



**BSRLM Conference Abstracts  
King's College London**

**Saturday 10<sup>th</sup> November 2018**  
**[#BSRLMNov18](#)**

**Bamber, Sally**

University of Chester

*Translating research into practice through collaborative planning: the case of the so called grid method*

Drawing on research that informs transformative teacher education experiences, this paper will reflect on early attempts at teacher education that were situated away from the site of learning in contrast to an ongoing study that develops mathematics teachers' knowledge and practice collaboratively. This paper reports on the experiences of a group of Welsh secondary school educators participating in collaborative classroom enquiry designed to develop GCSE pupils' understanding of linear and quadratic algebraic expressions. The paper identifies the potential to disturb and improve learning through the use of enactive and iconic representations of algebraic concepts, whilst identifying tensions that arise in the act of changing the context for learning in a secondary school classroom.

Key words: *Teacher education, algebraic expressions, collaborative enquiry*  
Session type: *Research paper*  
Duration: *30 minutes*

**Bishop, Emma**

Ysgol Bryn Eliau

*Evaluating the impact of 'Numeracy Mats' designed to model self-questioning on GCSE pupils' metacognitive awareness and self-regulatory strategies.*

This session follows the implementation of 'Numeracy Mats' that were designed to model a self-regulatory approach and improve memory retention for pupils working towards the GCSE Numeracy (WJEC) qualification. It will evaluate the impact of domain specific self-questioning prompts and regular exposure to common mathematical methods and formulae on pupils metacognitive awareness and ability to recall learnt information.

The concept of the mats are based on the theory of metacognition and its influence on problem solving. Important mathematical information was connected on the mats by questions that model a self-regulatory approach to arriving at the methods or formulae needed to calculate solutions. The colour and font on the mats was considered as these have been found to influence the recall of learnt information.

Pupils used and referred to the numeracy mats whenever they felt appropriate over four months but more so in the immediate lead up to their examinations once the syllabus had been covered. Students also created their own numeracy mats for Algebra and/or data as part of their revision.

Pre and post numeracy tests and Metacognitive Awareness in Maths Inventory scores will be compared to measure changes to pupils performance and metacognitive awareness. I will triangulate this with qualitative data collected from a focus group interview to strengthen the conclusions drawn.

Key words: *Numeracy; GCSE; Wales; metacognition; memory*  
Session type: *Research paper*  
Duration: *30 minutes*

**Black, Laura; Coles, Alf; Jones, Keith**

University of Manchester; University of Bristol; University of Southampton

*Writing and reviewing for Research in Mathematics Education*

In this workshop session we aim to encourage BSRLM colleagues to consider both submitting manuscripts to RME and putting themselves forward as reviewers. We will set out some of our aims for the journal, some of the characteristics of



strong papers and how the review process works. We will also be ready to answer questions from participants and are keen to seek the views of BSRLM members about the journal as it is now and as it could be in the future.

Key words: *Publishing; reviewing; Research in Mathematics Education*  
Session type: *Research workshop*  
Duration: *30 minutes*

**Brown, Julian**

University of Bristol

*Teacher noticing and teacher framing in teacher talk about a mathematics classroom*

Taking an enactivist perspective, when a teacher talks about what has happened in their classroom their speaking, learning and doing is a function of their past interactions, i.e. their structural coupling with the people and contexts with whom they interact repeatedly. With each interaction, they are changed and they change the world that emerges. Drawing on existing models for what can be inferred about teachers' epistemological framing from what teachers say about their practice, particularly in response to video clips of the classroom, this report considers one stimulated recall interview with a teacher of mathematics. Since teacher reflections provide a new interaction, building on, yet separate from, their noticing in the original classroom event, I consider how the teacher frames their accounts of the lesson with particular attention on accounts of what was noticed during the lesson and what this might indicate in terms of their post-hoc noticing.

Possibilities for using this to inform further classroom observations are considered.

Key words: *Teacher noticing; framing; teacher decisions; mathematics classroom*  
Session type: *Research paper*  
Duration: *30 minutes*

**Brown, Laurinda; Llinares, Salvador**

University of Bristol, UK; University of Alicante, Spain

*Enactivism and professional noticing: Is complementarity possible for mathematics teaching and learning in teacher education?*

Complementarity is a relationship or situation in which two or more different things improve or emphasise each other's qualities. Laurinda and Salvador both work in Mathematics Teacher Education (MTE) with different perspectives: 1) Enactivism helps to explain how activities in prospective teacher education or professional development can support prospective teachers or teachers in modifying their practice when they return to their own classroom (Bristol); 2) Professional noticing, is a way to become cognizant of mathematics teaching events by knowledge-based reasoning processes, providing a structure for prospective teachers to understand and act in particular contexts (Alicante). We are working, together with colleagues in our universities, with our goal being to discuss how taking aspects of enactivism and professional noticing approaches together can help us better to understand prospective teachers' learning, considering how activities in teacher education shape the way in which prospective teachers reason about teaching situations. In this paper, we focus on two current questions: i) how can activities support how prospective teachers reason about their or other's actions and how do they fit their actions to the goal they sought to accomplish; and ii) how can understanding the "practical reasoning" behind their actions encourage prospective teachers to sustain their learning/development/ change.

Key words: *Enactivism; practical argument; professional noticing; prospective teacher learning.*  
Session type: *Research paper*  
Duration: *60 minutes*

**Bustang; Foster, Colin**

University of Leicester, University of Leicester

*Secondary School Students' Understanding the Relative Probabilities of Events: Findings from a Pilot Study*

Research about relative probability comparisons has been conducted for many years (Chernoff, Vashchyshyn & Neufeld, 2018), leading to various theories and models to account for students' normatively incorrect judgements in comparing the



relative probabilities of events (e.g. Abrahamson, 2009; Chernoff & Russell, 2012; Fischbein, 1975; Konold, 1989; Tversky & Kahneman, 1974). However, research exploring the extent to which some of these normatively incorrect judgements may be caused by students' desire for deterministic explanations, such as misapplication of proportional reasoning, is limited (e.g. Van Dooren et al., 2003). In this presentation, I will summarise the literature about the theories and models that account for student's normatively incorrect judgements in comparing probabilities and present the initial findings from a pilot study investigating secondary school students' understanding in comparing the relative probabilities of events.

Key words: *Comparing probabilities; misconceptions; heuristics and biases; informal conceptions; probability and proportion*

Session type: *Research paper*

Duration: *60 minutes*

**Cascella, Clelia\***; **Maria Pampaka**; **Julian Williams**

University of Manchester

*Girl left behind in South? An empirical exploration of gender (in)equality in mathematics education*

Gender differences in math education have been studied extensively. Nevertheless, research has failed to explain important patterns across cultures and geographies. We explored gender differences in math achievement at local (provincial/regional) level in the hypotheses that the hypothesis that social conditioning and gender-biased environments can have effects on education (and Mathematics test performance in particular) with the hypothesis that gender differences can vary also within the same country, at regional and/or provincial levels. Multilevel analysis carried out on 38120 students confirmed our hypothesis.

Key words: *Gender; difference; Learning; social environment*

Session type: *Research paper*

Duration: *30 minutes*

**Cascella, Clelia\***; **Eleftheriadou, Sofia**; **Lei, Ka Hei\***; **Pampaka, Maria**; **Williams, Julian**

The University of Manchester

*Mathematics anxiety around the world*

The presentation will focus on mathematics anxiety as evidenced and experienced from research, policy and practice point of views in different countries around the globe. We start with an overview of the larger project this work builds on, a systematic review of mathematics anxiety funded by the British Academy from 2016-2018. We present selected findings from the overall review and then focus on a subsection which explores in detail policy and practice documents (what is usually called 'grey literature') from various countries. We focus on the cases of Italy, and Macau, and frame the resulting commonalities and differences concerning mathematics anxiety definitions, what policy documents and curricula tell about students' emotions and how the particular education systems structure mathematics teaching and learning. We link the above with further evidence from the UK and also recent international comparisons (e.g. PISA).

Key words: *Mathematics anxiety; emotions; pedagogy; systematic review*

Session type: *Research paper*

Duration: *30 minutes*

**Cross, Michael**

University of Bradford

*Failing GCSE mathematics "made me feel like a complete failure": Exploring narratives from numerate graduates.*

Drawing on data from personal narratives, this paper will present findings from a study which explored the experiences of numerate graduates who self-identify as struggling, or having struggled, with mathematics. Eight graduates took part in the study, all of whom were working as experienced professionals in fields that require evidence of specific mathematics skills including teaching, nursing, pharmacy, radiography and psychology. Creative qualitative methods were used to enable the participants to tell their stories. These involved the construction of a personal timeline and two in-depth interviews with each participant which were conducted two weeks apart. The data were analysed using a thematic approach. Two global thematic networks were developed from the data, entitled 'Purpose' and 'Identity', and common experiences among the



graduates were noted. Consequently, and with reference to literature, it will be argued that dis-empowering and inequitable tendencies within mathematics education are 'sticky' in nature and seem to be replicated, or preserved, over many years and in many contexts. The role of graduates as stakeholders in mathematics education will be highlighted and recommendations for practice and further research will be made.

Key words: *Narrative; graduate stakeholders; thematic networks*  
Session type: *Research paper*  
Duration: *30 minutes*

**Curtis, Fiona**

University of Reading

*Mentoring: what's important? A study of what trainee teachers believe is important in a mentor.*

Programmes of teacher training almost universally follow a model of school placement, at which an experienced teacher is assigned to the trainee, as mentor. The role of mentor encompasses many responsibilities, but rarely do mentors receive in-depth training. As a result of this and other factors the performance of the role has been found to be subject to great variation. With the role being so multi-faceted, I wanted to focus in on the aspects that were considered most important, in any attempt to improve the consistency of the trainee's experience. This research reports on the responses to two cohorts of secondary maths teacher trainees regarding their priorities, their experiences and what they believe is helpful, particularly looking to see whether there is any correlation between what they believe is important and their experiences.

Key words: *Mentoring; teacher training*  
Session type: *Research paper*  
Duration: *30 minutes*

**Dalby, Diane\*; Noyes, Andrew; Lavis, Yvonna**

University of Nottingham

*The mathematics teacher workforce: implications for supply, demand and sustainability resulting from current policy*

A national shortage of teachers in schools and colleges has been a concern for some years but recent policy changes and incentives to encourage greater participation in post-16 mathematics may have exacerbated the problem rather than provided a satisfactory solution. Findings from a recent mathematics teacher workforce survey and accompanying case studies, carried out as part of the Mathematics in Further Education Colleges (MiFEC) project, show how policy has a significant impact on mathematics teachers' roles, responsibilities and professional development needs in this sector. Whilst routes into teaching in Further Education may vary compared to traditional pathways into mathematics teaching in school, the effects of policy on these teachers' working lives raise issues of wider interest. In this session, the survey results will provide a starting point for a broader discussion about the impact of policy on the teacher workforce, including the implications for initial teacher training and on-going professional development of those who enter mathematics through a variety of routes.

Key words: *Professional development; teacher training; policy; Further Education.*  
Session type: *Research paper*  
Duration: *30 minutes*

**Davies, Ben\*; Jones, Ian\*; Alcock, Lara**

Loughborough University

*Comparative judgment and proof comprehension*

Proof is a famously difficult aspect of mathematics for students at all levels. Here, we present research using a comparative judgment-based approach to assess students' summaries of a proof demonstrating the uncountability of the open unit interval. First, we compare comparative judgment-based scores to two established measures of proof comprehension: a multiple-choice comprehension quiz and final scores on an undergraduate 'introduction-to-proof' module. We then invoke a mixed-methods analysis to develop a deeper understanding of the students' summaries and provide insight into the types of responses most favoured by expert mathematician judges.

We found strong quantitative evidence for both internal and inter-rater reliability. The comparative judgment-based scores



also yielded modest but significant correlations with both the multiple-choice comprehension quiz and module scores. From the follow-up analysis, we found the most successful summaries to be those focused on the key mathematical objects presented in the proof. These findings are both interpreted as substantive evidence for validity. We conclude by discussing possible applications and extensions of this work, including the need for a broader range of studies focused on both differing tasks and differing mathematical content.

Key words: *Comparative Judgment; proof comprehension, assessment; higher education*

Session type: *Research paper*

Duration: *30 minutes*

**Earle, Lorna; Rickard, Caroline**

University of Chichester

*TIMES TABLES: Children learning about multiplication facts*

The learning of times tables (the collection of multiplication facts up to 12x12) is currently in the spotlight with the planned introduction of a times tables check for all children in Y4 from 2020. Whilst not disputing the benefit of having well-embedded known facts, we were keen to establish the extent to which children saw times tables as a connected body of knowledge as opposed to 144 isolated facts. This led to a small project undertaken in two of our partnership schools where, after establishing the children's existing understanding, we gave them the opportunity to explore and reason about multiplication facts over four sessions. In this session we share some of our thoughts and recommendations.

Key words: *Multiplication facts; times tables; primary*

Session type: *Research paper*

Duration: *60 minutes*

**Evans, Sheila**

University of Nottingham

*What do students talk about when they tackle together unstructured non-routine problems?*

There is much evidence to indicate collaborative learning raises students' levels of achievement as measured by standardised tests. Classroom-based studies consistently show benefits to learning when compared to classes where the pupils study individually. Many studies, however, have reported that the vast majority of the time, while students may sit in groups, they are not functioning as a group. Pupils, for instance, loaf around. They can view their own personal contributions as not being essential to the group's chances of success. They allow others to take responsibility for the task. The aim of the study was to explore the circumstances in which students did engage in more and less productive conversations when solving challenging, unstructured, non-routine problems.

In four classroom-based lessons, a pair of 14 year olds were videoed, first reviewing each other's initial solution to a problem, and then jointly tackling the same problem. The transcript of their conversations was analysed using a tool based on the sustained scrutiny of how social metacognitive regulation manifested itself.

The results were rich and multifaceted. They indicated, for instance, that when students introduced a new strategy, different from their initial conception of the problem, their conversations were more productive compared to when no new strategy was devised. They were more effective, for example, when they adopted the role of tutor to explain their ideas to their partner.

Key words: *Collaboration, problem-solving, social metacognitive regulation*

Session type: *Research paper*

Duration: *30 minutes*

**Farmery, Helen, Bamber, Sally**

Middlesex University, University of Chester

*Working towards collaborative ITE that enables research to be translated into practice*

This paper will present models from primary and secondary initial teacher education programmes that are created with the purpose of collaboratively translating research into practice. We draw upon the work of internationally informed teacher



education authors such as Darling-Hammond to analyse the place of expert knowledge within collaborative, sustained professional development opportunities that influence beginning and early career teachers of mathematics. This exposes tensions and difficulties within the translation of research informed learning models at the site of practice and provides stimulus for discussion about how we might collaborate to support early career teachers within the wider school community.

Key words: *Initial teacher education. Research-informed practice*  
Session type: *Research paper*  
Duration: *30 minutes*

**Finesilver, Carla**  
King's College London

*Beginning mathematics teachers' attitudes, practices and knowledge regarding inclusion of students with SEN/D*

Teachers in the UK are required to teach a diverse range of students, with increasing inclusion of those with Special Educational Needs and Disabilities (SEN/D) in mainstream classrooms. Success depends on teachers having not only positive attitudes towards students with SEN/D, but theoretical and practical knowledge, skills and competencies. The development of these attributes poses a considerable challenge for both teachers and those involved in training them. This research investigates the initial conceptions of a Secondary Mathematics PGCE cohort regarding inclusive education of students with SEN/D, and the ways in which their attitudes, practices and knowledge developed over the course of the academic year. Many participants were willing to discuss their experiences, comment on the different perspectives and knowledge they gained during the year, and highlight those aspects with which they were still struggling. These early findings demonstrate a wide variety of initial conceptions of SEN/D and attitudes to inclusion, and indications of the kinds of educational experiences that prompted change. It is hoped that this will be helpful in improving and providing appropriate training for future mathematics teachers.

Key words: *Teacher training, secondary mathematics, inclusion, SEN*  
Session type: *Research paper*  
Duration: *30 minutes*

**Gifford, Sue; Trakulphadetkrai, Natthapoj Vincent**  
University of Roehampton, University of Reading

*Early Years and Primary Mathematics (EYPM) Working Group - Fourth Meeting (Where to Publish your Research)*

In this fourth meeting of the Early Years and Primary Mathematics (EYPM) Working Group, members of the BSRLM community who are passionate in EYPM research are invited to help build up a list of journals that they would recommend colleagues in the EYPM research field to disseminate their research findings in. This list will include both traditional peer-reviewed research journals and professional journals for practitioners. Participants are encouraged to share personal experiences in dealing with some of these journals - both positive and not-so-positive experiences. Recommendations for other dissemination platforms (e.g. blogs and magazines) will also be looked at. Finally, we will also briefly discuss any topical updates (e.g. revisions to Early Learning Goals, etc.). All new-comers with a particular interest in early years and primary mathematics education are very welcome.

Key words: *Early years and primary mathematics education*  
Session type: *Working group*  
Duration: *60 minutes*



**Golding, Jennie**

University College London Institute of Education

*Differentiated papers and quality of enacted curriculum: students' experiences of preparation for GCSE examinations at age 16*

The 2014 English national curriculum for mathematics, with its renewed focus on mathematical problem solving and reasoning, lays down that students from 14 to 16 should be taught one of two curricula, at 'Foundation' or 'Higher' tier. Related student learning is assessed at age 16 by two overlapping sets of papers, targeting GCSE grades 1-5 or 4-9 (with an allowed grade 3) respectively. I draw on two longitudinal studies that included classroom observations, and teacher and student interviews involving over 500 GCSE students and over 60 GCSE teachers, together with teacher and student surveys, in a representative sample of about 40 schools. Data suggest that enactment of the curriculum in the ways envisaged is unusual. Instead, and for a variety of reasons, teachers commonly adopt approaches that include teaching a broader range of content than students have opportunity to engage with via problem solving and reasoning; 'cherry picking' Higher tier topics so that students target the small number of marks needed for a Higher tier grade 3/4/5, sometimes in a mathematically rather incoherent experience, rather than preparing them for a broad and deep grasp of the Foundation curriculum; and setting out to teach for a proper subset of the curriculum, but within that, to engage with the range of mathematical knowledge, skills and processes. I consider apparent and reported implications of each of these.

Key words: *Assessment; differentiation; coherent curriculum; problem solving; reasoning*  
Session type: *Research paper*  
Duration: *30 minutes*

**Hodgen, Jeremy & Foster, Colin**

UCL Institute of Education, University of Leicester

*What strategies are effective at addressing low attainment in secondary mathematics? Findings from a systematic review and second-order meta-analysis*

In this session, we will present our findings from a systematic review conducted as part of the Investigating Mathematical Attainment and Progress: Low Attainment in Year 9 project (funded by the Nuffield Foundation), which focused on the nature and causes of low attainment in mathematics.

There have been several recent narrative and systematic reviews of mathematics education (e.g., Education Endowment Foundation, 2017; Nunes et al., 2010). Our review builds on these, but focuses specifically on the meta-analytic literature. In our review, we explored the current evidence from experimental studies on teaching mathematics, as well as identifying areas towards which future meta-analyses and primary experimental studies might be profitably directed. Second-order meta-analyses have been widely used in the medical and health sciences, and are becoming more common in educational research (e.g., Steenbergen-Hu et al., 2016). Based on pre-established inclusion/exclusion criteria, we identified through systematic literature searches around 50 meta-analyses, which summarise an extensive set of original studies ( $N \approx 2500$ ).

We will discuss the findings and the implications for mathematics teaching, paying particular attention to the contested and timely issue of direct instruction (e.g., Gibb, 2017; McMullen & Madelaine, 2014). We will also discuss the limitations of our approach to reviewing the literature.

Key words: *Low attainment; meta-analysis; systematic review*  
Session type: *Research paper*  
Duration: *30 minutes*

**Healy, Lulu\*; Nardi, Elena; Biza, Irene; Silos de Castro Batista, Érika**

King's College, London, University of East Anglia, University of East Anglia, Universidade Federal Fluminense

*Emphasising difference over deficiency in inclusive mathematics teaching*

This session will focus on aspects of our ongoing research, which is committed to challenging discriminatory visions of students' potential for mathematics learning. In the first part, we will share examples from our work with disabled learners



in order to explore our attempts to understand their mathematical practices and the mediational tools that support the emergence of alternative ways of working mathematically. In the second part, we will describe how these examples led to the design of situation-specific tasks which invite teachers to reflect on inclusive mathematics teaching. In the third part, we discuss how, as teachers engage with these tasks, they recognise how disability does not imply mathematical deficiency, they value and develop alternative mathematical strategies, including haptic, visual and gestural expressions, and they reflect on what counts as mathematics. Overall, our analysis indicates that the tasks contribute to a questioning of the hegemony of conventional practices of school mathematics regarding the roles of teachers and learners, as well as the privileging of certain forms of written and spoken communication.

Key words: *Inclusion in mathematics education; task design; ableism.*  
Session type: *Research paper*  
Duration: *60 minutes*

**Homer, Matthew (\*); Mathieson, Rachel (\*); Innocent Tasara; Indira Banner**  
University of Leeds

*Core Maths: Perceptions of its use and exchange value, and impact on student attitudes to mathematics*

This session focuses on data from a large-scale mixed methods project looking at the successes of and challenges facing the new post-16 Core Maths (CM) qualification in England. Findings from 13 case study institutions are presented in two separate but related talks.

Firstly, we use thematic analysis of interview data from teachers and students to explore their views on the value of CM, and this work suggests that it can be characterised as having both use and exchange value, but that these are not embodied in equal measure. Participants speak highly of the usefulness of the content of CM and of the mathematical ways of thinking it encourages; they also indicate that the signalling from Higher Education and others does not suggest that CM qualifications currently have high exchange value.

Secondly, we use longitudinal questionnaire data from over 100 students to measure CM students' changing perceptions of teaching and mathematical dispositions. We find some evidence that pedagogy in CM lessons is experienced as being a little more student-centred than at GCSE; however, there is little or no change in students' mathematical dispositions over a year of CM.

We conclude that there is work to be done in developing the exchange value of CM, and in embedding a new pedagogical approach to its teaching, before CM is likely to aid in achieving the ambitious government aspiration that most post-16 students study some mathematics at Level 3 where appropriate.

Key words: *Core Maths; post-16 mathematics; curriculum*  
Session type: *Research paper*  
Duration: *60 minutes*

**Jacques, Laurie**  
SMaR+ PD

*Developing Variation Pedagogy: When you vary the wrong thing...*

Teachers are increasing their awareness of variation pedagogy but there is much to be learned by teachers and researchers about how it can transfer to classroom in England. This workshop will present a vignette of data from a Doctoral study exploring primary teachers' developing variation pedagogies.

The vignette illustrates how an iterative process of 3 Learning Study (Marton & Pang, 2012) cycles using the Bianshi Framework (Gu et al, 2004) for analysis provides insight into teachers' evolutionary variation pedagogy, in this case when collectively the teachers were experiencing difficulties in choosing the appropriate variable to vary.

Key words: *Primary, learning study, variation, professional learning, multiplication*  
Session type: *Research paper*  
Duration: *30 minutes*





**Jacques, Laurie; Drury, Dr. Helen**  
SMaR+ PD Mathematics Mastery

*What do we really mean when we talk about 'deep' learning?*

A core principle of Mathematics Mastery (MM) is to ensure that pupils learn mathematics underpinned by three dimensions of depth: conceptual understanding, language and communication and mathematical thinking. Teachers using MM regularly comment that the pupils they teach demonstrate “a ‘deeper’ understanding of mathematics” than pupils they have taught in the absence of MM, but they struggle to articulate what it is their pupils do and say that leads them to this evaluation. As such, Helen Drury has begun to explore how MM teachers might be able to better articulate deep learning in mathematics by commissioning a literature review that seeks to understand what it can mean to evaluate mathematical learning as ‘deep’ or ‘deeper’.

The two presenters Helen and Laurie will share the emerging findings from the literature review and encourage workshop participants to discuss and contribute to a working definition to support teachers in assessing and evaluating deep mathematical learning using a common language.

Key words: *Primary; secondary; deep learning; assessing*  
Session type: *Research workshop*  
Duration: *60 minutes*

**Jones, Ian\*; Foster, Colin\* & Hunter, Jodie**  
University of Leicester, University of Loughborough, Massey University

*Standards over time in A level mathematics*

Comparative judgement methods have been used for over two decades to explore the relative ‘difficulty’ of A level mathematics examination papers over time. However, the scope of previous studies has been limited by a paucity of graded candidate scripts from previous years, as well as the expense and time required to transcribe and prepare such scripts into a consistent format for judging. Recent attempts to overcome these limitations have involved experts making judgements of relative examination difficulty by judging the questions only (without solutions) or judging artificial scripts comprising ‘perfect’ worked solutions. We will present a series of studies that adapted these new methods to study changes over time in A-level examination papers sampled from the past six decades. We report that investigating standards over time using questions alone produced broadly similar outcomes to studies that used artificial candidate scripts. We argue that using only examination questions offers a valid, reliable and efficient method that can provide a detailed and comprehensive picture of relative standards over time.

Key words: *A-level mathematics; standards; assessment; comparative judgement*  
Session type: *Research paper*  
Duration: *30 minutes*

**Kinnear, George**  
University of Edinburgh

*Developing an online course in introductory university mathematics*

I will report on recent work to develop a new online course at the University of Edinburgh, which has been introduced to provide better support for incoming students with a range of mathematical backgrounds. The course, “Fundamentals of Algebra and Calculus”, covers key topics from Advanced Higher and A-Level syllabuses, and is offered to students as a for-credit option alongside our existing Year 1 courses.

The course is delivered online, interleaving textbook-style exposition with videos of worked examples, interactive applets, and practice questions implemented in the STACK assessment system.

I will describe how ideas from education research have informed the design of the course, from its overall structure to the content of individual questions, and I will show examples from the course to illustrate how these ideas are put into practice. I will also discuss the plans which have been put in place for evaluating the course.



Key words: *Course design; assessment; online learning*  
Session type: *Research paper*  
Duration: *30 minutes*

**Koklu, Oguz**  
Marmara University

*Students' Statistical Thinking and Statistical Reasoning Skills at Tertiary Level*

Statistical understanding, which is becoming more and more valuable due to its potential to enhance the quality of decision making (Graham, Pfannkuch, & Thomas, 2009) in this data-driven world, is emphasized by different terms such as statistical thinking (American Statistical Association [ASA], 2005; National Governors Association Center for Best Practices [NGA] & Council of Chief State School Officers [CCSSO], 2010; Moore, 1990; Scheaffer, 2000), statistical reasoning (NGA & CCSSO, 2010; Franklin, 2013; Wild & Pfannkuch, 1999), and statistical literacy (ASA, 2005; Franklin et al., 2007; Gal, 2002, 2004). Today, the number of undergraduate programs that require students to take statistics is also increasing. The natural question that arise then is with what knowledge are students coming to classes and how do statistics courses help them to be better in understanding data, probability, and statistics. As an instructor who teaches undergraduate level statistics, I implemented Turkish versions of statistical thinking (Sahin, 2012) and statistical reasoning assessments (Garfield, 2003) to students in Sociology, Science Education, and Mathematics Education students. The analysis of the data suggested that students in Mathematics Education program performed higher in both of these tests than their counterparts in the other two programs. The results have also shown that statistical reasoning test was more challenging for most of the students.

Key words: *Statistics education; undergraduate statistics education; assessment of statistical understanding*  
Session type: *Research paper*  
Duration: *30 minutes*

**Küchemann, Dietmar**

*The influence of context and numerical complexity on the tendency to focus on scalar relations when solving missing-value ratio items.*

In this session I discuss responses to three pairs of missing-value ratio items given to lower secondary school pupils and PGCE mathematics students, and presented in the form of parallel 1-page written tests. The items varied in numerical complexity (involving ratios that ranged from 1:3 and 1:4 to 2:9 and 3:10). They also varied in the contexts used (recipe, geometric enlargement and currency exchange). Within each pair of items, the given numbers were the same but 'flipped', so what was a scalar relation of 1:3, say, in one item, became a functional relation of 1:3 in the other item. I use these notions of scalar and functional, derived from Vergnaud, to classify responses, and to examine the influence of context and numerical complexity on the frequency of such responses and on overall item facility. From a teaching perspective, the findings suggest that it is not helpful to think of ratio concepts as forming a simple hierarchy.

Key words: *Ratio; scalar relation; functional relation; multiplicative reasoning*  
Session type: *Research paper*  
Duration: *30 minutes*

**Lavicza, Zsolt**  
Linz School of Education, Johannes Kepler University, Austria

*Rethinking creativity for mathematics teaching: introducing multi- and trans-disciplinary approaches for schools*

There is a growing emphasis for encouraging creative thinking in mathematics education and needs to develop connections of mathematics with other subjects. Activities focusing on the creative process, rather than concentrating on achieving only results for posed problems, are being designed and trialled by innovative groups around the world. Often involving Arts, in a broader sense of design and creation, can be good a starting point for students to find their own interests and follow their own way of learning. Such creative activities often involve the development of collaborative problem-solving skills utilising students' strengths in different areas that adds up at the group level. Furthermore, such activity designs and the



opportunities offered by the availability of digital technologies inevitably afford new multi- and trans-disciplinary approaches for education. In my talk, I will introduce ideas and examples for mathematics teaching involving STEM to STE-A-M (by the inclusion of Arts) transitions. Examples will include STEAM research with the Experience Workshop Movement; studies related to GeoGebra and its new developments such as Augmented Reality, 3D Printing and mobile experiments; developing mathematical skills through robotics and connecting digital and physical worlds with 4D Frame; and possibilities to detect and nurture creative thinking processes from Big Data. An overview of such studies could offer new insights into developments of mathematical creativity, novel teaching approaches, and opportunities for further collaboration in these areas.

Key words: *Creativity, innovation, transdisciplinarity, technology, manipulatives*  
Session type: *Research paper*  
Duration: *30 minutes*

**Lake, Elizabeth**

UCL Institute of Education

*Illustrating teacher modelling of engaging in the learning of mathematics or of how 'to be' when learning mathematics*

One of the roles of a teacher is to model for students how to engage in the doing of mathematics. Modelling is defined here as socially located deliberate actions, designed to change and shift the actions of others, or to indicate how students should be feeling about their mathematics. In research which looks at the affective classroom practices of experienced secondary school mathematics teachers, there were many examples of teachers modelling the doing of mathematics. I will use examples from this data to illustrate some of the ways by which experienced teachers do this in the classroom. The selected examples address the place of 'stepping back', a part of modelling interest in mathematical calculations, such as when a teacher draws students into the modelling. I connect this form of modelling with positive emotions that are also related to engagement in learning mathematics. I consider how repeated experiences of seeing what might be deemed positive modelling can create a norm for students of how 'to be' when learning mathematics.

Key words: *Secondary school Teachers: emotions: classroom practices*  
Session type: *Research paper*  
Duration: *30 minutes*

**Lei, Ka Hei\* & Maria, Pampaka**

University of Manchester, University of Manchester

*Mathematics Self-Efficacy of Middle School Student in U.K.: The Role of Parental Support and Teachers' Teaching Practice*

In this presentation we draw on data from a large ESRC study of Secondary School students in the UK with a focus on the measurement of mathematics self-efficacy (MSE) and its relation with other variables. We are particularly interested in parental support and teachers' teaching practice and further explore how these relationships are affected when considering the individual characteristics of students, such as gender and year group. Our methodological approach includes a validation stage with the use of the Rasch model and a modelling stage with linear regression. Some indicative results with 13643 students showed that the effect of parental support on students' MSE varies depending on the gender and grade year of students. Furthermore, teachers' teaching practice is significantly associated with students' MSE, i.e. the higher the transmissionist teaching level, the lower the students' MSE. The results will be discussed in relation to their implications for practice and also in the context of an upcoming (comparative) study in Macau.

Key words: *Mathematics self-efficacy; parental support; teaching practice*  
Session type: *Research paper*  
Duration: *30 minutes*



**Lord, Ems**

University of Cambridge

*How to develop more resilient learners in mathematics - key messages from an NRICH pilot study*

One of the key issues facing mathematics teachers is developing resilient learners who can persevere when faced with a challenging, non-routine problem. At NRICH we are developing new resources for those learners and an accompanying progression ladder and support materials aimed at teachers. The resources have been trialled in four schools; two urban settings (one primary, one secondary) and two rural schools (one primary, one secondary). This session will explore the findings from those pilot schools, drawing upon four focus group sessions with the learners and four sets of teacher interviews.

Key words: *Resilience; perseverance; assessment; problem-solving*  
Session type: *Research paper*  
Duration: *60 minutes*

**Lyakhova, Sofya\*, Capraro, Mary Margaret, Capraro, Robert & Joubert, Marie\***

Swansea University, Texas A&M, Texas A&M, Swansea University

*Designing a curriculum based on four purposes: let mathematics speak for itself*

Current trends in curriculum reform internationally recognise the need to develop skills and competencies in addition to specifying what knowledge should be taught and when. However, an appropriate balance between skills and knowledge is sometimes difficult to achieve. In this study we consider a reform currently underway in Wales, from the perspective of a 'knowledge approach' and from the perspective of the Welsh reform which is, we argue, driven more by a skills approach. At the heart of the reform are 'four purposes': developing young people as ambitious, capable learners; enterprising, creative contributors; ethical, informed citizens; and healthy, confident individuals. Our interest is in the contribution that mathematics makes to the four purposes; and what is the contribution that the four purposes make (or do not make) to the development of a school mathematics curriculum. The study contributes to understanding the difficulties of re-contextualising school subjects from the academic disciplines and proposes that operating with a curriculum driven by big ideas or overarching statements places higher demands on the teacher knowledge of epistemological and other dimensions of the academic disciplines alongside the subject matter.

Key words: *Big ideas; skills; knowledge; curriculum*  
Session type: *Research paper*  
Duration: *30 minutes*

**Marks, Rachel; Barclay, Nancy; Barnes, Alison; Treacy, Paraic**

School of Education, University of Brighton

*Reviewing 15 Years of BSRLM Research: Final Report*

In December 2017 we were commissioned by BSRLM to produce a report analysing the Informal Proceedings from the Day Conferences from the last 15 years (2003 – 2017). We were asked to offer a critical reflection of the proceedings, with the aim of examining trends in research, highlighting strengths, identifying gaps and pointing to potential areas for future study.

During this 15 year period, there were approximately 1375 sessions held at 45 Day Conferences. Around 56% of these conference sessions (including research reports, workshops, discussions and Working Groups) were subsequently published as Informal Proceedings, resulting in 773 Informal Proceedings. In June 2018 we presented our interim statistical overview of these proceedings. In this session (November 2018) we present our final report prior to publication to the membership in January 2019. We will examine:

- The relationship of our review and key findings to the wider field of mathematics education;
- Population and age-phase trends (including mathematical topics), strengths and gaps;
- The changing policy climate and its impact on mathematics education;
- The strong emphasis on teachers and teacher development in mathematics.



Across each of the above and in relation to the full review, we will also make recommendations to BSRLM for future areas of focus in addition to considerations to support the future development of the society and its members.

Key words: *Systematic review; research trends; policy; teacher development; mathematical topics*  
Session type: *Research paper*  
Duration: *60 minutes*

### **Graham Millington**

*Achieving 'mastery' over Proportional Reasoning++ - a unifying pedagogy for mathematical content, skills and understanding.*

The practice of teaching mathematics as a series of seemingly distinct rules and skills misrepresents the true nature of the subject and can impede the learning efficiency and affective responses of students.

This session demonstrates a teaching programme for Proportional Reasoning (and related topics) which reflects the need to unify the content in a meaningful way and to include key pedagogical elements such as problem solving, investigations and the use of appropriate terms and language in order to encourage and demonstrate 'mastery'.

Subsequently the group would be asked to offer advice and guidance in regard to the programme and to suggest possible research methodology which might determine its effectiveness in conventional classrooms.

A limited amount of data will be offered for scrutiny and this includes:

- a. The nature of curriculum documentation in ten 'good' schools
- b. Responses from teachers and pupils who have negotiated the programme.

Key words: *Advice; research; proportion; mastery; unification*  
Session type: *Research workshop*  
Duration: *60 minutes*

### **Oakes, Dominic, Andrew Davies, Joubert, Marie, Lyakhova, Sofya**

FMSW Wales, FMSW Wales, Swansea University, Swansea University

*Exploring teachers' and students' responses to the use of a 'flipped classroom' teaching approach in mathematics*

Many teachers of mathematics claim that they would like to teach in ways that promote understanding but that, because the curriculum is so crowded, they do not have time. One approach to freeing up time is known as the 'Flipped Classroom' approach, in which students learn new content at home, using resources such as videos and written explanations and then for teachers to use time in the classroom to deepen understanding.

Ultimately, this project aims to research whether and how the flipped classrooms approach results in shifts in pedagogy towards teaching for understanding. Initially, however, in a preliminary study, the research concerns the responses of teachers and students towards the adoption of the flipped classroom approach, in terms not only of how they feel about the approach but also about what they choose to do. In this presentation we report on the preliminary study.

The research took place in North Wales, and involved six secondary teachers with classes across mathematics and further mathematics A-level and Level 2 additional mathematics. Teachers inducted students into the flipped classroom approach and then followed this approach for their mathematics lessons for eight weeks.

Key words: *Flipped classroom; resources; pedagogy; depth; secondary*  
Session type: *Research paper*  
Duration: *30 minutes*

### **Özdemir, Ahmet Şükrü; Yalçın, Volkan**

Marmara University, Turkey

*Competencies of mathematics teachers who prepare students to mathematics olympiads*

The aim of this paper is to explore competencies of mathematics teachers who prepare students to mathematics olympiads. Competencies related to mathematics teachers and gifted students' teachers were investigated in literature. Experts opinions were taken to determine related competencies. Competencies determined by experts were classified into



three sub-competency groups as “Professional Knowledge”, “Professional Skill” and “Attitudes and Values” by using Delphi method. After determination and classification of competencies, order of importance of these competencies were calculated by using Analytic Hierarchy Process (AHP) which is a multiple criterion decision making method. By using AHP, pairwise comparison of all competencies in the same groups were made and competencies were ordered according to their order of importance. The most important competencies determined by AHP are “he/she uses proof techniques such as induction, contrapositive and direct proof in order to demonstrate mathematical propositions”, “he/she constructs classroom environment which promotes mathematical thinking and reasoning” and “he/she renovates himself/herself perpetually”.

Key words: *Competencies of mathematics teachers; mathematics olympiad teachers; mathematics olympiad preparation*

Session type: *Research paper*

Duration: *30 minutes*

**Özdemir, Ahmet Şükrü; Sevimlib, Eyüp; Aydın Emin**

Marmara University, Turkey , **Gaziosmanpaşa University, Turkey**, Marmara University, Turkey

*Examining the opinions of mathematics teacher candidates on the effectiveness of coding activities in the teaching-learning process*

One of the qualities that are highlighted in STEM education approaches and one of the skills that are oriented towards mathematics is coding. Although basic mathematical skills such as algorithmic and/or relational thinking are necessary for coding from a traditional point of view, it is argued that such mathematical skills can be developed by coding through STEM focused approaches. It is thought that there may be two-way transitions between coding and mathematical skills from a higher perspective. As a matter of fact, some research results indicate the effects of coding on mathematics learning as visualizing abstract concepts, promoting problem solving skills and making learning fun. In this study, it is aimed to evaluate the reflective thoughts of mathematics teacher candidates who are faced with coding activities in STEM education process and their positive and negative aspects in mathematics education. In this sense, the research is seeking an answer for the question that "What is the opinion of the prospective mathematics teachers about the effectiveness of coding activities in the learning-teaching process?" The research was conducted with 28 senior mathematics students studying at the education department in Turkey. During the fall semester of the 2017- 2018 academic year, the participants were faced with modeling activities under the " Problem Solving with STEM Education " selective course in the mathematics laboratory. The data obtained from the opinions of the participants were collected through the questionnaire and analyzed with descriptive statistics. The participants stated that especially coding activities supported the students in terms of algorithmic thinking (n = 19) and that they provided the opportunity to learn mathematics by playing (n = 14). Additionally, participants indicated that the interest in mathematics could increase by coding activity but also though that mathematics achievement was not related to coding. In the presentation, other important findings will be discussed in the light of relevant literature.

Key words: *STEM Education, Teacher Training, Coding*

Session type: *Research paper*

Duration: *30 minutes*

**Phillips, Sheldon**

University College London Institute of Education

*Primary Mathematics Talk: The art of engaging in mathematical discussions*

A core component of mathematical knowledge acquisition is linked to the use of mathematical talk and language (Goos et al, 2014). The purpose of this observational study is to describe the type of talk (Mercer, 2004) that children use to solve, reason and explain mathematical ideas whilst using manipulatives in mathematics. The setting is an inner city 2 form entry inner city primary school. This observational research study design involves students engaged in their normal classroom behaviour. Two types of qualitative data are collected for this study: video recording of the mathematics activity within the classroom and audio recordings of the follow up semi-structured stimulated- recall interviews with students. Disputational, cumulative and exploratory talk types are present to varying amounts when students used manipulatives. This study demonstrates that schools and teachers need to consistently create opportunities for students to demonstrate and explain their thinking and that scaffolding is required to ensure that mathematical reasoning occurs (Mason et al, 1982; Mason, 2000). It also highlights the need to ascertain which types of tasks develop disputational, cumulative and exploratory talk.



Key words: *Discussion; Reasoning; Whole School Impact*  
Session type: *Research paper*  
Duration: *30 minutes*

**Pusmaz, Alaattin**  
Marmara University

*Student reasoning about eigenvalues and eigenvectors*

Linear algebra courses are considered to be one of the most complex courses students encounter at undergraduate level. In linear algebra courses, often basic concepts are defined, and then new concepts are created with these, and then algebraic structures are constructed. Also hypotheses are established and proven. Sierpinska (2000) reports three modes of thinking and reasoning in linear algebra which are synthetic–geometric, analytic–arithmetic and analytic–structural. The aim of this research is to examine the students’ reasoning about eigenvalues and eigenvectors using Sierpinska’s framework. The subject of eigenvalue–eigenvector in linear algebra courses is explained in algebraic structure in one of two different classes and the other class received the instruction with an extra support with graphic representation. In order to collect data, a test consisting of seven questions was applied to both groups and one-time semi-structured interviews were conducted with five students from each group. Analysis of both data showed that, both groups focused more on arithmetic operations in the solution of the questions, but the students in the second group showed better synthetic–geometric reasoning than the first group did.

Key words: *Mathematical reasoning, linear algebra, eigenvalue, eigenvector*  
Session type: *Research paper*  
Duration: *30 minutes*

**Russel, Chris**  
University of Bristol

*A consideration of the potential of four practice structures to facilitate superior performance in secondary mathematics*

I will report on my recent research which proposed the concept of relative superior performance and how this could be facilitated in secondary school mathematics. The competing roles of talent and practice are considered in mathematics and related fields. To this end, four practice structures are identified; repetition, pupil-led practice, subordination and deliberate practice. Each of these models will be defined and evaluated. To compare their effectiveness, I designed a research framework which had in-depth case studies with two students at the centre. This study tentatively concluded that pupil-led practice was the most effective, however also proposes grounds for further related research.

Key words: *Practice; superior performance; secondary mathematics*  
Session type: *Research paper*  
Duration: *30 minutes*

**Ryan, Maria D.\*; Fitzmaurice, Olivia; Johnson, Patrick**  
Mary Immaculate College; University of Limerick

*Like a Red Rag to a Bull! Investigating Mathematics Anxiety among Mature Students*

An increasing number of students entering higher education undergraduate programmes in Ireland are required to take modules in mathematics, or ‘service mathematics’ where mathematics is a component of the programme, but not the main discipline of study. For some students, their approach to learning service mathematics can be accompanied by apprehension and fear, particularly if previous experiences of mathematics have been negative. This can be particularly true in the case of mature students, who may not have had exposure to formal mathematics for a number of years and may feel at a disadvantage compared with those ‘traditional’ students who entered higher education after completing school. Such a dislike of mathematics can be described as ‘mathematics anxiety,’ a term used among researchers to conceptualise the apprehension and fear among students in relation to their dealings with mathematics. Research on mathematics anxiety is frequently conducted using measurement scales such as the Mathematics Anxiety Scale UK (MAS -UK) or equivalent, to ascertain the level of mathematics anxiety. In the present study, the Mathematics Anxiety Scale–UK was



distributed to a sample of undergraduate mature students who have service mathematics in their programme of study. The test results showed varying levels of mathematics anxiety among these mature students and gave an insight into the situations that lead to high levels of mathematics anxiety for mature students.

Key words: *Mathematics anxiety; mature students; service mathematics*  
Session type: *Research paper*  
Duration: *30 minutes*

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

University of Nottingham, University of Nottingham, University of Nottingham

*Helping Students Learn Two-dimensional Representations of Polycubical Shapes*

The challenge of learning two-dimensional representations of polycubical shapes has received considerable attention in the last decade (e.g., Fujita et al., 2017; Saralar, Işıksal, & Bostan, 2018; Widder & Gorsky, 2013). For example, in our previous research published in BSRLM Spring 2018 proceedings, we reported average or low performance of middle school students in their use of orthogonal and isometric drawings and exemplified their common mistakes (Saralar, Ainsworth, & Wake, 2018a). Our current study focused on improving these students' learning experiences and understanding of the topic with the help of the RETA (Realistic, Exploratory, Technology-based, and Active) three-dimensional shapes teaching model (For further information about this model see Saralar, Ainsworth, Wake, 2018b). We prepared six lesson plans and an experienced mathematics teacher volunteered to teach these lesson to one of her Grade-7 classes (16 females, 14 males) after making minor changes such as the order and details of the discussion questions. Our findings showed that the planned lessons have the potential to solve the challenge of learning 2D representations. After the intervention, students answered all of the orthogonal drawing questions on the worksheet correctly (Mpre = 14.97, SDpre = 4.88; Mpost = 20, SDpost = .0), and they performed better in the isometric drawing questions (Mpre = 9.07, SDpre = 6.41; Mpost = 17.6, SDpost = 2.63).

Key words: *Middle school students' learning; two-dimensional representations; three-dimensional shapes, polycubical shapes*  
Session type: *Research paper*  
Duration: *30 minutes*

**Skilling, Karen**

King's College London

*Shifts in engagement characteristics of high and low achieving early secondary students*

The engagement construct, which includes behavioural, emotional and cognitive elements, is crucial when considering affect in relation to mathematics learning and by implication, for teaching. This study involving Year 7 students (11-12 years) used self-reported measures of engagement and motivation to establish unique engagement/achievement groupings. In-depth interviews then investigated factors influencing student engagement distinct from levels of achievement. This paper reports findings from high and low achieving students differentiated by engagement. The students report upwards and downshifts shifts in adaptive and maladaptive factors between their last year of primary and first year of secondary school and have implications for the instructional approaches teachers might use to promote student engagement in mathematics.

Key words: *Engagement; motivation; mathematics; early secondary*  
Session type: *Research paper*  
Duration: *30 minutes*

**Smith, Cathy**

The Open University

*Differing constructions of mathematics and further mathematics in discourses of time and maturity*

Previous post-structural studies suggest that choosing to study A-level mathematics at age 16 is discursively constructed as a performance of masculinity, of self-belief and of dependability, and that such constructions have traction within both neoliberal and traditional cultures of schooling. This paper focuses on language associated with 'time' and 'maturity' in the





accounts of adolescents choosing to study mathematics and further mathematics. Drawing on interview data from a 2-year study, the paper identifies differences in the discursive patterns that structure the intelligibility of their participation: 'moving/improving' is associated with mathematics, while 'getting ahead' is associated with further mathematics. Two case studies show the inclusions and exclusions created and maintained by these discursive alignments.

Key words: *Participation; A-level; discourse*  
Session type: *Research paper*  
Duration: *60 minutes*

**Solares, Armando; Coles, Alf**

CINVESTAV, Mexico; University of Bristol

*Conceptualising the relationship between out-of-school experiences and mathematics in school: a case of a working child in Mexico*

Life in the neighborhood October 2 Camp, Mexico City, is between urbanity and marginalization; the bustle of the tianguis (market), businesses, schools, and conflicts over the leadership of the territory. The neighborhoods and houses in which families congregate also characterize the place, typical of the illegal way in which the land was occupied a few decades ago by its inhabitants. This is the type of scenario in which the primary school, in which the present investigation is carried out, is located. In this session, we draw on one vignette of empirical data in order to illustrate and develop arguments about the relationship between these children's out of school experiences, particularly those 'working' or 'street' children, and their learning of mathematics in school. We recapitulate work done on Street Mathematics and the cultural, historical perspective which has been brought to this work and point to alternative conceptualisations of the relationship between children's out of school experiences and their learning of mathematics in school.

Key words:  
Session type: *Research paper*  
Duration: *30 minutes*

**Strohmaier, Anselm R.\*; Molina, Natalia; & Reiss, Kristina M.**

Technical University of Munich

*"I added the numbers, it's math!" How sense-making in age of the captain problems differs between a mathematics and a language classroom.*

The way that students solve mathematical word problems depends on the situation they are in, e.g. the school subject (Dewolf et al., 2011). We focused on a specific type of word problems, so-called age of the captain problems (ACP; Verschaffel et al., 2000). ACP present a situation that makes no sense, but are nonetheless frequently "solved" by a majority of primary school students that typically take the available numbers and add them. We analysed what different approaches to these problems emerge in a mathematics and a language classroom. Participants were 48 primary school students (age M = 9.4, 54% female). They were given ten word problems, five of which did not have a meaningful solution. In the first group, the word problems were presented in a mathematics class and with a cover sheet introducing a mathematics test. A second group worked on the same items during a language class as a problem-solving test. Afterwards, a classroom interview was conducted in both groups. Quantitative analyses show a non-significant tendency that students in the mathematics class were more likely to provide an arithmetic response to ACP. Interviews revealed that students in both groups experienced a cognitive dissonance regarding the expectation to provide an arithmetic solution. However, arguments concerning the nature of mathematical word problems were more present in the mathematics classroom. This suggests that sense-making in ACP is influenced by the classroom context.

Key words: *Word problems; primary school; sense-making; context effects*  
Session type: *Research paper*  
Duration: *30 minutes*



**Sunde, Pernille B.\*; Sayers, Judy\***

VIA University College, University of Leeds

*Girls count, boys retrieve: A Longitudinal study of mental strategies in single-digit addition in the first years of school*

Mental strategy use in single-digit addition is an indicator of numerical comprehension and early strategy use has been shown to predict later mathematics achievement as well as difficulties.

We investigated Danish primary students' use of mental strategies, when solving 36 single-digit addition tasks in an interview-based assessment. Strategies were categorised as 'error', 'counting', 'direct retrieval' or 'derived facts'.

Proportional use of each strategy was analysed as multi-level functions of school age and sex.

In 147 students (77 girls, age 7-11, one school, eight classes: 3 classes were tested thrice in subsequent years; 3 classes twice; and 3 classes once) we found decreasing use of counting and increasing use of direct retrieval and derived facts through year 1-4. Girls used counting substantially more and the other two strategies substantially less than boys, equal to more than two years' development. A subsequent study of 83 students (26 girls, age 7) from six classes from three other schools gave similar results, suggesting that the pattern is pervasive in Danish primary schools.

Our result cohere with international findings that girls seem to count substantially more than boys. However, we find it noteworthy that the magnitude of this difference equals more than two years' of development. This give rise to questions on the characteristics and explanations of the link between early strategy use and later mathematics achievement and difficulties.

Key words: *Sex differences; single-digit addition; mental strategies; years 1 to 4*

Session type: *Research paper*

Duration: *30 minutes*

**Thouless, Helen & Gifford, Sue**

UCL-Institute of Education, University of Roehampton

*Early Childhood Teachers Learning in a Community of Practice*

A group of expert early years teachers have participated in the collaborative research project *Passionate about Patterns* for 2 years. In this research session we will analyse their learning using the framework of a community of practice, particularly focusing on the teachers' mathematical learning, how their engagement with their practice changed over time, and how the teachers' change in practice impacted their children's learning of mathematics. We would like feedback on how we are theorizing about and analysing this community of practice.

Key words: *Early Years Teachers; Community of Practice; Patterns*

Session type: *Research paper*

Duration: *30 minutes*

**Clare Tope**

University of Winchester

*An exploration of the potential for the study of examples presented in textbooks to enhance the practice of learner teachers and teacher educators*

This session reports on a research project which examined learner teacher responses to the study of examples presented in textbooks. This research project was underpinned by a line of argument presented by Watson and Mason (2005:5) which concluded that careful choice of examples 'might be seen as central in the learning and teaching of mathematics'.

Textbooks were chosen as a source of examples as the outcomes of large scale and wide ranging analysis of textbooks and learning materials from around the world undertaken by Cambridge Assessment (2014 and 2016) suggested that textbooks can play a key role in the improvement of educational arrangements and in sustaining quality.

The study explored three research questions:

- What do students notice about sets of examples?
- How does this change over time?
- What are the implications for my practice as a mathematics teacher educator?

The key conclusion of the project was that the careful study of examples presented in textbooks could

be justified as part of a programme of initial teacher education because over time students became increasingly critically



aware of some the complexities involved the choice of examples. However, when this was combined with reflections on what our programme of study already offers students I concluded that emphasis needed to be given to opportunities to explore the pedagogy of textbook use and the professional decision making that is necessary to use textbooks effectively.

Key words: *Textbook; examples; learner teachers; notice*  
Session type: *Research paper*  
Duration: *30 minutes*

**Trakulphadetkrai, Natthapoj Vincent**

University of Reading

*How to generate (and evidence) research impact? The case of MathsThroughStories.org*

In this session, participants will be encouraged to think about what (educational) research impact is and what it isn't. We will also discuss how best to generate (and evidence) research impact. Participants will be introduced to my MathsThroughStories.org research project and will be asked to help brainstorm ways in which the project can generate and evidence its research impact. It is hoped that any ideas shared during the session will be useful for participants' own research project(s) too.

Key words: *Maths through stories; research impact*  
Session type: *Research workshop*  
Duration: *30 minutes*

**Treacy, Páraic\***

University of Brighton

*Incentivising advanced mathematics study at upper secondary level: how does this impact teachers and classroom practice?*

The Bonus Points Initiative (BPI) is an incentive which aims to boost the number of students opting to study upper secondary mathematics in Ireland at the most advanced level (Higher Level). The BPI was put into practice for the 2012 Leaving Certificate examinations (terminal secondary examinations) and has been in place since. Students who achieve at least a passing grade (> 40%) in their mathematics Leaving Certificate examination at Higher Level are awarded 25 points in addition to the points they achieve for their given grade. It would seem that the BPI is succeeding in its intended aim as the proportion of students opting to study Higher Level mathematics for the Leaving Certificate examinations has increased from a typical proportion of about 16% prior to the BPI coming into effect for the Leaving Certificate examinations in 2012, to 31.5% in 2018 after a steady increase in the intervening years. This session will explore the impact this increase in students studying upper secondary mathematics at Higher Level has had on teachers and their classroom practice. Findings and analysis of data gathered using a questionnaire completed by 266 teachers of Higher Level upper secondary mathematics will be presented. The findings indicate that teachers have struggled to adapt to wider ranges of attainment in their classrooms and are experiencing increased workloads as well as higher levels of stress as a result.

Key words: *Teachers; advanced secondary mathematics; incentives; classroom practice; differentiation*  
Session type: *Research paper*  
Duration: *30 minutes*

**Wollaston, Nicholas**

University College London, Institute of Education

*Policy Enactment in Primary Mathematics*

In this presentation, I report on the analysis of a small number of interviews conducted in 2016, and how the teachers position themselves in relation to a number of policy discourses. This research is set in the context of the UCL Institute of Education KS2 Mathematics Test Preparation Project, funded by the Nuffield Foundation, which involved interviews with 30 Y6 teachers from 24 primary schools in 2015, and interviews with Y6 teachers from the same schools in 2016. I begin the presentation by setting out some theory in relation to policy implementation and some methodological considerations, and how these have influenced the way I analysed the interview transcripts. I present some findings from the analysis, concluding that there are various areas of influence on teachers' practice such as The National Curriculum, other guidance such as that produced by the NCETM, the desire to ensure mathematical understanding, and the KS2 SATs.

Key words: *Policy Enactment; Curriculum; Calculation; KS2*



Session type: *Research paper*  
Duration: *30 minutes*

**Wright, Pete**

UCL Institute of Education

*Visible pedagogy and challenging inequity in school mathematics*

This workshop paper reports on the initial findings of a research project aiming to explore ways of addressing concerns regarding the persistent gap in mathematics achievement between children from different socio-economic backgrounds and low levels of engagement of significant numbers of students with school mathematics. It argues that such concerns can be addressed without the need to abandon a commitment towards progressive teaching approaches. It highlights the potential of adopting a critical model of participatory action research for challenging existing classroom practices that contribute towards reproducing inequities in mathematics education. The workshop will include an opportunity to engage with some of the strategies developed by two teacher researchers in Stoke Newington School (North London) for making progressive pedagogies more visible so that students become more aware of the intentions of the teacher and what they need to do to be successful in school mathematics. Further information about the project can be found at

<https://visiblemathspedagogy.wordpress.com/>

Key words: *Inequity; participatory action research; school mathematics; visible pedagogy; Key Stages 3 & 4.*  
Session type: *Research workshop*  
Duration: *60 minutes*

**Zerafa, Esmeralda**

University of Malta

*Developing a Pedagogical Model for Supporting Learners with Mathematics Learning Difficulties*

The session will present a pedagogical model which I have developed through the data analysis of my PhD study. After carrying out an intervention programme with six children having mathematics learning difficulties (three of which also had Reading Difficulties), I developed a model that could be followed when designing future intervention for learners with MLD. The study was carried out with learners in Grade 5 (9- 10) year olds in Malta, hence the model is mostly appropriate for primary children. The conceptual framework which underpinned the model is based on Vygotsky's theories. The session will demonstrate how the model developed showed that there are three forms of strategies that have been found to be effective in supporting learners with MLD in internalising the numeracy components needed for the learning of more complex mathematics. These strategies can be classified as either driven by the More Knowledgeable Other (MKO), or the use of tools or the learner himself. I will not only present different strategies that seemed effective for each category but will also seek to illustrate how the strategies within these different categories have a symbiotic relationship that facilitates the internalisation of the numeracy components at hand.

Key words: *Mathematics Learning Difficulties; primary; pedagogical model; Vygostky; internalisation*  
Session type: *Research paper*  
Duration: *30 minutes*