of professional learning throughout their careers, focusing on the ways in which their learning is supported. Four in-depth life histories were elicited through semi-structured interviews in the form of guided conversations, supplemented by time-lines of mathematics and of professional learning. The teachers' narratives reveal that much professional learning is informal, with teachers accorded limited agency and support. Spaces to discuss mathematics learning and teaching are constrained, with teachers appearing isolated within school environments. Where opportunities for collaborative professional learning exist, women participate actively in the wider mathematics education community. Analysis of the narratives suggests that teachers' agency over their professional learning needs to increase, creating spaces for women to collaborate on mathematics-focused professional learning.

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Responding to students' contributions in the mathematics classroom: the case of Saudi trainee primary teachers

This ongoing doctoral study focuses on five case studies of trainee mathematics teachers practising in primary schools in grades four, five and six (10, 11 and 12 year olds) in Saudi Arabia. The main goal of the study is to identify and explore the relationship between the trainee teachers' subject matter and pedagogical content knowledge and their response to their students' contributions in mathematics lessons. The teachers are observed and videotaped while they are teaching in order to identify how they deal with students' contributions. This is followed by individual face-to-face semi-structured post-lesson interviews in which selected episodes from the lessons are discussed in order to investigate the teachers' rationales for their actions. In this session we will introduce the study and invite discussion on preliminary analyses an episode from one lesson. Our approach to analysis is informed by Rowland and colleagues' Knowledge Quartet.

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Exploring Prospective Mathematics Teachers' School Placement Induction through Communities of Practice

'Communities of practice' is one of the most common interdisciplinary terms which is mainly used by anthropologists, sociologists and educationalists. This paper aims to analyse the induction experiences of prospective mathematics teachers during their school placements through the lens of communities of practice. The main research question is concerned with how prospective teachers perceive what constitutes the practice of the community. For that purpose, the research was designed as a qualitative cross-sectional study. Eight prospective mathematics teachers were selected by using a purposive sampling method based on gender and availability of the sample. Data collection consisted of face-to-face interviews, observations and journal writing. The data was analysed by using content analysis. Findings will be discussed with regard to participants' interaction with the head teacher, head of mathematics and their school-based mentors; participants' observations of professional interaction among colleagues in the school; and how these observations affect their perception of being a mathematics teacher.

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Measuring the Attainment Gap in Mathematics

The achievement gap between disadvantaged and non-disadvantaged students is receiving considerable attention from politicians and the press, and measures of this gap are now included in the school performance tables. This session will explore some different measures of this gap and the implications that the choice of measures may have on the judgements made about schools. Some different statistical models will also be examined for their potential to identify effective mathematics departments in schools. The outcome measure used in these models is the expected progress measure for mathematics as it is the only publically available outcome that is specific to mathematics.

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Calculating: What can Year 8 children do?

This session presents the findings from a sample of 985 Year 8 pupils who were given age-appropriate calculation questions and it examines the range of strategies they used. The introduction of the National Numeracy Strategy (NNS) Framework (DfEE, 1999) brought together research and recommendations that sought to improve primary age children's calculation strategies. The Years 7, 8, 9 Framework (DfEE, 2001) for Key Stage 3 was the conduit for sharing this with secondary schools. Fourteen years later, just as the mathematics curriculum in the UK has been revised again, this study considers how pupils in Y8 respond to questions for each of the four operations. While over the last decade a range of strategies have been promoted and recent research (e.g. Nunes, Bryant and Watson, 2009) has focused, in particular, on methods of calculation, our study suggests that Y8 pupils still struggle to select an efficient and effective strategy.

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Mathematical modelling: providing valid description or lost in translation?

What is commonly referred to as mathematical modelling comprises a range of activities that often include chains of re-descriptions across professional practices and academic disciplines, and the activity might involve direct or indirect communication between experts from all of these. In mathematics education, the activity described as 'the modelling process' appears more uniform and is depicted as starting with some sort of 'translation' into mathematics and ending with 'validation', including cycles of adaption and refinement, or rejection. One goal associated with school mathematical modelling is to initiate students into mathematical modelling by means of exemplary projects within the range of mathematical and other expertise of the participating students and teachers. In our presentation we shall refer to activities intended to serve this purpose. With a focus on 'translation' and 'validation', we will discuss elements of a language of description that captures a range of strategies and criteria deployed in these stages of the process and demonstrate its usefulness for constructing, analysing and evaluating school mathematical modelling activities. We see this as part of a larger project of developing a sociology of mathematical modelling and its recontextualisation in the form of school mathematical modelling.

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Cornerstone Maths – Scaling for sustainable success

This session will report the most recent outcomes of the Cornerstone Maths project, which is primarily concerned with the process of scaling professional development to support over 100 schools to embed pupils' uses of dynamic mathematical software in hundreds of key stage 3 classrooms. Following a brief overview of the project, which was previously presented at BSRLM June 2012 (<http://www.bsrlm.org.uk/IPs/ip33-2/BSRLM-IP-33-2-Full.pdf>), we will describe the

new methodologies being adopted to research the development of teachers' classroom practices at scale. The early outcomes of the first stage of this scaling will be described and we will engage in a critical discussion of the theoretical ideas that continue to inform the research process and share the challenges that we face as we continue to scale the project.

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"Take care of the symbols and the sense will take care of itself": the challenge of Dick Tahta,

Caleb Gattegno and Bob Davis

Caleb Gattegno outlined a radical vision for mathematics education that, in his own hands, led to remarkable progress (a five year curriculum, taught to mastery in 18 months or less). Gattegno influenced the equally remarkable work of Bob Davis (in the USA) and Dick Tahta (in the UK). In this session, I offer a lighting on their work and suggest that one common feature was an avoidance of concern with student understanding, if that is taken to mean the linking of concrete to abstract, or the ability to explain why something works before using it as a tool. Instead, I suggest, the attention of these teachers was on developing student awareness of relationships. Visible and tangible resources are used to support the awareness of relationships between symbols, rather than offer a meaning for symbols. I draw on my own research work to illustrate this perspective further and reflect on some of the skills required, as a teacher, in order to develop awareness of relationships, as seen so vividly in the teaching of Gattegno, Tahta and Davis.

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Peer talk and helping activity in mathematical problem-solving groups

This session reports on a study of two classes of similar mathematical attainment, one which was taught groupwork skills to enable them to work in groups on open-ended mathematical problems and the other which worked in self-selecting friendship groups without direct teaching of skills for groupwork. Findings indicate a greater degree of 'helping' activity within groups in the class which was taught groupwork skills (with the exception of one group which is explored more fully in this session) and mutually-derived solutions to problems reflecting the inputs of each group member in groups in the class which was not taught group skills. Analysis of audio-recordings of peer talk within groups in both classes was undertaken and thirty distinct types of talk/activity were identified. Comparisons were made about the frequency of occurrence of each of these types of talk across groups in both of the classes and suggestions offered for reasons why specific frequencies occur in each of the groups/classes.

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Key representation types for students struggling with multiplicative thinking

The move from understanding and working with additive structures to multiplicative structures requires a significant change in children's thinking. This paper explores the visuo-spatial representations of multiplicative structures created by children struggling with that change, during individual numeracy tuition. Participants were all in KS3-4 mainstream education, and some of the lowest-attaining in their respective year groups (all NC level 3 or below). They all had a good understanding of addition and subtraction but not multiplication or division, and tended to rely heavily on counting-based strategies.

Four particular interlinked representation types are discussed: Unit containers, Unit arrays, Array-container blends, and Number containers. These are used to investigate the roles of visuo-spatial representation in the students' developing multiplicative thinking, and the relationship between representational and arithmetical strategies in natural number division tasks.

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Analysing teachers' descriptions of mathematical tasks

The mathematical tasks that teachers use in the classroom have a considerable influence on what students learn. Mathematical tasks may be described using words such as 'rich', 'open', 'real-life', 'engaging', etc. It seems unlikely that the many adjectives employed are all independent, but how are they related? For example, is a task that is described as 'real-life' more or less likely also to be described as 'engaging'? In this study we asked mathematics teachers (n = 360) to indicate on a five-point Likert scale how well each of 84 given adjectives described a particular mathematical task of their choice. Using exploratory factor analysis, we determined that the teachers viewed mathematical tasks as varying on five independent dimensions, which we characterise as engaging, contextual, demanding, procedural and unusual. These five aspects of task quality capture the structure of the language that teachers use when describing mathematical tasks. Our findings imply that simplistic claims about mathematical tasks, such as contextual tasks are engaging or procedural tasks are unengaging, are not in accord with the way in which teachers use these words. We suggest that this five-dimensional categorisation of mathematical tasks may be useful in informing their design.

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Analysing two group-tasks and a collaborative classroom practice with Engeström's activity theory

Two teachers, Olaf and Knut conduct two group-tasks in succession, early in the academic year at a Gymnasium in Norway. In such conduct they steer classroom practice from traditional instruction with Olaf alone as teacher, to cooperative learning in small groups with guidance from both. While 'When Together' initiated cooperative learning by students within groups, the second 'How Heavy' initiated student groups to build upon group cooperation and work with other student groups in a collaborative classroom practice. It was Olaf and Knut's intention as teachers to conduct instruction with students cooperating in groups at all times, and student groups collaborating with each other on occasion. A few months into the year, when their collaborative practice had become the norm, Olaf and Knut's students had the opportunity to articulate their rules of engagement. Using examples of students' attempts at their group-tasks, I portray Olaf and Knut's collaborative classroom practice. Using Engeström's activity theory, I examine how student participation in the two group-tasks transformed the classroom practice to meet their teachers' intentions.

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Culture and disadvantage in learning mathematics

There is concern internationally that socio-economic class and ethnicity remain the most significant predictors of outcomes in mathematics; performance is often largely dependent on family income and level of parental education. Consequently the influence of pupils' socio-economic backgrounds remains a major challenge to those of us in the field concerned with achieving equitable education. However, the ways in which socio-economic factors play out in different parts of the world subject to different political systems and structures, remains unclear. In this paper we present an analysis of mathematics achievement in tri-cultural Penang to offer a localised perspective on the ways in which socio-economic status and ethnicity affect achievement. Of particular interest is the different ways the three cultures experience mathematical achievement in Primary schools - particularly the Tamil community who appear to be succeeding against the socio-economic prediction. This is a development from our paper to BSRLM in Edinburgh after a visit to Penang by Peter.

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Real World Issues in the Mathematics Classroom

I present the initial stages of my doctoral study that aims to ascertain teachers' opinions and practice relating to the place of real world issues in the mathematics classroom and identify any barriers they perceive. I approach the study from a Freirian perspective contextualised in the mathematics curriculum. Although academics have examined ways to implement a culture of critical mathematics education, it has also been suggested that there is little evidence of real world problems being addressed in the mathematics classroom. The National Curriculum states that mathematics is "for understanding the world, the ability to reason mathematically, and a sense of enjoyment and curiosity" which contrasts starkly with a 'back to basics' curriculum in which citizenship at key stages 3 and 4 has been disapplied.

Data will be collected through exploratory interviews and notes from observing lessons. The pilot interviews investigated the beliefs of participants in relation to classroom mathematics critically addressing real world problems and were prompted by a card sort exercise outlining different beliefs systems. Although prompts can suggest possible responses and interrupt the spontaneity of interviews, in this case they provided the participant with initial stimuli, leading to thorough explanations of their beliefs and minimising researcher intervention.

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Preparing students for the extended numeracy demands of the modern workplace

This session focuses on improving the numeracy skills for employability of students in vocational and academic level 3 courses at a Further Education college in North Wales.

There is concern by Government that students leaving education are inadequately prepared for numeracy tasks in the workplace. Employers require staff with adaptable numeracy skills: an ability to analyse quantitative problems, select appropriate solution methods and apply them to a suitable level of accuracy. Staff must use new technology, communicate mathematical ideas effectively, and quickly learn new mathematical techniques. They must make various types of measurement, and operate machinery where numerical settings are required.

A series of course activities relevant to workplace numeracy were designed and conducted with student groups. These include:

- * Construction: designing the conversion of a disused chapel into a private house
- * Engineering: design of a small domestic wind turbine
- * Business studies: evaluate tourism ventures to increase the financial viability of an upland farm
- * Environmental education: measurement of river parameters
- * Computing: design a public travel information system for a region of Wales

Following the course activities, changes in student attitude towards numeracy for the workplace were explored.

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Understanding and addressing low attainment in school mathematics

In Phase 1 of the ESRC-funded Investigating Confidence and Competence in Algebra and Multiplicative Structures (ICCAMS) project we found that the end of Year 9, the proportion of students whose responses failed to reach even the lowest defined level of performance appeared to have doubled in Algebra and Ratio to more than 15% of the cohort. The increase in the very lowest attaining group in the Decimals test is smaller, but nevertheless the proportion is more than 10% of the cohort. In this session, we will discuss the ICCAMS findings on low attainment. In addition, we will present a review of the literature on low attainment in mathematics and consider the strengths and weaknesses of the research in this area.

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The interactional treatment of mathematical errors and the role of errors in the learning of mathematics

In this session we will explore the role of errors in both the teaching and the learning of mathematics. Analysis of classroom interactions will be shared that show that mathematics teachers implicitly treat errors as something to avoid even when they explicitly comment on the positive role they have in the learning of mathematics. However this leads us to consider, and therefore explore, what possible roles errors may have in the learning and teaching of mathematics.

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“Arbitrary numbers and much palaver”: Engineering students’ recognition of university mathematics

The analysis reported in this paper is part of a larger research project (funded by the Swedish Research Council) about the transition from secondary to university mathematics education. The goal of the project is to develop an integrated view of mathematical, didactical and social aspects of the ‘transition problem’. Here we report from the second of three interviews with around 70 engineering students at two Swedish universities conducted throughout their first year of university enrolment. This interview attempted to provide insight into their awareness of the type of mathematics they have experienced in their first undergraduate mathematics courses, and how this related to their achievement. In the project we draw on discursive approaches, in particular on Bernstein’s theory of pedagogic discourse. For the purpose of the analysis reported here, the concepts of classification and recognition rules are of particular relevance. As a methodological tool for the reading of our data, we employed categories from Halliday and Hasan’s social semiotics. The outcomes of our analysis indicate that the students’ recognition of specific features of an ‘undergraduate university mathematics register’ is predictive of their achievement.

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Has A-level Mathematics got easier over time?

It is commonly considered important that standards in A-level Mathematics remain broadly similar over time. We report a study in which we compared the performance of A-level mathematics candidates in England achieving grades A, B and E in the 1960s, 1990s and 2010s. We applied a comparative judgement technique to an archive of exam scripts for which candidates’ grades were available. A strength of the comparative judgement approach is that it can be used to directly compare scripts based on different exam papers. Twenty expert mathematicians, naive to the purpose of the study, judged pairs of responses to exam questions, deciding in each case which candidate was “the better mathematician”. The experts’ judgement decisions were statistically modelled to produce an ability estimate for each candidate, and these estimates were then analysed in terms of the relative achievement of candidates at grades A, B and E over time. We report that A-level standards appear to have declined since the 1960s, but not as sharply as some might suspect, and that standards appear not to have declined at all since the 1990s.

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Research on the teaching and learning of geometric constructions in secondary school mathematics

Geometric constructions have been a component of the mathematics curriculum for some considerable time. The intention is not only developing mechanical competence with the handling of relevant instruments (be it ruler and pair of compasses, or the equivalent computer software) but also, and perhaps primarily, to highlight the link between a construction that learners have

been asked to perform and a related proof problem. This session provides an overview of research on the teaching and learning of geometric constructions in secondary school mathematics.

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The perceived causes of the 'problem' of mathematics education in England

This paper assumes that there is a problem with mathematics education (while acknowledging that the measures used to establish the problem exists are problematic); the focus is on what has caused the problem. The research investigates the views of society generally as represented by a) 'official' reports on mathematics education and b) a survey of over 100 individuals.

50 reports on mathematics education, published between January 2011 and December 2013, were analysed. Many suggest why there is a problem: the mathematical activity of young people; the curriculum, qualifications and assessment; and teachers, teaching and schools. There is little sense, however, of which of these causes is the most important or of the views of 'ordinary' people. The reasons given above were used to construct a survey that aimed to better understand public perception of the causes of the problems. The results suggest that the most important reason is a prevailing negative attitude in society towards mathematics, although assessment, curriculum and teaching are also seen as contributing to the problem. Qualitative free responses also suggest reasons such as low aspirations, poor textbooks and lack of relevance to the real world.

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Prospective Mathematics Teachers' Preferences for Instrumental Orchestration Types and Endorsed Norms

As a result of the emphasis on integrating technology into instruction, there is a growing need for research on teachers' and prospective teachers' choices, strategies, views and endorsed norms. This study aims to explore social and socio-mathematical norms embraced by prospective mathematics teachers during their technology-integrated lessons. Technology integration practices will be investigated through the lens of instrumental orchestration. With this aim, a case study was conducted. The participants of the study are two female prospective mathematics teachers who were enrolled in a teacher preparation course. Through collaboration, they prepared and taught a lesson on functions in one of the partnership schools using Graphics Calculus software. Data was collected through observations and semi-structured interviews. Findings will be discussed with regard to participants' preferences for orchestration types, social and socio-mathematical norms embraced by them and how these norms influence their preferences for using a particular orchestration type.

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Teaching and Learning the Common Core State Standards for Mathematical Practice

Released in 2010 by the Common Core State Standards Initiative (CCSSI), the Common Core State Standards for Mathematics have been adopted by the majority of states in the USA and are expected to be fully implemented by the end of 2014. With this in mind, teacher education programs must provide training in the new standards immediately, especially in those states that have already adopted the standards. Otherwise, new mathematics teachers may enter the profession with little to no exposure or understanding of the standards that they will be expected to teach. The Common Core State Standards consist of two major components: (1) Standards for Mathematical Content and (2) Standards for Mathematical Practice. This conference session will focus on the Standards for Mathematical Practice, which are devoted to the nurturing of problem solving skills, critical thinking abilities, and mathematical habits of mind. Participants will be introduced to the eight Standards for Mathematical Practice and will have opportunity to reflect upon the meaning and importance of the standards. Discussion will include future possibilities for teacher education programs and research inspired by the Common Core.

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Looking for Goldin: Can adopting student engagement structures reveal engagement structures for teachers? The case of Adam

As part of a PhD study into active emotional engagement of mathematics teachers, I aim to develop an approach that provides a means of addressing the complexity of classroom interactions, yet incorporates teacher beliefs. Goldin et al.'s (2011) 'engagement structures' are designed as nine useful, idealised multileveled hypothetical constructs for framing analysis of the complex nature of affect.

I will encourage discussion on whether the 'engagement structures' construct can be appropriately adapted for secondary mathematics teachers. If this is the case, then linking teacher and student engagement structures could support detailed examination of classroom interactions. I am collecting and analysing teacher data: a pre-observation life story; videoed observations; and, post-observation discussions of video extracts where the teacher is asked to recall and articulate their emotions. The selection of lesson extracts is informed by data collected through a galvanic skin sensor, worn by the teacher during the lessons, which acts as an approximating gauge of emotional shifts in the intensity of the teacher engagement at given points in the lesson.

I will examine one cycle of data and investigate the fit of emerging affective characteristics to each of the strands outlined by Goldin.

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Promoting primary children's verbal reflections on fraction tasks in an exploratory learning environment

Fraction tasks (especially computerised ones for primary education) are often limited in scope and their approach is typically procedural rather than conceptual. Encouraged by various studies that have demonstrated the potential of 'think-aloud' approaches in conceptual understanding, we are designing an exploratory learning environment (FractionsLab) that allows students not only to interact with different fractions representations but also provides verbal feedback that encourages students to 'reflect-aloud'.

In this session we will present the challenges we are facing in promoting this approach both during our design experiments and more realistic settings. We will also discuss preliminary findings that suggest that the combination of exploratory activities with explicit reflection stages help students develop their cognitive and meta-cognitive skills. Delegates with their own laptops will be able to interact with FractionsLab and familiarise themselves with its affordances and discuss its potential.

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Use of generic examples in university mathematics tutoring

Research on university teaching practice can inform understanding of university mathematics teaching and produce resources that novice and experienced university teachers might access for professional development (Speer, Smith & Horvath, 2010). However, research regarding pedagogy and mathematics puts an emphasis on school teaching (Jaworski, 2003) and very little exists concerning the teaching practices and knowledge of university mathematics teachers (Speer & Wagner, 2009). We report early findings from university mathematics teaching in small group tutorial settings. Tutorials are 50 minute weekly sessions and a group includes five to eight first year undergraduate mathematics students. Observation notes were kept and the sessions were audio-recorded and transcribed. The study addresses characteristics of the teaching of an experienced research mathematician and through interviews, her underlying considerations. The characteristics emerged through a grounded analytical approach of a small number of tutorials and were subsequently traced throughout the data. Our focus is on one of these characteristics: the use of generic examples to reveal aspects of a mathematical concept. A teaching episode has been selected from a vast amount of data as a paradigmatic case to illuminate the tutor's actual teaching

with generic examples, and links with her particular research practice, didactics and pedagogy emerge.

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Rethinking the Value of Advanced Mathematics Participation

This session will introduce the Nuffield-funded project 'Rethinking the Value of Advanced Mathematics Participation' (REVAMP). This project weaves together five strands of largely quantitative analyses to understand the current and changing attitudes to, participation in, and value attributed to A level mathematics. The project utilises high-quality secondary datasets and includes a large-scale survey of 17-year-olds' understandings of the value of mathematics in their educational and life choices and aspirations. The four quantitative strands of the project are 1) Updated research on the economic return to A level mathematics; 2) An investigation of the nature of changing participation in A level mathematics from 2005-13; 3) Modelling of the relationship between A level mathematics and outcomes in a range of science and social science degree programmes; 4) A large-scale survey of 17-year-olds. The project also incorporates a policy trajectory analysis. Some early findings will be presented. I will also spend some time setting the project in context including an overview of the current reforms of A level; the introduction of 'Core maths' and consultation on accountability measures; the growing interest in school-HE transitions and, finally, the work of the ACME.

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Mathematical modelling in a reformed curriculum

I have previously made a series of presentations on drivers for reform of the secondary mathematics curriculum. Equating mathematical modelling with applied mathematics has the potential to highlight some reform issues. I examine two modelling examples: one in the "real-world" domain of STEM professionals (decay of radioactive material) requiring knowledge of probability; and one in money-management education (cost-of-ownership of a moped) requiring knowledge of linear relations. The processes of model-making and model-use are examined and the roles within them of pure mathematics knowledge and the modellers' viewpoints. It is notable that (a) the modellers reside in the application domain- outside the domain of pure mathematics - and their viewpoint is the needs of the domain, but (b) they need appropriate pure mathematics knowledge. Mathematical reasoning is deductive and a general case model that must also be true for specific instances demonstrates the importance/power of mathematics in modelling. Conclusions relevant to curriculum reform seem to be implied. In the world outside the classroom modelling is undertaken by professionals in the domain where the problem occurs, but their model-making is restricted by their mathematics knowledge and teaching modelling in the mathematics classroom squeezes the time available for pure mathematics learning.

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What do primary teachers perceive as the effective elements of a specialist-coaching approach when developing their classroom practice in mathematics?

I report on a small-scale study that sought to provide insight into specialist coaching as a model for teacher professional learning by researching its effectiveness in a sustained mathematics development project. Informed by the research literature on specialist-coaching as a model of Continuing Professional Development, primary teachers' attitudes towards and views of mathematics and Professional Learning Communities, I adopted a case-study approach and used semi-structured interviews to collect data along with documentary evidence from the Ofsted reports.

The study explored the impact of the specialist-coaching approach on three teachers at a primary school in south-east England. The principal driver for improvement of teaching and learning was the outcome of an Ofsted inspection, with the school being required to improve. The mathematics

development project took the form of regular specialist-coaching sessions for every teacher combined with whole-school training, both of which were delivered by me, the researcher. The picture that emerged is complex. The analysis resulted in a set of recommendations emerging for the specialist coach and guidelines for schools considering adopting the specialist-coaching approach.

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Exploring Academic Achievement in Mathematics and Attitude towards Mathematics: The role of Bourdieu's elusive habitus

Although scholarly interest in the role of attitudes towards mathematics and achievement has increased, more research work is still required to explore the explanatory potential of Bourdieu's trilogy of habitus, capital and field in addressing the subject of mathematical achievement and attitudes towards mathematics. Attitude is an ambiguous construct that is characterised by theoretical conflicts (Potter & Wetherell, 2010).

Bourdieu's conceptual framework used in this study aligns well with the mixed method approach and it addresses the polarisation of structuralism and constructivism. Bourdieu's conceptual tools have been utilised to investigate educational choices and effect of social class. However, the number of past quantitative studies which examined the role of habitus have been limited (For example: Dumais, 2002 and McClelland, 1990)

This study is conducted across three comprehensive secondary schools in England all with contrasting achievement data and have Ofsted grades of 'Outstanding' to 'Requires Improvement' respectively. I have collected primary data from 1106 students in Years 10 and 11 using a survey. I will present the results of the quantitative analysis of the survey and outlining the preliminary findings regarding the complexities of how social class, ethnicity, gender and attitude towards mathematics affect both attainment and progress in mathematics.

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Assessment and evaluation of project material

There have been many attempts to provide satisfactory evaluation procedures for students' mathematical works, but project work raises problems that require consideration of aspects from wider background knowledge, related contexts, presentation, and applicability of material. A brief summary of some current assessment procedures will consider the contrast between assessment and evaluation. The material presented will contain drafts for consideration by an international panel on "The question of evaluation and assessment of experiences with introducing history of mathematics in the classroom" at a conference to be held in July 2014 at the European Summer University on History and Epistemology in Mathematics Education.

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"Arithmetic is being able to count up to twenty without taking off your shoes." - Mickey Mouse

This workshop will be an opportunity to explore the concept of number sense from a range of theoretical perspectives. I will begin by outlining how cognitive psychology positions number sense and reflect on how this view has come to dominate educational policy and practice.

Following this, I will use situated cognition to demonstrate the importance of social factors in learning mathematics. Finally, I turn to Bourdieusian social theory and consider the implications of this for mathematics education generally and the concept of number sense specifically. It is hoped these contrasting perspectives will provide the background for a lively discussion regarding the role of number sense in the mathematics curriculum and beyond.

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Using mental imagery exercises to produce and exploit visualisations in secondary school mathematics

In mathematics and mathematics education, visualisations play a certain, if not a crucial, role. However, it seems empirically that there is a lack of clarity about what exactly this role is and what type of visualisation – written on paper, virtual on a computer screen or mental in our minds – plays what role.

Nevertheless, in everyday mathematics education visualisations can be very fruitful. In the first part of this session I will present a case study on visualisations produced by a class of upper secondary school students, stimulated by a mental imagery exercise in mathematics. In the second part I will focus on the design of mathematical tasks relying on such student visualisations. Finally some implications for teacher education will be discussed.

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Democratic Participation in the Mathematics Classroom

We believe students' participation in school activities should be democratic and that this can best be achieved by planning for 'authentic' mathematical activity, which is characterised by the way in which students and their teachers work together mathematically. Students have the opportunity "to pose their own problems, make their own conjectures and discoveries, to be wrong, to be creatively frustrated, to have an inspiration, and to cobble together their own explanations and proofs" and to engage in mathematics as "art of explanation" (Lockheart, 2000). This is distinct from critical mathematics (Skovsmose 1990, Frankenstein 1983) where mathematics education provides tools for empowering young people socially and politically. We share that aim, but believe that, whereas the step from democratic participation in powerful, authentic mathematics, to critical mathematics is a short one, travelling in the other direction is not so easy.

We make use of 'Big Ideas' as a tool for shifting the object of activity in the mathematics classroom to participation in authentic mathematical activity. Our presentation will draw on data from an EU sponsored research project, 'Awareness of Big Ideas in Mathematics Classrooms', and a small scale follow-up project with Secondary Mathematics PCGE students at London South Bank University.

Working Groups

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*Institutional, sociocultural and discursive approaches to research in (university) mathematics
education: (Dis)connectivities, challenges and potentialities*

In this session we draw on the experience of working towards a Special Issue (SI) for Research in Mathematics Education (Institutional, sociocultural and discursive approaches to research in university mathematics education, 16(2), Summer 2014). The approaches we selected are: Anthropological Theory of the Didactic; Theory of Didactic Situations; Instrumental and Documentational Approaches; Communities of Practice and Enquiry; and, Theory of Commognition. The five SI papers were contributed by an international group of authors and cover several aspects of university mathematics education: institutional practices, teacher practices and perspectives, mathematical and pedagogical discourses, resources and communities of practice.

We will invite session participants to work on a small number of research problems in order to discuss how different issues are dealt with by the different approaches exemplified in the SI. We wish to explore how these approaches may have welcome commonalities but also vital points of divergence and incompatibility, even incommensurability. We will use the 90' session for: an outline of the SI rationale and contents and an introduction to said research problems (10'); group-work on these problems (30'); brief contributions on how the approaches presented in the SI tackle these problems (20'); plenary discussion of (dis)connectivities across the different approaches (30').

Evans, Jeff; Monaghan, John; Noyes, Andy & Pope, Sue

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*Using statistics in mathematics education research: The use of surveys - international
performance surveys*

In this session, we focus on two surveys: PIAAC (aka Survey of Adult Skills) and PISA.

Jeff Evans will begin by outlining some basic points to look for in the methods used in educational surveys, and illustrating these in relation to the PIAAC adult skills survey results. He will focus on methodological design validity and issues going beyond this, to include the way that the survey's measured scores are conceptualised, interpreted or reconceptualised in presentations and reports of various interested parties.

Jeremy Hodgen will respond to Jeff's presentation by considering how the issues raised in connection with PIAAC arise in connection with PISA; for example, how the definition of 'mathematical literacy' in PISA has changed, culminating in the 2012 (Round 5) conceptualisation. David Pepper will outline the OECD validation of PISA and argue that it is not sufficient for the proposed high stakes use of the assessment. David will focus on the PISA assessment of student confidence in mathematics and argue that, by combining quantitative and qualitative sources of validity evidence, the OECD could identify more threats to validity and potentially avoid them in future rounds of the survey.