



BSRLM Conference Programme
University of Birmingham, School of Education
Saturday 8th June 2019

Barclay, Nancy*; **Harvey-Swanston, Richard*** and **Marks, Rachel***
School of Education, University of Brighton

Examining Newly Qualified Teachers' use of Textbooks to Support a Mastery Approach to Mathematics Teaching in Primary Schools

In this presentation, we report the findings from a small-scale case study of four primary schools who have adopted mastery textbooks/schemes for their mathematics teaching. We focussed on the circumstances of Newly Qualified Teachers (NQTs) who bring to their first post recently developed understanding of mathematical learning theory together with limited experience in the classroom. In joining a school undergoing what Mathematics Subject Leaders (MSLs) will hope to be transformational change in mathematics teaching practices, they face a unique situation: how to learn to take responsibility for their pupils' mathematics learning while also learning how to manage the structure, organisation and recommendations of the mathematics textbook/scheme, and how to draw on and make sense of mathematics learning theory in so doing. While we explored changes in teacher practices and subject knowledge, our chief and unique focus was on how textbook use by NQTs has been supported in the case-study schools and how these new teachers are beginning to mediate and take responsibility for their use of textbooks to support pupil learning.

Key words: *Mastery; Textbooks; Newly Qualified Teachers; Primary Mathematics*
Session type: *Research paper*
Duration: *30 minutes*

Bokhove, Christian*
University of Southampton

The role of 'opportunity to learn' in the geometry curriculum: A multilevel comparison of six countries

In international comparisons for mathematics in PISA and TIMSS, Asia outperforms England considerably at secondary level. For geometry this difference is even greater. With a new maths curriculum having come into play in England in 2014, and hence the need to explore the impact of the curriculum on student achievement, In this presentation I report on how differences in achievement might be attributed to differences in 'opportunity to learn' within a country's curriculum. Two aspects will be highlighted. Firstly, I describe an integrated conceptual framework that combines elements from educational effectiveness, a curriculum model and 'opportunity to learn' for analysing curriculum effects, which we call the Dynamic Opportunities in the Curriculum (DOC) framework. Secondly, using multilevel models, TIMSS 2011 data is empirically investigated: is 'opportunity to learn' in the curriculum associated with achievement in geometry education in six countries. In essence, I show how the model, with the conceptualisation of 'opportunity to learn', might be useful in analysing curriculum effects..

Key words: *International comparison; geometry education; curriculum; grade 8 mathematics education*
Session type: *Research Paper*
Duration: *30 minutes*



Brown, Julian* & Wyllie, Marion
University of Bristol

Teacher questioning and teacher attention in a mathematics classroom

Given that it is inevitable that teachers cannot attend to all aspects of the complex environments of mathematics classrooms in an equal way, it is possible that the locus of teacher attention gives insight into teacher awareness of the learning of students. Such insight, in turn, might open spaces in which teachers can explore their practice. This session considers the questions asked by a mathematics teacher in a classroom as a possible mechanism for tracing teacher attention through observable behaviours. Drawing on ideas developed by Mason and considerations arising from applying a framework based on attention within an enactivist stance, we consider observations made in a series of mathematics lessons with a class of 14- and 15-year-old students and the subsequent discussions between the class teacher observed and the observer/researcher. Differences in the classifications of questions made by the teacher and the researcher are used to highlight moments of ambiguity which are, in turn, used to probe the awarenesses of both participants. Methodological and ethical implications arising from the experiences are discussed with a view to developments for future data collection and analysis.

Key words: *teacher attention; teacher questioning; awareness; mathematics classroom; observable behaviours*
Session type: *Research workshop*
Duration: *60 minutes*

Capraro*, Lee & Yujin
Texas A&M University

A cross-cultural differences in motivation and affective mathematics engagement

Researchers compared a sample of Korean ($n = 33$) to U.S. ($n = 30$) students to understand how culture affects and complicates the understanding of intrinsic and extrinsic motivators. Motivation and affective mathematics engagement were measured on the Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich, Smith, Garcia, and McKeachie (1991) and the Measuring of Affective Mathematics Engagement (MAME) by Lee, Capraro, and Bicer (2019). Independent t-tests using subscale scores of students' motivation and affective mathematics engagement were used to examine whether there were statistically significant mean differences between students. Results revealed a difference between Korea and U.S in terms of intrinsic motivation ($t = -14.628$, $df = 61$, $p < .001$). Hedge's g effect size was 3.645, and the 95% confidence interval was [2.770, 4.520]. Furthermore, the difference in extrinsic motivation was also statistically significant ($t = 2.338$, $df = 61$, $p < .001$). Korean students possessed more extrinsic motivation than those in the U.S suggesting that countries that are more likely to encourage intrinsic motivation may foster higher self-acknowledgement and value, but students in countries where extrinsic motivation is valued higher attitude and emotion may dominate.

Key words: *culture; intrinsic and extrinsic motivation; Korea; United States*
Session type: *Research paper*
Duration: *30 minutes*

Davies, Ben*, Jones, Ian* & Alcock, Lara
Loughborough University

What makes a good proof summary? An interview study with mathematicians in a comparative judgment context.

Proof is famously difficult for students of mathematics. Yet, despite its importance, there is relatively little research documenting how experts evaluate student-produced texts. In this talk, we present research focused on experts' decision-making in a comparative judgment-based assessment of proof comprehension.

Nine research-active mathematicians were interviewed immediately after making a series of 20 pairwise comparisons between written summaries of a proof demonstrating the uncountability of the open unit interval. We



report findings from a thematic analysis alongside the quantitative comparative judgment-based data.

Six themes influencing judges' decision-making were identified. This talk will focus on a subset including judges' attitudes to the necessity of content, reading strategies and general approaches to assessment. Despite the variety of factors influencing decision-making, the inter-rater reliability of these decisions suggests a high degree of agreement between judges.

We conclude that while judges readily identify specific features of summaries motivating their decisions, it seems likely that some less tangible shared sense of mathematical quality underlies these surficial motivations. This proposal is consistent with our motivation for using comparative judgment in this context and the claim that comparative judgment-based approaches are most beneficial in contexts where specific assessment criteria are difficult for experts to agree upon.

Key words: *Proof comprehension; Comparative judgment; Semi-structured Interviews; Thematic analysis,*
Session type: *Research paper*
Duration: *30 minutes*

Kevin Duckett

Maths Leader, Little Common School, Bexhill.

The use of a bar model in developing children's understanding of ratio and proportion in a primary school.

An action research project for an M.A, focussed on a form of mathematical representation which has recently been promoted by the Teaching for Mastery programme in many primary schools. The research examined the impact on children's understanding of one of the most challenging areas of the mathematics primary curriculum. This small scale study carried out in a Year 6 classroom, using observations and semi-structured interviews, discovered that with the correct application of teacher knowledge, it is an effective form of representation in developing children's understanding in this topic. However, vignettes of children's responses reveal the research also uncovered some issues which can undermine the effectiveness of the bar model in being able to answer questions in this mathematical area.

Key words: *Primary maths curriculum; 10- 11 years*
Session type: *Research paper*
Duration: *60 minutes*

Francome*, Tom; Hewitt, Dave; Jones, Ian

University of Birmingham, University of Loughborough, University of Loughborough

Intrinsic interleaving via Practice-through-progress: results of an exploratory randomised controlled field trial

Both teachers and students at all ages of schooling report spending a lot of time practising in mathematics lessons. How should this practice be designed to best support learning? Previous research has shown that most practice is blocked together on content immediately following instruction. However, a body of mathematics education research has demonstrated that there may be costs, as well as benefits, to organising practice in this way. In this session I report on an exploratory intervention study comparing three modes of practice designed for learners to develop their procedural fluency. One hundred and thirty seven students aged 12-13 from seven classes received a paper-based lesson on two topics; multiplying fractions and calculating area. They were randomised at the pupil level to receive one of three conditions: standard blocked practice, an interleaved practice intervention, or the practice-through-progress intervention. Students completed an immediate post-test and a delayed post-test after four weeks. The results suggest that the organisation of practice seen in the majority of resources may not be the most effective way to support learners' development of procedural fluency.

Key words: *practice; learning; mathematics; interleaved; practice-through-progress*
Session type: *Research paper*
Duration: *30 minutes*



Gifford, Sue*; Marks, Rachel*

Brunel University, Roehampton University, University of Brighton

Early Years and Primary Mathematics (EYPM) Working Group – 6th meeting

In this sixth meeting of the Early Years and Primary Mathematics (EYPM) Working Group, we will continue to build on the networks that are developing within the group, but we also welcome new members with an interest in EYPM – please do feel welcome to join us.

We are aware of some interesting research being/being done in the use of text books in EY/P so this session will focus on this work. We will share some of these findings but please come along prepared to talk about experience you may have had in using/researching a particular scheme.

We will also highlight some updates about topics we have recently discussed in the group, in relation to the Early Learning Goals and the maths specific Ofsted Guidance, and although it is still early days,

Rachel will discuss some of her project team's thoughts about the EEF review of evidence on early years and key stage one mathematics teaching. We welcome members' suggestions of evidence that the project team may wish to consider..

Key words: *early years mathematics; primary mathematics; textbooks; EEF*
Session type: *Working group*
Duration: *60 minutes*

Gripton, Catherine*

University of Nottingham

"The tricky table": Young children's lived experiences of 'ability' in mathematics

'Ability' informed practices, such as 'ability' grouping, are commonplace in mathematics lessons in English primary schools yet how young children experience these has received only limited attention in research. This case study of the classrooms of 5-7 year old children in two schools in the East Midlands of England explores the lived experiences of children in mathematics lessons. The results indicate that children's lived experiences of 'ability' are highly individual and shaped by the interaction of a broad range of social, structural and pedagogic aspects of mathematics teaching in their classrooms. Implications are that specific teaching choices can have a significant impact upon a child's perception of their own mathematical 'ability', of mathematics as a subject and of 'ability' in general.

Key words: *primary mathematics; ability; children's perspectives; case study*
Session type: *Research paper*
Duration: *30 minutes*

Harvey-Swanston, Richard*

University of Brighton

How can we improve 8-9 year olds' fluency in mental multiplication?

The development of fluency in arithmetic is a central aim of mathematics teaching and of the primary National Curriculum in England. However, the nature of the mathematical fluency which might be sought is bound up in beliefs about the relative value of conceptual, procedural and factual knowledge and how connections between them might be developed. This presentation will report on a small-scale, classroom-based action research study which sought to enable 8-9 year old children to develop such connections in mental multiplication.

Central to this study was the aim of extending and connecting conceptual knowledge so that children were able to innovate their own solving procedures rather than only applying known strategies. Examples of such innovation and the affordances and constraints of the teaching approaches applied will be discussed.



Key words: *mental multiplication; fluency; flexibility; primary;*
Session type: *Research paper*
Duration: *30 minutes*

Homer, Matt; Mathieson, Rachel
University of Leeds

Can Core maths solve the post-16 maths problem?

In this session, Dr Matt Homer and Dr Rachel Mathieson will discuss the latest findings of their three-year, Nuffield funded, project on Core Maths, the new post-16 Level 3 mathematics qualification. The project takes a mixed methods approach, using national pupil data, and interviews with key stakeholders and data gathered in 13 case study institutions where Core Maths is being taught. Matt and Rachel will describe different models of implementation of Core Maths in the current post-16 landscape, what teachers and students think of it, and what the evidence shows about patterns of uptake across England. They will also discuss the likely future of Core Maths, and the extent to which there is evidence of Core Maths supporting attainment in other post-16 subjects, and progress into HE.. We will discuss the opportunities for the mathematics curriculum and implications for the classroom.

Key words: *post-16; core maths; curriculum;*
Session type: *Research paper*
Duration: *30 minutes*

Jacques*
University College London (UCL)

Interpreting a primary Shanghai Showcase Lesson through a 'variation' Lens

Over recent years in England visiting teachers from Shanghai have taught public lessons in English primary schools for teachers to observe. One feature of Shanghai (and other East Asian cultures) teaching practices is the use of deliberate variation or 'Bianshi' (Gu et al, 2004). The use of procedural and conceptual variation is not a common deliberate practice by teachers in England. As such teachers' reflections on these public lessons often do not focus on the pedagogical choices made by the Showcase teacher but on superficial differences in classroom organisation. This session analyses a Showcase lesson (that was observed live by the researcher) through a 'variation' (Bianshi) theoretical lens. This analysis is part of a doctoral thesis that seeks to understand what necessary pedagogical practices teachers in England must develop to promote learning from variation,

Key words: *variation, primary, Shanghai, task design*
Session type: *Research paper*
Duration: *60 minutes*

Johnston-Wilder, Sue*; Mackrell, Kate*
Warwick University, Institute of Education, UCL

Nonviolent communication, compassion and mathematical resilience

Nonviolent (compassionate) communication was developed in the 1960's by Marshall Rosenberg (2015), a clinical psychologist and peace activist, as a means of addressing conflict. Fundamental assumptions are:

- humans are naturally compassionate;
- all human behavior is an attempt to meet needs (including a need to contribute to the welfare of others);
- emotions serve as indicators of needs.

Nonviolent communication involves empathic dialogue; participants seek to understand their own feelings and needs, and those of others, and to explore strategies for meeting the needs of all.



The aim of “mathematical resilience” is to address the issue of mathematics anxiety and avoidance. There are important resonances with the theory and practice of NVC: in particular, researchers in mathematical resilience affirm the importance of alleviating suffering caused by mathematics anxiety, recognizing that strategies such as simplifying the mathematics to the “safe” point will not meet the learners’ needs for challenge and growth. The importance of the need for connection is affirmed in both approaches. We look at the potential for NVC to illuminate and address some of the issues faced by mathematical resilience and conclude with some specific suggestions for practice.

Key words: *mathematical resilience; instructional resources; mathematics anxiety*
Session type: *Research paper*
Duration: *30 minutes*

Kinnear, George*; **Bennett, Max**; **Binnie, Rachel**; **Bolt, Roisin**; **Zheng, Yinglan**
University of Edinburgh

Reliably classifying the skills assessed in school and university exams

The MATH taxonomy was introduced by Smith and colleagues in 1996 to help teachers of mathematics in higher education to construct more balanced assessments. The MATH taxonomy classifies tasks according to the skills needed to solve them; the categories are arranged in three broad groups which can be roughly described as "factual recall and routine procedures", "using knowledge in new ways", and "applying knowledge to construct mathematical arguments". The MATH taxonomy has since been applied in a range of school and university contexts - in particular, to compare the demands of different assessment regimes.

This talk will report on a recent undergraduate project in which four coders developed a common understanding of the MATH taxonomy and applied it to a range of assessments. After an initial process of calibration, coders were able to achieve a high level of inter-rater reliability, and subsequently moved to independent coding of different school and undergraduate assessments. We will outline this process, as well as the findings obtained - in particular, we will make comparisons between the skills assessed in A-Level, SQA and IB mathematics exams, and contrast these with the skills assessed in a first-year undergraduate module at the University of Edinburgh.

Key words: *assessment; taxonomy; reliability*
Session type: *Research paper*
Duration: *30 minutes*

Lord, Ems*
University of Cambridge

Developing curiosity in the classroom: The case of the four triangles

In our increasingly crowded curriculum, curiosity can be easily overlooked in the mathematics classroom. This paper reports the findings from an ongoing NRIC project addressing the scarcity of curiosity in many of our classrooms. Through the lens of a geometric classroom activity, it explores the extent that primary-aged learners are able and willing to work in a curious manner. This paper draws upon both teacher interviews and focus group discussions with the learners. It reflects on the obstacles towards embedding a culture of curiosity in our schools and possible avenues for further investigation.

Key words: *curiosity, curriculum, teacher development, shape and space*
Session type: *Research paper*
Duration: *30 minutes*



Lyakhova, Sofya*; **Neate, Andrew***
Swansea University, Swansea University

Further Mathematics, students choices and transition to university for non-maths STEM degree students.

The transition from studying mathematics at school to university can be challenging for students. We have been investigating student choices of studying Maths and Further Maths A-levels, and the implications of these decisions on student transition to studying for a STEM degree at university. In this presentation we consider students who are studying for a non-maths STEM subject. The study consisted of a questionnaire used to access the opinions undergraduate students studying STEM subjects at a range of UK universities, followed by individual interviews of students to enrich the questionnaire data and provide further insight into the implications of their choices on the transition to university. The study identified several factors and barriers influencing student choice which included the attitudes and perceptions of the students to Maths and Further Maths, as well as those of their teachers and parents. We discuss student perceptions of how studying Further Maths affected their transition to university and consider what aspects of Further Maths they perceived to be most useful.

Key words: *transition to university; STEM education; post 16 education; Further Maths*
Session type: *Research paper*
Duration: *30 minutes*

Makar, Katie
The University of Queensland, Australia

Collaborative research with teachers over time to operationalise and adapt mathematical inquiry pedagogies

The development of more ambitious pedagogies such as inquiry-based learning has been an aim of mathematics education over the past three decades. An Australian study involved a collaboration between a researcher and a number of practicing primary teachers over many years to adopt mathematical inquiry pedagogies. A reflexive relationship developed between the researcher and a consistent core of 6 teacher-researchers over 10+ years. Their collaboration progressed shared understandings into the challenges, opportunities and ways forward for building capacity in mathematical inquiry beyond those involved in the study. Although the researcher contributed and developed theory, much of the knowledge in the study emerged from the teachers' work to operationalise and adapt pedagogical innovations and strategies. Five phases of funding 2007-2019 focused on different aspects of building teachers' capacity for teaching mathematics through inquiry. The presentation will outline key findings that emerged and how the teachers transformed the study.

Key words: *mathematical inquiry; teacher-researcher collaboration*
Session type: *Research paper*
Duration: *60 minutes*

Mayorga, Pablo
University of Roehampton

Understanding Student Teachers' Knowledge of Fractions for Teaching

A common tool used in Initial Teacher Education which seeks to assess student teachers' subject knowledge, is a subject audit. Student teachers (ST) from the University of Roehampton at undergraduate level have completed a subject audit in each year of their 3-year degree course. During the second year of their Primary Education (QTS) BA degree, STs complete a subject audit on fractions as it is the main topic covered in their mathematics sessions that year. In order to understand better student teachers' knowledge of fractions for teaching, the audit was moved from a paper-pencil format to a web-based format with the aim to analyse their responses closely. In addition to this online audit, two other tools were employed in order to delve deeper into the complex area of fractions for teaching. The second tool used is a novel psychometric survey developed in the US which has been adapted to the English context and administered to a sample of student teachers. The final tool used was an analysis of the sequence of lesson plans on fractions carried out by all 2nd year STs. This presentation will share the findings and



analysis of the data gathered as part of this study.

Key words: *Teacher education; student teachers; subject knowledge; fractions*
Session type: *Research workshop*
Duration: *30 minutes*

MUJIASIH, MUJIASIH*

Mathematical Communication on Divergence Problems Solutions Viewed from the Geometric Analogy Reasoning Type of Student

Geometric Analogy Reasoning is one form of reasoning in the geometry that needs to be grown so that the quality of students' skills of Mathematics Education is increasing. Geometric Analogy Reasoning for students becomes qualified when it comes to Divergence Problems and students are able to communicate. The problem, how the results of the analysis of the difference of Mathematical Communication on Divergence Problems solutions viewed from the Geometric Analogy Reasoning type of student? This article is based on the research with qualitative approach. Data analysis includes: data reduction, display data, data interpretation, and conclusion. Through a triangulation, the results of the analysis are (1) Geometric Analogy Reasoning type in students there are 3 types, namely total analogy, partial analogy, and analogy in the way of completion. (2) Based on Geometric Analogy Reasoning type, there are three different ways of communicating of Divergence Problems solution. Suggestions, (1) the student must be able to make a problem form of Divergence Problems. (2) Students must have the ability to communicate a Divergence Problems solution depending on the type of Geometric Analogy Reasoning.

Key words: *Mathematical Communication, Geometric Analogy Reasoning, type of student*
Session type: *Research paper*
Duration: *30 minutes*

Oakes, Dominic*; Birch, Teri*, Sofya Lyakhova*

University of Swansea, Wrexham Glyndŵr University, University of Swansea

Researching a 3D Curriculum

We presented previously on 'Bringing a connected curriculum to life' regarding when we looked at how we can improve developing mathematical thinking by looking at the connections in the material using the Unreal Game Engine to create a 3D Curriculum to allow students and teachers to travel through the curriculum.

Can we use this resource to grow our teachers' (& students') understanding of the patterns running through mathematics? Developing the 3D Curriculum is a first step in our research, which aims to investigate firstly whether and how teachers of A-level Mathematics could use the 3D Curriculum to inform their short- and long-term teaching plans and secondly whether students will find it valuable in developing their mathematical understanding.

In this workshop we will look at progress so far. We will then discuss how best to research the value of our 3D Curriculum.

Key words: *Connection; curriculum mapping; game engine; KS5*
Session type: *Research workshop*
Duration: *30 minutes*

Oakes, Dominic*; Joubert, Marie*; Lyakhova, Sofya*

University of Swansea, University of Nottingham, University of Swansea

Exploring teachers' use of time gained due to the use of a flipped classroom approach in mathematics

In response to teachers' complaints about an overcrowded curriculum, FMSP in Wales initiated a research project in two phases. We have reported on Phase 1 at previous conferences.



In Phase 1 we researched teachers' and students' experience of introducing and using the FCA. In this second phase of our research we are focusing on the teaching and learning of mathematics, looking at how teachers are using the time gained and students' perceptions of improved mathematical learning?

The research is set in North Wales, with two secondary teachers with classes in Mathematics and Further Mathematics A-level which took part in our initial research. During the project we worked collaboratively with teachers to design two lessons intended to develop deep levels of mathematical understanding for students. The researchers observed the two lessons, interviewed teachers, surveyed students using an online questionnaire and interviewed a sample of students.

Ultimately, it is intended to develop good practice guidance in this area (both in terms of flipped resources and classroom pedagogy). During the session we will be looking at what we have found so far and inviting discussion of our findings.

Key words: *flipped classroom, time gained, A-level*
Session type: *Research paper*
Duration: *30 minutes*

Parish, Alison
No affiliation

Digital technology and secondary mathematics in England, have we moved on from the Cockcroft vision of 1982?

What has happened to the vision of the 1980's where using computers would be part of teaching of secondary mathematics? In 1982 the Cockcroft Committee referred to the computer as 'an aid with the ability for interactivity and graphical representations' (paragraph 404) but pointed out that at the time there was under-use of the technology in schools and lack of good quality software for mathematics. Around the same time HMI's looked at A-level use of calculators as replacement for mathematical tables but suggested that use in examination courses was not widespread and, 'was often interpreted to mean that they cannot be used at any time during the course'. Move forward 37 years and some of these comments are still relevant. What is restricting digital technology use in developing more efficient working practices by students, improving the quality of work produced; developing problem solving strategies; applying mathematical ideas to the 'real' world and acting as a stimulus and motivator when digital technology plays such an important role in modern life? This presentation looks at some of the reasons for lack of progress including the technology acceptance model, constraints and barriers encountered by teachers and digital technology training issues. sample study, mathematics educators should be able to relate the findings to their own experiences and settings.

Key words: *digital technology; constraints; teachers; secondary schools*
Session type: *Research paper*
Duration: *30 minutes*

Ramirez, Paola
University of Bristol

Observing the historicity of a mathematics teacher

Based on enactivist approach this paper shows what actions of distinction make a mathematics teacher with their 23 students (ages 13–14 years old) when they were doing mathematics in their usual way and also when working with a mathematical modelling task for the first time. Noting how the distinction of the actions of the teacher is linked with his/her historicity, triggering mathematical inter-actions in their students.'

Key words: *teacher training, inter-actions, distinctions*
Session type: *Research paper*
Duration: *30 minutes*



Rogers, Leo* & Pope, Sue*

Not available

History of Mathematics Working Group : Tools and Processes for Using Historical Materials in the Classroom

We will develop the idea of Concept Maps using significant objects and problem situations from the history of mathematics to build connections with the curriculum where we can develop particular opportunities relevant for classroom practice.

We will share examples that offer rich problems appropriate for the curriculum adapted from historical contexts, suitable for use with teachers and learners. They include starting points such as introducing iconic images and offering problem-situations adapted from historical contexts

The theoretical background involves studies of visualisation and perception of objects in their contexts, together with developing questions about their origins, and both cultural significance and practical uses. These situations are intended to recognise the metacognition involved in learning processes and the epistemological possibilities of working with learners.

Bring your memory stick - examples and other resources will be available for participants to download.

Key words: *history of mathematics; curriculum*
Session type: *Working group*
Duration: *60 minutes*

Saralar, İpek*; Ainsworth, Shaaron & Wake, Geoff*

Improving middle school students' understanding of geometrical shapes: An experimental study of the RETA model

It is often argued that geometry and spatial thinking are interrelated. Much research has shown that middle-school children have difficulty in understanding 2d representations. A series of studies have been used to refine the RETA model to address this; Realistic, Exploratory, Technology-enhanced and Active. This presentation describes the final quasi-experimental study where 205 (85 intervention, 120 control) students participated in lessons based on it. Findings showed students engaged more with the mathematical content when the RETA lessons were adopted by their teachers and also significantly improved their understanding and construction of 2d shapes compared to peers taught with traditional methods.

Key words: *Reta lessons, 3d shapes, middle school children*
Session type: *Research workshop*
Duration: *30 minutes*

Simsek, Emine*; Jones, Ian*; Xenidou-Dervou, Iro; Hunter, Jodiematttlewis@gmail.com

Loughborough University, Loughborough University, Loughborough University, Massey University

Teacher Knowledge Predicts Students' Understanding of Mathematical Equivalence

Mathematical equivalence is a critical foundation for arithmetic and algebra learning. However, much research has shown that students have different interpretations of this concept. Students who hold the operational conception of mathematical equivalence see the equals sign as a 'do something' signal and focus solely on the computation, proceeding from left to right as they read number sentences, whereas students who hold the relational conception assess the value sameness of the two sides of the equals sign and appreciate the interchangeability of the two sides. Despite students' understanding of equivalence being widely researched, little is known about the factors relating to their understanding.

I report here a cross-cultural study which focuses on teacher knowledge as a predictor of student understanding. With a sample of 114 primary school teachers and 2813 students (ages 8-12) from their classrooms (from six countries, namely China, England, New Zealand, South Korea, Turkey, and the US), we conducted multilevel modelling to investigate the relationship between students understanding and teacher knowledge. Our preliminary findings suggested that teachers' knowledge about students' relational conception predicts students' understanding of mathematical equivalence whereas teachers' knowledge about students' operational conception does not. The implications of this will be discussed in the presentation.

Key words: *mathematical equivalence; teacher knowledge; the equals sign*
Session type: *Research paper*
Duration: *30 minutes*



Simsek, Ali**

UCL Institute of Education, University College London

Integrating dynamic digital technology into the actual classroom: a multiple case study of secondary mathematics teachers teaching geometric similarity

Successful integration of digital technology into the classroom is a demanding process for mathematics teachers as they need to develop teaching-with-technology expertise to promote students' mathematical learning. More recent research has focused on teachers' classroom practices that involve the use of digital technological tools. The main goal is to increase our understanding of the complex process of teachers' integration of digital technology and to identify their accompanying expertise. The present research seeks to investigate the actual classroom practices of three English secondary mathematics teachers as they use a dynamic mathematical tool (DMT) to teach a fundamental concept in lower secondary mathematics, geometric similarity (GS). The Structuring Features of Classroom Practice framework along with the Instrumental Orchestration model were chosen to guide my research since they provide useful conceptual lenses for analysing classroom practice with technology. Video-recorded lesson observations, audio-recorded post-lesson teacher interviews, and the scrutiny of lesson resources were employed as qualitative data collection methods. My preliminary results indicated there are differences in the ways the teachers exploited the affordances of the DMT in the classroom when teaching GS, especially during whole-class discussion and students' independent work that involved the DMT.

Key words: *classroom practice; secondary mathematics teachers; dynamic digital technology; geometric similarity*
Session type: *Research paper*
Duration: *30 minutes*

Staples, Megan, Cavanna, Jillian

University of Connecticut, University of Connecticut

Inservice teachers' evaluations of students' arguments: Results from a professional development project focused on mathematical argumentation

Developing proficiency with mathematical argumentation is a central goal advanced by current standards and guidelines. Teachers, however, have little training in how to achieve this goal. In this session, we report on a two-year professional development project working with three cohorts of grades 3–11 (years 4 – 12) teachers on mathematical argumentation in the United States. We share an overview of the project and report results from an assessment designed to elicit teachers' views of students' mathematical arguments, specifically their evaluations of the quality of students' work. Results from the pre-professional development administration documents an initial lack of consensus around features of a high quality (written) argument, as well as some differences between elementary and secondary teachers. Results from the post-professional development administration demonstrate increasing consensus of teachers' evaluations of most work samples (though full consensus is never reached), with some interesting remaining divisions in teachers' evaluations. The shifts from pre- to post-administration point to areas where professional development can have an important impact on the coherence and consistency in teachers' evaluations, which is particularly important for students as they move between grade levels and work to understand the characteristics of a high quality mathematical argument.

Key words: *Teacher Training; Secondary Mathematics; Argumentation*
Session type: *Research paper*
Duration: *30 minutes*



Sutherland, Pierre
Randstad Education

Using Research Problems Rather than Research Questions to Aid Working Across Disciplines

Research problems are posed in contrast to research questions as a departure point for social scientific inquiry. Classroom discussion inertia, or, the tendency of fewer students speaking in a classroom over time, is used as an example to contextualize the concept of a research problem. Various responses to this problem are discussed and framed using problem-based terminology. Specifically, the two main problems discussed are referred to as inertia and blockages respectively.

Research problems form part of a larger methodology proposed in the author's PhD dissertation (Sutherland, 2016) aimed at investigating technological interventions into educational settings. The concept of a problem is appropriated from *A Thousand Plateaus* (Deleuze & Guattari, 1987) but it is also influenced by concepts from complexity theory, sociology, biomathematics, and artificial intelligence. Finally, problems are positioned within the larger methodology and examples of the resulting theory networking and multidisciplinary work are discussed.

Key words: *Method; multidisciplinary approach; mathematics education; educational research; philosophy*
Session type: *Research workshop*
Duration: *30 minutes*

Venkat, Hamsa; Askew, Mike
Wits School of Education, University of the Witwatersrand

Studying the possibilities for scaling up success: Working with district advisers

In a South African context of low performance in mathematics at all levels, success in terms of pre- to post-test learning gains have been achieved in a series of post-graduate and research team-led short-term intervention studies focused on multiplicative reasoning in the primary grades. These interventions have been small scale, usually working with single classes in the case of most of the postgraduate studies, or with all nine Grades 1-3 classes in one school in the case of the research-team led intervention. With imperatives to look at possibilities for scaling interventions showing promise, in 2019, we have worked with a group of Foundation Phase (Grades 1-3) district Subject Advisers in one province, leading workshop sessions with them on multiplicative reasoning and intervention logistics, with each of them now supporting two teachers in a primary school in their district. In the session, we share and discuss the qualitative feedback provided by the Subject Advisers on the ways in which this professional development activity overlaps and differs from the kinds of development they have tended to receive. We also provide insights into pre- and post-test learner performance data from the lesson sequences enacted by the teachers that the Subject Advisers worked with.

Key words: *multiplicative reasoning, teaching development, mathematics teacher education, South Africa*
Session type: *Research paper*
Duration: *60 minutes*

Wake, Geoff*, Morgan, Debbie*
University of Nottingham, National Centre for Excellence in the Teaching of Mathematics (NCETM)

Didactics

It is the intention that this working group explores what a didactics of mathematics education in England might entail, and to consider this by drawing on some ongoing work that might help provide insight. In this initial meeting group the intention is to explore potential interest in such a BSRLM working group, to consider "didactics" at a general level and to have a first, and necessarily limited exploration of didactical design of approaches to teaching a topic from Chinese (Shanghai) and Japanese, as well as English perspectives.

Key words: *Didactics; curriculum; teaching and learning; mathematics knowledge for teaching*
Session type: *Working Group*
Duration: *60 minutes*



Wright, Pete*

UCL Institute of Education

The Visible Maths Pedagogy Project: Challenging inequity through making teachers' pedagogical rationale more explicit to learners

During this session I will report on the methodological findings from the Visible Maths Pedagogy Project. This participatory action research (PAR) project embraces the potential of open-ended, discursive and problem-solving teaching approaches to tackle the persistent gap in mathematics achievement between children from different socio-economic backgrounds. It highlights concerns raised by some researchers that children from disadvantaged backgrounds often struggle to recognise the intentions of their teachers when adopting less-structured teaching approaches, and hence find it more difficult to realise success. The project aims to address these concerns by exploring strategies to make the teacher's pedagogical rationale more explicit to learners. I will present the findings from a thematic analysis of a series of research meetings between myself and the two teacher researchers, Tiago and Alba, from Stoke Newington School (North London), with whom I conducted the research. The meetings focused on reflecting critically on existing practice by engaging with key research findings, collaboratively planning strategies for making pedagogy more visible, evaluating these strategies by making use of various research tools including research journals, student surveys, interviews, and video-stimulated reflection. Further information about the project can be found at www.visiblemathspedagogy.wordpress.com

Key words: *Inequity, participatory action research, school mathematics, visible pedagogy.*
Session type: *Research paper*
Duration: *30 minutes*