

**BSRLM Conference Abstracts
Durham University
Saturday, 6 June 2015**

Plenary - Janet Duffin Award Lecture

Marks, Rachel
University of Brighton
r.g.marks@brighton.ac.uk

Educational Triage: Ability grouping and the trajectory of the 'urgent', 'safe' and 'hopeless' cases in primary mathematics

In this lecture I outline use of the term 'Triage' in the educational sphere from the late 1970s to today, arguing that the term and practices are intricately interwoven into a dominant discourse of fixed-ability. I examine how, whether labelled as triage or not, responses to policy pressures may change the nature of teachers' work as they grapple with the logic and moral consequences of intended triage outcomes, whilst simultaneously facing the fallout of unintended consequences. In the context of mathematics education, I will present findings from a case-study of a primary school employing strong fixed-ability thinking and triage practices – allocating resources to pupils with the intention of maximizing outcomes in mathematics statutory testing at the end of primary schooling – and will outline the consequences for all pupils whether triaged to receive heightened resources (the 'urgent' cases) or triaged not to receive additional support (the 'safe' and 'hopeless' cases). Whilst this is a case-study, the findings appear not to be unique. Through recent international research and more anecdotal evidence into the widespread use of this practice in mathematics education, I argue that a common set of pressures and beliefs permit triage practices to continue unabated and it is these we need to continue to debate in future research.

Parallel Presentation Sessions

Adams, Gill*; **Boylan, Mark***; **Willis, Ben**; **Demack, Sean**; **Stevens, Anna & Verrier, Diarmuid**
Sheffield Hallam University
g.adams@shu.ac.uk

Teacher professional learning: the experience of teachers involved in the Multiplicative Reasoning Project (MRP)

In this paper we present findings from the process evaluation into the Multiplicative Reasoning Project (MRP) which was delivered by the National Centre for Excellence in the Teaching of Mathematics (NCETM) in 2013-14. The process evaluation was undertaken as part of a Randomised Control Trial (RCT). The project engaged teachers from 30 schools in three regional professional development networks, supporting them to address key aspects of multiplicative reasoning. Curriculum materials were developed by a team of designers using three different approaches. Teaching approaches encouraged the use of mathematical models, visual supports and problem solving strategies. Distinctive features of the professional development approach included the involvement of university-based designers and mathematics education researchers together with professional development leads. Data collection activities for the process evaluation included interviews, documentary analysis, observation of project events and interviews with key staff in 9 case study schools. Analysis of data revealed features of the project which were effective in supporting teacher professional learning and the evaluation also gives insights into barriers to innovation in the current

landscape. Here we focus on changes teachers identified in their beliefs and practices and on aspects of the project that enabled this change.

Key words: *professional development; barriers; enablers*

Age range: *Secondary education*

Duration: *30 minutes*

Alanazi, Mansour

University of Manchester

mansour.alanazi@postgrad.manchester.ac.uk

Constructing a dialogic teacher's identity: a case study exploring the impact of community of practice

Drawing on recent developments in dialogic approaches to learning and teaching mathematics, my PhD study investigates how Saudi mathematics teachers develop their understanding of classroom dialogue through a professional development process in mathematics teaching. The nature of this study is qualitative. It involved an embedded case study focusing on a teacher development programme (TDP) for three Saudi primary mathematics teachers in relation to their use of dialogic teaching. This research draws upon the community of practice theory (Wenger 1998). The analysis of data shows how the three mathematics teachers' identities have been developed through their participations within the emergent community of practice. This paper will show evidence of the emergence of new professional identities for two teachers as a certain kind of reflective practitioners in relation to dialogic teaching.

Key words: *dialogic teaching; professional development; communities of practice; teachers' identities*

Age range: *Primary education*

Duration: *30 minutes*

Aysel, Tugba*; **Brady, Emer***; **Corrigan, Brigid***; **Dooley, Therese***; **Haines, Isolde***; **Rooney, Aine***

St. Patrick's College, Dublin

tugba.aysel@dcu.ie

Using Lesson Study to explore primary/post-primary transitions in mathematics

The primary/post-primary transition is perceived as challenging for students from a number of perspectives. In terms of mathematics these issues are exacerbated because of different teaching approaches and changes in emphasis in content. In Ireland, a transition reform group has recommended greater collaboration between primary and post-primary institutions with the aim of developing bridging courses that ease the transition for students and prepare them for the changeover in their learning of mathematics. To this end, a group of four Irish teachers (primary and post-primary) engaged in a cycle of Lesson Study. As fractions were identified as an area of particular difficulty for students, a lesson based on this topic was taught to a senior primary class and to a junior post-primary class. During this working group session, participants will be given an opportunity to view video-clips of both sets of students working on the same task and to examine samples of their written work. There will be follow-up discussion on the teaching of fractions with particular reference to transitions across educational levels.

Key words: *transitions, fractions, Lesson Study*

Age range: *Primary and post-primary education*

Duration: *60 minutes*

Back, Jenni*; **Gifford, Sue***; **Griffiths, Rose***
University of Leicester, University of Roehampton, University of Leicester
s.gifford@roehampton.ac.uk

Making numbers - developing a teachers' guide to using manipulatives: initial thoughts from the literature

In this session, we present our initial findings and thoughts from the first phase of our research into the role of manipulatives in the development of children's number sense. A consideration of the literature raises issues such as: How do we know what sense children make of manipulatives and how do these help develop abstract number concepts? Is it true that the key resources were invented by women teachers? What are the most productive kinds of activities e.g. comparing representations and justifying equivalences? Can these contribute to an enquiry based and even creative approach to developing number sense? We will discuss such issues in relation to primary practice.

Key words: *manipulatives; number sense; teacher education; primary*
Age range: *Primary education*
Duration: *60 minutes*

Borg, Philip & Hewitt, Dave*
University of Malta; Loughborough University
d.p.hewitt@lboro.ac.uk

Developing meaning for expressions with Grid Algebra: developing the CAPS framework

The learning of formal notation for arithmetic expressions can be problematic for many learners. Here we look at a small group of low-attaining 11-12 year olds in a Maltese school as they begin to grapple with expressions, particularly within the environment of the software Grid Algebra. In the early stages of this research, we make a case for looking at the relationship between concepts, actions, pictures and symbols.

Key words: *notation, symbols, computer software, pre-algebra*
Age range: *Secondary education*
Duration: *30 minutes*

Boylan, Mark*; **Maxwell, Bronwen**; **Jay, Tim**; **Demack, Sean**; **Wolstenholme, Claire & Adams, Gill***
Sheffield Hallam University
m.s.boylan@shu.ac.uk

Policy, innovation and evidence in current mathematics education research

Recently, policy makers in England are increasingly funding mathematics education research that supports, what is described as, evidence based teaching and that assesses immediate impact. Over the last five years, there have been a number of relatively large scale trials of innovations in mathematics education: these include Education Endowment Foundation evaluations, for example of the ARK Mastery programme; ESRC funded projects with an impact evaluation aspect such epiSTEMe and ICCAMs (now to be the focus of an EEF trial); and DfE evaluations using RCT designs of Every Child Counts and the Multiplicative Reasoning Project. Currently, the Primary Shanghai Mathematics Exchange evaluation includes a quantitative strand using a quasi-experimental methodology. This session is an opportunity to reflect on these developments. We present the evaluation protocol of the Shanghai evaluation as well as drawing on experiences of evaluation of MRP and EEF projects. We highlight the tensions between: the demands of policy makers; the nature of current education landscape, styled in policy as a self-improving system; the form and

structure of RCTs and similar methodologies; and the existing corpus of research on mathematical learning, mathematical teacher professional development and mathematics education research.

Key words: *research methodology; evaluation; policy*

Age range: *Methodological focus*

Duration: *30 minutes*

Bretscher, Nicola

UCL Institute of Education

n.bretscher@ioe.ac.uk

Dominant practices in mathematics teachers' use of technology: using ICT to enhance pedagogic aspirations

English secondary mathematics teachers' use of technology (n=183) was surveyed as part of a PhD study with a broad aim of developing a deeper understanding of both how and why mathematics teachers use technology in their classroom practice. Rasch analysis was used to construct a transmissionist measure of teachers' self-reported pedagogic practice from the survey data. The survey data suggested that 'teacher-centred' practices involving ICT may instead be construed as 'dominant' practices, since they are most frequently occurring across all teachers, irrespective of their transmissionist or connectionist orientation. Case study data involving two transmissionist and two connectionist teachers supports the survey finding of dominant practices, suggesting that, superficially at least, there is little difference between connectionist and transmissionist teachers' use of ICT. Both connectionist and transmission-oriented teachers used software in interactive-whiteboard and computer suite lessons to enhance general pedagogic aspirations rather than to transform mathematics pedagogy.

Key words: *technology integration*

Age range: *Secondary education*

Duration: *30 minutes*

Clark-Wilson, Alison* & Hoyles, Celia*

UCL Institute of Education

a.clark-wilson@ioe.ac.uk

A developing methodology to research the impact of dynamic mathematical technologies on teachers' knowledge and emergent practices

The introduction of dynamic technologies into secondary mathematics teaching can, we conjecture, have a transformative effect on teachers' mathematical knowledge for teaching (MKT) and their associated mathematical pedagogic practices (MPP). Our current Nuffield funded project aims to research these aspects at scale within the context of a research-informed set of curriculum units, Cornerstone Maths that address 'hard-to-teach' topics at Key Stage 3 (algebraic patterns and expressions, linear functions and geometric similarity). In this session, we outline the underlying theoretical ideas that have informed the development of our research methodology that seeks to make teachers' learning visible within the professional development setting and provide insights into teachers' espoused classroom practices.

Key words: *dynamic technology; mathematical knowledge for teaching; mathematical pedagogic practices; professional development; large-scale research*

Age range: *Secondary education*

Duration: *30 minutes*

Clarke, Nichola
nichola.clarke@insightera.co.uk

To relevant tasks and beyond: mainstreaming environmental sustainability in mathematics education

In this Working Group (Environmental sustainability in mathematics education) session, we begin by sharing mathematics learning resources relevant to the theme of environmental sustainability. We will then discuss evidence about the extent to which sustainability issues are embedded in classrooms. This will be developed to consider different strategies making environmental sustainability more than personal teacher choice. Should we, and if so, how can we, mainstream environmental sustainability in mathematics education?

Key words: *teacher education; curriculum; resources*
Age range: Primary and secondary education
Duration: *60 minutes*

Clarke, Nichola
nichola.clarke@insightera.co.uk

Structure, relevance, realism, and inclusion: identifying factors for designing “real world” mathematical tasks

Structure, relevance, realism, and inclusion: identifying factors for designing “real world” mathematical tasks. In this session, I discuss how theoretical perspectives inform the use of context in designing mathematical tasks set in “real world” contexts. I raise questions from practice and research about the use of “real world” tasks, then outline Realistic Mathematics Education, sociocultural, and post-structural understandings of the work done by “real world” contexts. From that, I will attempt to identify heuristics to guide the choice and representation of context for task designers. This research project is at an early stage, and I hope that colleagues will be generous and bring their own expertise to the session. There will be some contextualized mathematics tasks to work on, to support our thinking.

Key words: *“Real world”; inclusion; theory*
Age range: *Secondary education*
Duration: *30 minutes*

Curtis, Fiona
University of Reading
f.r.curtis@reading.ac.uk

Challenge: always a good thing?

The importance of providing students with challenge has become entrenched in our understanding of learning, set down as the first teaching standard and sought by Ofsted. But what do we mean by challenge? Challenge implies a testing task, a result of struggle. While struggle may be a path to learning for some, reproducing Piaget’s idea of cognitive conflict as the precursor of change, I would argue that for many children mathematical struggle is not stimulating but threatening, and leads to the phenomenon of maths anxiety. This paper uses my doctoral research of six intervention sessions with each of four small groups to illustrate the reaction of low-attaining maths students to challenge. I find that the learning of algebraic concepts is hampered by feelings of panic and low self-esteem, and that the more challenging the material, the less appropriate the response. Improved results were achieved by reinforcing and developing students’ understanding of unchallenging material, corresponding to Bryant’s belief that confirming evidence is better for learning. The significance of this for

teachers is to recognise that challenge is not universally positive, but developing unchallenging material by stealth can be preferable.

Key words: *curriculum; teacher training*

Age range: *Secondary education*

Duration: *30 minutes*

Darlington, Ellie

Cambridge Assessment

darlington.e@cambridgeassessment.org.uk

Students' perceptions of A-level Further Mathematics as preparation for undergraduate mathematics

As part of a large project involving over 4,000 STEM and social science undergraduates, undergraduate mathematicians who had taken a minimum of AS-level Further Mathematics (N=928) took part in an online questionnaire. Participants were surveyed regarding their experiences of studying Further Mathematics, motivations for doing so, and the extent to which A-level study had prepared them for their undergraduate course. Those who had taken 'extension papers' such as STEP and AEA were also asked to 'review' those as means of preparation for undergraduate mathematics. Unsurprisingly, participants were positive about Further Mathematics, describing it more favourably as preparation for undergraduate study than the A-level Mathematics. When considering Further Pure Mathematics, Mechanics, Statistics and Discrete Mathematics units, participants were by far most positive about Further Pure as preparation for their degree. Similar proportions of those who had done Mechanics and Statistics described those units as useful, although only one-quarter described either module as very useful preparation. Few were positive about Discrete Mathematics. Additionally, 81% of those who had done STEP described it as good preparation for their degree, compared to only 42% of those who had done AEA. Consequently, this research suggests that admissions tutors and schools should consider at least encouraging prospective undergraduate mathematicians to take A-level Further Mathematics and STEP even if they are not requirements for entry to their chosen universities in order that they can be better-prepared for future study.

Key words: *A-level; transition; undergraduate*

Age range: *Further education*

Duration: *60 minutes*

Dodd, Mary

Durham University

m.d.dodd@durham.ac.uk

Why mature students might have difficulties understanding mathematics in science: Evidence from their proportional reasoning

Mature students (18 years to 60 years) on a foundation programme designed to prepare students for year 1 of degree courses in the sciences and social sciences at a large research-intensive university in the northeast of England were asked to complete a series of mathematics calculations. These calculations formed a part of their regular study of mathematics, although students studied slightly different combinations of mathematics, science and social science modules to provide the knowledge and skills appropriate for their progression. This session will focus on the responses of 50 students to two of those questions and what we might learn from them, particularly regarding their difficulties in understanding scientific calculations requiring proportional reasoning. There will be an opportunity to discuss implications for practice.

Key words: *proportional reasoning; science; operation selection*
Age range: *Secondary and higher education*
Duration: *30 minutes*

Farsani, Danyal
Universidad de Chile (Chile)
dfarsani@dim.uchile.cl

What every BODY is saying: Primary and secondary students' patterns of proxemics behaviour in response to their mathematics teacher's hand gestures

This working group session (part of the 'Mathematics Education and the Analysis of Language' working group) presents a cross-cultural analysis of primary and secondary mathematics teachers' use of non-verbal language during their instructional information conveying pertinent mathematical ideas. It incorporates aspects of body language to understand classroom meaning making practices. In particular, this session examines teachers' unconscious non-verbal cues for turn taking, addressing students with either an index finger pointing or an open hand palm-up gesture in the UK and in Chilean schools. Students very subtly not only follow the explicit non-verbal cues very well, but also displayed particular patterns of proxemics behaviour. In this session, prior knowledge on semiotics or body language is not needed and participants in this session are encouraged to look for other unconscious non-verbal cues for turn taking and meaning making.

Key words: *turn taking; proxemics; pointing; engagement*
Age range: *Secondary education*
Duration: *60 minutes*

Grasso, Giancarlo
King's College London
giancarlo.grasso@kcl.ac.uk

Using dynamic software effectively in secondary mathematics classrooms

In this presentation, I present findings on the effect of the use of dynamic geometry software (DGS) in secondary school mathematics education. In particular, I consider the way in which DGS can be used to combat the cognitive dissonance intrinsic to the study of geometry in which the only access to abstract objects is through their visual representations. The study also addresses the way in which student perception of problems can be affected by direct interaction with DGS as opposed to the use of traditional pen and paper methods. A sequence of lessons was taught to a Year 7 class at a state funded inner-London secondary school in which DGS was used as a demonstrative tool by the teacher as well as an investigative tool used by learners. The sequence was assessed through the use of short tests in order to ascertain understanding held by students on the subjects of angle and definitions of geometric shapes. Qualitative data was also collected through both formal interviews and more informal observation in order to determine student perception. This data demonstrates both the positive effect that the use of DGS can have, as well as some of the dangers associated with the use of any representation of abstract geometric concepts.

Key words: *geometry; shape; technology; secondary*
Age range: *Secondary education*
Duration: *30 minutes*

Gray, Leanne
University of Birmingham
lfoxall1.211@lgflmail.org

How does children's competence in counting develop during the Nursery year in a primary school in where all children speak English as an additional language?

This study explores how children's competence in counting develops during the Nursery year in a state-funded primary school in central London where all of the children speak English as an additional language. For this doctoral research project, I have been tracking the developmental journey of seven individual children in the Nursery setting. I have carried out task-based interviews with the children over the year and have evaluated their counting skills and their ability to spot mistakes made by a puppet when counting in a real-life context. I have also observed the children counting in class and reviewed their class teacher's planning and assessment of counting to triangulate the data gathered in the task-based interviews. I interviewed the parents of the children involved at the beginning of the study to establish relevant contextual information. Although I have not yet completed my data collection, in the presentation I will discuss the emerging findings from the initial analysis of the data. I will focus on two contrasting case studies to illustrate the differences in children's development.

Key words: *counting; EAL; Nursery*
Age range: *Early years education*
Duration: *30 minutes*

Harth, Helen*, **Jaworski, Barbara** & **Robinson, Carol**
Loughborough University
h.harth@lboro.ac.uk

The use of activity theory in conceptualizing the teaching of statistics at university

In this presentation, I explore what are the actual relations between abstract knowledge (theoretical) and concrete forms of representation (contextualised) in the teaching of statistics at university. More specifically, I am interested in conceptualising statistics lecturers' teaching of introductory statistical concepts. Using examples from my own observations of actual teaching of statistics, I turn to activity theory as a theoretical perspective since it offers a set of useful perspectives on human activity that can help explain the teaching process. The focus of my analysis is on the lecturer, statistics and the context of statistics. Overall, the context of teaching statistics is a simultaneous shift between micro (internal) context in the lecture theatre where lecturers construct relevant statistical meaning for students using concrete conditions and the macro (external), social and historical context in which the teaching takes place.

Key words: *teaching; statistics; activity theory*
Age range: *Higher education*
Duration: *30 minutes*

Hernandez-Martinez, Paul* & **Harth, Helen**
Loughborough University
p.a.hernandez-martinez@lboro.ac.uk

Exploring non-participation in undergraduate engineering mathematics

Non-participation in mathematics learning has been explained through many different lenses: from motivational aspects (e.g. inauthentic, unrealistic, elitist, etc.) through to cognitive aspects (e.g. abstract, conceptual unconnectedness, non-ability, etc.). In this presentation, we will take a socio-cultural stance to analyse why some undergraduate engineering students

decide not to participate in the activities of a medium size (51 students) second year mathematics for engineering module. The module was taught at a large research-intensive university in England, and it was designed to enthruse participation by adopting a mathematical modelling approach, along with an emphasis on the development of employability skills. By using activity theoretical perspectives on identity, we explore issues of agency and alienation. We conclude that, for some students, non-participation in the module has little to do with the mathematics or the pedagogical approach, but more with their developing identities as university students and what they are experiencing in their lives at the time when they take the module. We will discuss the implications for further research and practice in mathematics education.

Key words: undergraduate mathematics; socio-cultural theories; identity; engineering mathematics; non-participation

Age range: Higher education

Duration: 30 minutes

Karadeniz, Mihriban*; **Baran, Tuğba***; **Gökçek, Tuba & Aydın Güç, Funda***

Giresun University (Turkey); Kırıkkale University (Turkey); Karadeniz Technical University (Turkey); Giresun University (Turkey)

tgokcek@ktu.edu.tr

Contextual examination of the middle school mathematics Turkish teachers' exam questions

The current study aims to present the distribution of ten middle school mathematics Turkish teachers' exam questions in terms of Blooms' cognitive process and knowledge dimension as well as the question types. Additionally, it will prove if there is a statistically difference on the questions' placement in the Revised Bloom taxonomy (Remember, Understand, Apply, Analyse, Evaluate, Create) with the grade level and question types. In the study, the middle school mathematics teachers' exam questions posed during the first semester of the 2013-2014 academic year were analysed. The review of 77 exam papers was made and the total of 1,152 questions from these papers were examined separately. Chi-square test was used to determine whether the cognitive process and knowledge dimensions of the questions were statistically different by grade level and question types. The results gained from the study reveal that mathematics teachers usually prepare questions at the lower cognitive dimensions of the Bloom Taxonomy. According to chi-square test results, there was a significant difference between knowledge dimensions of the questions and the grade level as well as the question types. Besides, there was a significant difference between cognitive process dimensions of the questions and the grade levels. Based on the chi-square test results there was also a significant difference between cognitive process dimensions of the questions and the question types.

Key words: mathematics exam; Bloom Taxonomy; grade level; question types

Age range: Secondary education

Duration: 30 minutes

Kent, Geoffrey

UCL Institute of Education

g.kent@ioe.ac.uk

Cryptography and financial mathematics as foci for critical approaches to mathematics education: Developing a research agenda with a peculiar motivation

This presentation explores two topics in applied mathematics and considers their potential value as foci for the development of practical approaches to the development of Critical Approaches to mathematics education. Why might some topics in mathematics be more or less useful in the development of critical approaches to mathematics education? What are the

ethical issues in addressing or not addressing potentially controversial issues in the context of school mathematics? I argue that critical approaches to mathematics education are vital for a peculiar reason: for the continued relevance of mathematics education as an independent discipline that is able to resist being subsumed into constellations of bureaucratic apparatus of control. In the context of several concrete examples of tasks, I will elaborate on the potential for research in critical mathematics education research focused around the idea of using cryptography and financial mathematics to teach mathematics for social justice. Finally, I will present initial thoughts on how to develop these ideas as a research agenda for discussion.

Key words: *Critical Mathematics Education; cryptography; financial; tasks; theory*

Age range: *Secondary education*

Duration: *30 minutes*

Kent, Geoffrey* & **Foster, Colin***

UCL Institute of Education, University of Nottingham

g.kent@ioe.ac.uk, colin.foster@nottingham.ac.uk

Distinguishing conceptual and procedural understanding in mathematics

In this presentation we consider conceptual and procedural understanding of mathematics. Recently, the authors have engaged in critical theoretical reflection on literature on understanding in mathematics education. In particular we have been considering interrelationships between conceptual and procedural understanding of mathematics in the context of individuals and groups. We question the enterprise of attempting to assess learners' mathematical understanding by inviting them to perform a (perhaps unfamiliar) procedure or offer an explanation. Would it be appropriate to describe a learner in possession of an algorithm for responding satisfactorily to such prompts as displaying conceptual understanding? We relate the discussion to Searle's "Chinese Room" thought experiment and draw on Habermas' Theory of Communicative Action to develop potential implications for addressing the problem of interpreting learners' mathematical understanding. We consider how these reflections on conceptual understanding from hermeneutic, critical and analytic perspectives could be leveraged to design research instruments and inform analysis.

Key words: *conceptual understanding; Habermas; procedural understanding; Searle*

Age range: *Secondary education*

Duration: *30 minutes*

Lee, Stephen* & **Knights, Carol**

Mathematics in Education and Industry

stephen.lee@mei.org.uk

Continuous Professional Development – enriching and engaging classroom teachers via a 'paired days' approach

Mathematics in Education and Industry (MEI) are an independent, charitable, curriculum development organisation that offers extensive support to teachers, including a wide range of CPD events. MEI provides over 2,000 teacher days' worth of CPD annually, and such experience will be reflected upon in this session. The main focus will be on one aspect of MEI's Further Mathematics Support Programme, which has had funding to devise and implement CPD for teachers focusing on extension and enrichment activities for Key Stage 4 students. One feature of provision during the last three years has been a two-day course presenting teachers with new materials and encouraging them to reflect on effective pedagogies. A number of strategies to engage teachers and to increase the amount and range of extension and enrichment activities they use with students have been utilised, together with evaluation tools to assess the overall effectiveness. One of the outcomes of the programme has been that teachers report using a wider range of approaches and activities

with their students, rather than offering them extension or enrichment materials more frequently.

Key words: *Teacher CPD; pedagogy; extension and enrichment; Key Stage 4*

Age range: *Secondary and teacher education*

Duration: *30 minutes*

Major, Louis

University of Cambridge

lcm54@cam.ac.uk

Developing instructional and pedagogical design for the Cambridge Mathematics Education Project: A design-based research approach

This paper details how the Design-based research (DBR) methodology is being used to support a sub-component of the Cambridge Mathematics Education Project (CMEP). It is set in the context of on-going research taking place at the University of Cambridge's Faculty of Education that involves the development of instructional/pedagogical design to support and enhance A-level mathematics education. An introduction to both DBR and CMEP is provided while details of the developed research strategy are outlined. This is followed by an overview of data collection activities completed to-date and discussion of planned future research directions.

Key words: *design-based research; A-level; post-16; development; evaluation; teaching resources*

Age range: *Further education*

Duration: *30 minutes*

Nardi, Elena*; Healy, Lulu & Biza, Irene*

University of East Anglia, Universidade Anhanguera de São Paulo, University of East Anglia

e.nardi@uea.ac.uk

The CAPTeaM project – Challenging ableist perspectives on mathematics teaching: Preliminary findings

According to the ableist world-view, the able-bodied are the norm in society and disability is an unfortunate failing, a disadvantage that must be overcome. Within education, ableism results in institutional and personal prejudice against learners with disabilities, and has a drastic effect on approaches to teaching. The project on which this session reports (CAPTeaM: Challenging Ableist Perspectives on the Teaching of Mathematics) investigates how ableist perspectives impact on the teaching of mathematics, a quintessential part of the curriculum, and a discipline where public perceptions of ability as innate often shape pedagogical perspectives and practice. This one-year project is funded by the British Academy and is co-led at UEA (UK) and UNIAN (Brazil). Our focus is on mathematical faculties typically associated with visual and auditory perception. Our research design combines Nardi and Biza's approaches to investigating and transforming teachers' beliefs about mathematics and about teaching in the UK and Healy's research with mathematics learners with disabilities in Brazil. We are developing and trialling tasks that invite teachers to reflect upon the challenges of mathematics teaching in inclusive classrooms. In this seminar we will discuss our currently-in-progress analyses of pre- and in-service teachers' written responses to one such task.

Key words: *ableism in mathematics teaching; teacher beliefs; teacher practice; task design*

Age range: *Teacher education*

Duration: *60 minutes*

Otieno, Herine
Sheffield Hallam University
herine.a.otieno@student.shu.ac.uk

Kenya secondary school students' intelligence beliefs - A case study in mathematics

Beliefs that students hold towards their intelligence have been shown to affect their orientation towards learning. In situations considered challenging, those with incremental views have been shown to exhibit adaptive motivational patterns whereas those with entity views have been shown to exhibit maladaptive motivational patterns. In this session, I will share my findings on the extent of incremental and entity beliefs amongst a group of 26 Kenya secondary school students. The findings are based on an integrated analysis (Using Dweck's implicit theories of intelligence model) of metaphoric diagrams drawn by the students on their perception on knowledge and knowing of mathematics, verbal reports on thought process during a mathematical exercise and observations made during a problem solving task.

Key words: implicit theories of intelligence; motivational patterns; metaphoric diagrams; Kenya secondary school students

Age range: Secondary education

Duration: 60 minutes

Pampaka, Maria & Omuvwie, Michael*
University of Manchester
maria.pampaka@manchester.ac.uk

Associations of teaching styles with students' mathematics dispositions in secondary education

The presentation deals with two unresolved issues in mathematics education: (a) the decreasing dispositions of students in mathematics, and (b) the relationship of teaching styles and students' learning outcomes. A recently completed large scale UK study (www.teleprism.com) aimed to shed more light into these issues, with an ultimate scope to map teaching practices with students learning outcomes (including dispositions) in mathematics. The project was a mixed method study involving longitudinal surveys and cases studies. The quantitative surveys with students and their teachers, took place in 40 schools at three occasions: start and end of the academic year 2011-12 and at the start of the next academic year 2012-13. Students were asked to report their dispositions to mathematics and their perceptions of the teaching they receive, along with other background information. A teacher survey was also carried during the first academic year with teachers reporting their pedagogic practices for the studied classes. Case study work with interviews and classroom observations in two schools also provided more in-depth accounts of the same concepts. The presentation will focus on the main outcomes from various sources of information regarding the effect of teaching styles on students (dropping) dispositions throughout secondary education.

Key words: attitudes; dispositions; pedagogic practices; secondary education

Age range: Secondary education

Duration: 30 minutes

Peatfield, Nicholas
University of Bristol & John Cabot Academy
n_peatfield@hotmail.com

Affective aspects of mathematical resilience

I link the concept of mathematical resilience, as introduced by Johnston-Wilder & Lee (2010), to the emotional and affective issues that a student might have with mathematics. My main research questions were: 1) What can we do as teachers to engender the positive emotions associated with mathematical resilience? 2) Does having more time explicitly ring fenced for the development of learning and thinking skills have a positive impact on mathematical resilience? 3) Is there a case for making a distinction between long-term and short-term mathematical resilience? I gained insight into answer these questions by focusing on a case study of 2 of the classes I taught in an 11-18 school in the UK. I videoed each class looking for evidence of the use of thinking skills and mathematical resilience (or its absence) and then selected 3 students from each class to interview. Thus my research methods fell into the case-study model described by Burgess (1990) as the 'multi-site case-study' (p.5), whilst trying to describe some 'paradigmatic cases' as described by Freudenthal (1981, p.135).

Key words: *resilience*
Age range: *Secondary education*
Duration: *30 minutes*

Pettersson, Kerstin
Stockholm University (Sweden)
kerstin.pettersson@mnd.su.se

University students' discourse on a threshold concept related to their approaches to study

This on-going study aims to explore the relation, if any, between university students' discourse on the concept function and their approaches to studying. Data were collected as part of a large project exploring students' approaches to studying in both campus based and web based settings. Data on the students' approaches to studying were collected using the short version of Approaches and Study Skills Inventory for Students (ASSIST), resulting in a profile for each student comprising their own ratings according to deep, surface and strategic approaches. 43 undergraduate students in the beginning of engineering education at a large university of technology in Sweden were invited to take part of interviews to explore their discourse on function, nine students accepted. A commognitive framework was used to analyse their discourses. The preliminary results indicate that there is a correlation between a highly strategic approach and a discourse including few mathematical words and unclear narratives. There are also indications of a correlation between a deep approach and a discourse dominated by use of graphs as visual mediators and as a base for the narratives.

Key words: *students' conceptions; approaches to studying; threshold concepts, function*
Age range: *Higher education*
Duration: *30 minutes*

Pomeroy, David
University of Cambridge
dcp33@cam.ac.uk

Is physical education the opposite of mathematics? Subject preferences, the mind/body dichotomy, and socio-economic status

There is a widely held idea that mathematics is a discipline for 'brainy' people; a cerebral subject. This idea can position mathematics as incompatible with activities such as Physical

Education and sport, seen as associated with the body, not the brain. Drawing on questionnaire and interview data from New Zealand Year Nine students (aged 13-14 years), I will suggest that there is a relationship between socio-economic status and the social value of 'brain' versus 'body' activities. For example, low socio-economic status students were especially likely to list Physical Education as their favourite subject and mathematics as their least favourite. In New Zealand, students from all social backgrounds play a lot of sport, but low socio-economic status students are especially likely to list professional sport as a career aspiration. This session will explore my in-progress interpretation of data that connects school mathematics, the mind/body dichotomy, and socio-economic status. My hope is to facilitate a discussion in which all present can contribute to making sense of the research participants' preferences and narratives.

Key words: *social class; subject choice; sociology of mathematics; mind/body*

Age range: *Secondary education*

Duration: *30 minutes*

Rowland, Tim

University of East Anglia & University of Cambridge

tr202@cam.ac.uk

Teacher learning provoked by teaching: equal-area triangles

My short talk arises from an ongoing interest in 'contingent' events from authentic mathematics classrooms, their demands on mathematics teacher knowledge, and their potential as a stimulus to develop it. This 'amuse bouche' presentation has mathematics in the foreground and the growth of teacher knowledge as the context. The quasi-elementary mathematics in focus in this instance is equal-area triangles.

Key words: *teacher knowledge; contingency; area*

Age range: *Primary, secondary, and teacher education*

Duration: *30 minutes*

Siedel, Helen* & Skilling, Karen*

University of Cambridge; King's College London

helensiedel@hotmail.com

"There's so much out there!"

Facilitating the selection of instructional resources

In this presentation, we will introduce an analytic tool we are developing for use by individual teachers, school mathematics departments, or the larger mathematics education community to support the selection of instructional resources for a particular school or classroom context. In recent years, the availability of new technology that can be used by mathematics classroom teachers has been accompanied by a proliferation of instructional resources. Keeping abreast of these developments can be challenging for teachers who must assess the mathematical and pedagogical affordances and constraints of what they draw on for planning and teaching. However, to date there has been little systematic investigation accompanying the uptake of available resources. In the absence of formal research, the tool we introduce employs the notion of content curation as a way to marshal and exhibit information. We envisage multiple applications, such as informal analysis of individual resources, comparative analysis of resources, and the production of informed data for evidence-based decisionmaking. Using examples from the currently popular MyMaths program, we will demonstrate ways the tool might be used.

Key words: *instructional resources; secondary mathematics; content curation*
Age range: *Secondary education*
Duration: *30 minutes*

Styles, Jack
King's College London
jack.styles@kcl.ac.uk

Extending students' conceptual understanding of area to incorporate formulae

Conceptual understanding of area can be compromised by the introduction of formulae for the areas of specific shapes. The progression of ideas presented to students in order to promote conceptual understanding of these formulae may be an important contributory factor. Numerous authors suggest the following progression: arrays to rectangles to parallelograms to triangles, then from parallelograms to trapezia. However, few have provided data illustrating merits and pitfalls of this approach. This presentation discusses findings of the effect of a sequence of lessons following this progression on a Year 8 class. Short tests taken before and after the sequence of lessons were used to help assess the sequence's impact, which were supplemented by classroom observations. The data indicate that some parts of this progression were particularly successful, whilst illustrating potential pitfalls with others. More widely, it highlights the potential usefulness of more critical appraisals of progressions of ideas in the teaching of mathematics.

Key words: *area; formulae; secondary*
Age range: *Secondary education*
Duration: *30 minutes*

Thouless, Helen
University of Roehampton
hthouless@yahoo.com

Using a single-subject research design to examine the effectiveness of a mathematical instructional activity

This presentation examines a single-subject research design as a means to assess the effectiveness of an instructional activity in mathematics. A single-subject research design is a quantitative research design that is commonly used in special education research to examine the effectiveness of instruction when it is impractical to have a large number of similar participants due to the unique nature of their special educational needs. By referring to a research project in which I used a single-subject multiple-baseline research design to assess the effectiveness of the instructional activity of counting collections at helping students with dyslexia develop base-ten concepts, this presentation will examine the strengths and weaknesses of this research design for use in mathematics education research. I will then propose additions to this design that make it more explanatory and therefore more useful in examining the students' learning. This presentation will be followed by an opportunity for audience questions.

Key words: *single-subject research design; special educational needs; place value; Dyslexia*
Age range: *Primary education*
Duration: *30 minutes*

Wright, David*; **Clark, Jill**; **Tiplady, Lucy**
Newcastle University
d.g.wright@ncl.ac.uk

Design research in formative assessment with technology

This paper will report on the ongoing work and progress of the Raising achievement through Formative Assessment in Science and Mathematics Education (FaSMEd) project, which is a design research project, now in the second year of a three year programme. FaSMEd aims to develop the use of technology in formative assessment classroom practices in ways that allow teachers to respond to the emerging needs of low achieving learners in upper primary and secondary education in mathematics and science. This international project adapts and develops existing research-informed pedagogical interventions (developed by the partners), suited to implementation at scale, for working with low attaining pupils and transforming teaching. The project aims to: foster high quality interactions in classrooms that are instrumental in raising achievement for low achievers and expand our knowledge of technologically enhanced teaching and assessment methods addressing low achievement in mathematics and science. The project involves partners from eight countries across Europe and South Africa working with 40 schools and up to six teachers in each school as practitioner researchers to produce case studies in the application of tools to support formative assessment. The project will be producing a toolkit for teachers to support the development of practice and a professional development resource to support it. See <https://research.ncl.ac.uk/fasmed/> for more information.

Key words: *formative assessment; technology; design research*

Age range: *Secondary education*

Duration: *60 minutes*