BSRLM Conference Abstracts
Liverpool Hope University (EDEN Building)
Saturday 11th November 2017

Alderton, Julie*; **Donaldson**, Gina; **Ineson**, Gwen*; **Rowland**, Tim*; **Voutsina**, Charis & **Wilson**, Kirsty*
University of Cambridge, Canterbury Christ Church University, Brunel University, University of Cambridge, University of Southampton, University of Birmingham
k.e.wilson@bham.ac.uk

Pre-service primary teachers' approaches to mathematical generalisation

In our teaching with primary pre-service teachers, each of us includes generalising tasks in the context of mathematical reasoning. Whilst we believe that these are important experiences, we set out to explore the value of such activity from the perspective of a student teacher. We have collected a range of data from four universities, including 15 individual interviews with postgraduate student teachers following a taught session (agreed among the author-tutors) in which the students explored 'growing patterns.' In this presentation, we will focus on the mathematical reasoning that the students engaged in, and offer a case study of one student's thinking when working on two tasks: 'flower beds' and 'matchstick squares.' We analyse the ways in which this student teacher attends to: looking for a relationship between quantifiable elements; seeing structure within a single figure in a sequence; and seeing sameness and difference between figures in a sequence. We consider what motivates shifts in attention, and in doing so, we reflect on the significance of students' prior experience, and of student collaboration in our teaching sessions.

Key words: *generalisation; reasoning; primary teacher training*
Session type: *Research paper*
Duration: *60 minutes*

Asghari, Amir
Liverpool John Moores University
asghari.amir@gmail.com

Historical phenomenography of equivalence and its lessons for teaching number

One of the main problems of a study of the history of mathematical concepts is to find a way to suspend our own understanding of those concepts usually captured by well-developed definitions. On the other hand, one of the main tenets of phenomenography is to offer a way to suspend (i.e. bracket) our own understating, seeing the concepts with others' eyes. Historical phenomenography is the natural, though never applied, adoption of phenomenography for the study of the history of concepts. We use the notion of equivalence as experienced in certain historical contexts to introduce historical phenomenography. In particular, we depict a line by line comparison between Euclid conception of equivalence and Russell's, showing how focusing on one conception over the other could radically change the way in which we teach early number.

Key words: *equivalence; Euclid; historical phenomenography; Russell; teaching early number*
Session type: *Research paper*
Duration: *30 minutes*

Barmby, Patrick*; **Wheadon**, Chris & **Jones**, Ian
No More Marking Ltd, No More Marking Ltd, Loughborough university
patrick@nomoremarking.com

Using comparative judgement to assess conceptual understanding in mathematics: An overview of findings from recent data collections

Comparative judgement is an alternative to criteria-based assessment, useful for making holistic judgements about pieces of work where a number of factors need to be taken into account in the assessment process. This is applicable for trying to assess conceptual understanding in mathematics where we want to go beyond the procedural fluency shown by the student, but also consider factors such as the connections made between mathematical concepts, level of explanation, and the variety of representations drawn upon. In this presentation, we will present the findings from a national Year 7 assessment project carried out in June 2017 involving 180 schools in England and 31,465 students. Specifically, the conceptual understanding shown in specific areas such as number and the progression in the understanding shown over the range of students will be examined and discussed.

Key words: *assessment; comparative judgement; conceptual understanding*
Session type: *Research paper*
Duration: *30 minutes*

Brown, Julian
University of Bristol
jb0438@bristol.ac.uk

Teacher awareness of awareness in a mathematics classroom

Starting from the position that it is desirable for students of mathematics to develop awareness of mathematics and acknowledging that it is not possible for a teacher to access students' awareness directly, I am exploring the ways in which teachers use their pedagogical and subject knowledge to educate this awareness. Drawing on in-class observation, review of video record and teacher interview, I will report an attempt to mark instances of teacher awareness of student awareness and to trace the teacher's decision-making relating to student attention within a mathematics lesson. I will consider differences in what is noticed by observer and teacher and how this might relate to a teacher's on-going development.

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

Brown, Laurinda
University of Bristol
laurinda.brown@bristol.ac.uk

What does what is done in first lessons tell about cultural practices and beliefs?

I have been revisiting interviews from about 25 years ago that have not, formally, been written up. Soon after each teacher's first lesson with a new group, I interviewed them focusing on the detail of what happened in the spirit of Bruner's "cultural psychology", how does what is done give insight into thoughts and beliefs. I would now describe the process differently, but the current interest is driven by the question, *How possible or desirable is it to try to import the culture and practices of one country to another?* After sharing the outcomes of the original interviews, I will compare and contrast teaching and learning mathematics in Hungary and the UK drawing from a 25-year experience of an exchange link.

Key words: *teaching strategies; cultural psychology; cross-cultural comparison; first lessons*
Session type: *Research paper*
Duration: *60 minutes*

Cantley, Ian*; **O'Meara**, Niamh; **Prendergast**, Mark; **Harbison**, Lorraine & **O'Hara**, Clare
Queen's University Belfast; University of Limerick; Trinity College Dublin; Dublin City University; Central Statistics Office, Dublin
i.cantley@qub.ac.uk

A cross-national comparative study of teachers' views on the transition from primary to post-primary mathematics education

International research shows that transition from primary to post-primary education tends to have deleterious effects on student achievement and motivation in mathematics. Issues pertaining to lack of curricular and pedagogical continuity across the transition have been identified as contributing factors in this apparent regression in students' mathematical learning, and it has been suggested that relevant teacher Continuing Professional Development (CPD) may lead to improvements in teachers' cross-phase curricular and pedagogical knowledge, thus alleviating such discontinuities for students at transition. Findings from a cross-national comparative study, in a jurisdiction with a transition-related CPD project (Northern Ireland) and a jurisdiction without such an initiative (Republic of Ireland), suggest that CPD has potentially beneficial effects for teachers' cross-phase curricular and pedagogical knowledge. However, the qualitative findings from the study indicate that the ultimate benefits for students' mathematical learning are likely to be maximised only if measures are taken to address organisational and societal barriers to successful transition. For example, some Northern Irish teachers suggested that patterns of mathematics teaching associated with preparing students for academic selection tests during the final year of primary education were distorting students' overall mathematical learning experiences and, ultimately, disrupting the experiential continuum in their mathematical learning on transition to post-primary education.

Key words: *transition; primary; post-primary; mathematics; teacher Continuing Professional Development (CPD)*
Session type: *Research paper*
Duration: *30 minutes*

Cameron, Sinéad
Liverpool Hope University
10079229@hope.ac.uk

A study of the impact of setting and mixed ability grouping upon eight- and nine-year-old pupils' mathematical self-perception

Setting is prevalent in UK primary schools even though there is a wealth of literature reporting the negative effects of setting. From a practitioner's perspective, the research findings are thought provoking as Muijs and Reynolds (2017) suggest setting has the potential to harm the self-concept of the lower ability sets. Boaler (2013) identifies that setting harms the achievement of pupils in the low and average sets and does not improve the achievement of the pupils' in higher sets. This research investigated the effects of setting and mixed ability grouping on the mathematical self-perception and mathematical attainment of two Year 4 classes. The findings suggest that mixed ability grouping had no statistically significant effects on mathematical self-perception and attainment in comparison to setting. The qualitative data gave an insight into eight and nine-year-old pupils' perspectives of setting in comparison to mixed ability grouping. It found that although pupils may experience the same mathematics class, their mathematical ability influences their perception of setting in comparison to mixed ability grouping in terms of the different ranges of mathematical ability within their class, the emotive use of the language of mathematical ability, pupils' experiences of competiveness, their mindset and their mathematical self-perception.

Key words: *primary mathematics; setting and mixed ability grouping; teachers*
Session type: *Research paper*
Duration: *30 minutes*

Clark-Wilson, Alison*; **Wake**; Geoff* & **Wright**, Pete*
UCL Institute of Education, University of Nottingham, UCL Institute of Education
a.clark-wilson@ucl.ac.uk
@aliclarkwilson @geoffwake1

Building and Sustaining Active Research Collaborations with Teachers of Mathematics Working Group

Many researchers are deeply concerned with ensuring they have opportunities to work with and involve teachers in the process of doing, and engaging with the findings, of mathematics education research. The current educational landscape in which, research schools, teaching schools and Maths Hubs are being encouraged to engage with, and participate in, more 'research-informed' practices offers a range of challenges, but also opportunities to develop new collaborative ways of working. The working group meets to share and discuss experiences, current projects and initiatives with a view to developing a range of resources that might inform and support future work.

Key words: *collaborative research; teacher inquiry; research-informed practices*
Session type: *Working group*
Duration: *60 minutes*

Croft, Julia* & **Fisher**, Sam*
University of Bedfordshire, Redborne Upper School and Community College
julia.croft@beds.ac.uk

Supporting the reconstruction of identity within subject specialism transition: Shaping the roles of tutor and coach within the TSST programme

The shortage of teachers is forcing schools to use teachers who have not qualified as mathematics and physics specialists to teach those subjects. In 2015-2016, the Teacher Subject Specialism Training (TSST) programme was launched to attract teachers who have previously qualified to teach other subjects. Our decision to offer TSST was taken after much debate about the extent to which it is possible to develop sufficient subject specific knowledge and pedagogy within the constraints of the programme. In this case study, we have explored the responses of participating teachers, departments and tutors through focus groups, questionnaires, individual interviews and observations of participating teachers. We propose a model of plural transitions to and through "complex identit[ies]" (Leach & Moon, 2000, 397) as perceptions of competence are disrupted and reconstructed. Viewing the findings from a socio-constructivist perspective, we have been caused to examine the roles of tutor and coach in this identity formation. In this workshop, we will share our findings and open a debate about the construction of identity as a subject specialist teacher, building on the work of Shulman (1986), Korthagen (2004) and others, and the role of influential others in that construction.

Key words: *teacher professional development; subject specialism; teacher supply*
Session type: *Research workshop*
Duration: *60 minutes*

Evans, Sheila
University of Nottingham
sheila.evans@nottingham.ac.uk

In what ways can designed student responses act as a mediating tool to help students practice metacognition within groups?

Students productively tackling together a challenging, unstructured, non-routine problem means engaging in social metacognitive regulation (SMR). This can take the form of students regulating their own cognitive processes. Or they may scaffold their partner's understandings by taking on the role of a teacher. Or there may be times when students together, equitably regulate their joint cognitive processes. However, the substantial benefits of working effectively together can remain illusive for many. Worked-out solutions, in the form of designed student responses (DSRs) to problems can help students practice SMR. Features, such as coherence, anonymity,

accuracy, unfamiliarity, and a focus on understanding rather than performance, can promote SMR. By encouraging students to complete, critique, and link DSRs' invariant properties, metacognitive strategies may be fostered. How, these potential benefits are realised in a classroom is the focus of the talk. The results from analysing a pair of Year 9 students' interactions indicate they extensively engaged in SMR (82.4% of all utterances were classified as SMR) whilst working with DSRs, but the focus of their conversation quickly shifted. Any issues were swiftly resolved. This raised questions concerning the extent of their learning. The talk considers these and other findings, and outlines the methodological approach of the study.

Key words: *designed student responses; group work; metacognition; unstructured, non-routine problems*
Session type: *Research paper*
Duration: *30 minutes*

Gates, Peter*; **Povey**, Hilary*, **Ghosh**, Suman* & **Wright**, Pete*
University of Nottingham, Sheffield Hallam University, UCL Institute of Education, UCL Institute of Education
pete.wright@ucl.ac.uk
@PeteWrightIOE

Critical Mathematics Education (CME) Working Group - including discussion on 'What next for critical mathematics education?'

During the first part of the meeting, Peter Gates will lead a discussion on recent developments in the field of Critical Mathematics Education (CME) and possible directions for future research. He will be reflecting on his work in the field of CME and asking what opportunities are opened up by the growth in support for the 'Corbyn agenda' and the growing likelihood of the election of a Corbyn-led socialist government. During the second part of the meeting (chaired by Hilary Povey), we will decide foci for future meetings of the working group. Please be ready to share your ideas with others. The CME Working Group (launched in November 2015) is open to all and aims to promote research that brings about positive social change through mathematics education. CME aims to identify and challenge ways in which mathematics is commonly used to maintain the status quo and reproduce inequities in society. It proposes an alternative and empowering conceptualisation of mathematics, which enables people to better understand their social, political and economic situations, and to advocate and bring about changes leading to a more just and equitable society.

Key words: *critical mathematics education; empowerment; equity; social justice*
Session type: *Working group*
Duration: *60 minutes*

Gifford, Sue* & **Trakulphadetkrai**, Natthapoj Vincent*
University of Roehampton, University of Reading
n.trakulphadetkrai@reading.ac.uk
@NatthapojVinceT

Early Years and Primary Mathematics (EYPM) Working Group - First meeting

In this first 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 participate in an exploratory discussion on how this new Working Group can benefit its members and the wider community. Specifically, what should the key objective(s) of this Working Group be, how research collaboration among the Working Group's members can be encouraged, what the Working Group can do to help develop its members' research (and writing) skills, and which aspects of EYPM might the wider society benefit from more research. At a more practical level, ideas on how the Working Group can summarise and publicly present its members' research expertise are also welcomed. It is hoped that a summary of this first meeting will be presented as a blog piece on the BSRLM website and/or a short article in the Proceedings.

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

Haunch, Adam
Liverpool Hope University
hauncha@hope.ac.uk

The variation of emotional affect in subject knowledge enhancement (SKE) students when undertaking problem solving exercises

We examined the emotional affect of a small cohort of nine postgraduate students enrolled on a subject knowledge enhancement (SKE) course on a teacher training programme in the northwest of England as they undertook a series of three substantial mathematical investigations, namely: an investigation into the orbits generated by the doubling map when applied to fractions; an investigation into the orientations of dice when rolled along a path and an investigation into the Collatz conjecture (an open problem in mathematics). In doing so, we studied the influence of progress in problem solving on their emotional affect. We monitored the emotional affect of the students at three points during each session using the short Positive and Negative Affect Schedule (PANAS) questionnaire and then related these scores to the students' output from the sessions. We noted a relationship between creative attempts at the problems and an increase in anxiety in the students. Additionally, we also note the differences in affect of the students when working on this third problem in comparison to the other two. The results from the study appear to show that some students undergo substantial emotional changes, both positive and negative over the course of an investigation, despite the maturity of the cohort of students. This suggests that some additional thought should be given to the emotional wellbeing of students when planning intensive, investigative, mathematics lessons.

Key words: *problem solving; emotional affect; subject knowledge enhancement; investigations; creativity; anxiety*
Session type: *Research paper*
Duration: *30 minutes*

Helliwell, Tracy
University of Bristol
tracy.helliwell@bristol.ac.uk

Learning the use of verbal metacommunication as a mathematics teacher educator

Both as a teacher of mathematics and a new mathematics teacher educator, I have been struck by the importance of communication at a meta level. Having worked on making my verbal metacommunication (communication about the communication) explicit in the classroom for over many years as a teacher of mathematics, it seems to me that work now needs to be done on my meta level communication as a mathematics teacher educator. This process of 'considering the meta level' began having experienced, for the first time, teaching a group of pre-service mathematics teachers using an activity that I had used in secondary school classrooms many times before. Considering the purpose of the activity with a group of pre-service teachers led to a question about what is different with this group of people, the difference seemed to be at the meta level. In this session, I will present some data from discussions with a collaborative group of mathematics teachers that I am working with. The focus is on my communication as the facilitator of the discussion, in particular, what, when and how meta level communication is used.

Key words: *verbal metacommunication; mathematics teacher educator learning*
Session type: *Research paper*
Duration: *30 minutes*

Inglis, Matthew
Loughborough University
m.j.inglis@lboro.ac.uk
@mjinglis

How should research be communicated to teachers? A critique of the Sutton Trust Teaching and Learning Toolkit

The Sutton Trust Teaching and Learning Toolkit has dramatically changed the way teachers engage with research findings. It consists of summaries of the 'effect' of various educational interventions expressed as standardised effect sizes. In this presentation, I will argue that this is a misguided approach to communicating research findings to teachers for at least two reasons. First, standardised effect sizes cannot be easily compared between different interventions; and second, most quantitative research in education seeks to test theories not estimate effects. The implications for how research should be communicated to teachers, if my argument is right, will be discussed.

Key words: *communication; Education Endowment Fund (EEF); research findings*
Session type: *Research paper*
Duration: *30 minutes*

Joubert, Marie* & **Mostert**, Ingrid
University of Swansea, University of Johannesburg
marievjoubert@gmail.com

Maintaining student interest in whole class discussions: The use of 'big cards'

This presentation reports on one aspect of the Formative Assessment in Science and Mathematics Education (FaSMEd) project in South Africa. In the project, secondary school teachers trialled lessons which generally involved the use of small cards to match or classify mathematical objects (e.g. functions and graphs). While the success of this kind of task is generally well recognised in terms of challenging and engaging students, it also seems to be the case that bringing the lesson to the close tends to be more problematic. To address this, big versions of the small cards were provided for teachers. The research investigated whether, and how, the teachers used the cards and to what extent the way they used them help maintain the students' interest. This presentation reports on strategies adopted by three teachers in their use of the big cards in the concluding part of the lesson. The findings suggest that teachers use the cards in a variety of ways, some of which appear to be more effective than others. Overall, however, it seems that they can be used to maintain some of the energy and momentum of the pair work.

Key words: *class discussion; card matching; instructional resources*
Session type: *Research paper*
Duration: *30 minutes*

Kirkland, Heidi
University of Leicester
heidirosekirkland@gmail.com

The experience of mathematics anxiety in primary school

Mathematics anxiety: What is it? How can we identify it? Is it the same for everyone? This session will aim to explore how children in primary classrooms experience mathematics anxiety. This research aims to answer the following questions: How is mathematics anxiety presented in primary school children? How does mathematics anxiety affect mathematical learning? I will discuss the case study from the pilot research, based upon one Key Stage 2 pupil in the East Midlands, in relation to current literature. Findings from this will then be explored and how behaviours and emotions towards mathematics were identified through qualitative analysis and what themes emerged. Positive steps forward will be discussed in order to identify how to support children with mathematics anxiety in the primary classroom and how my pilot study has informed my research.

Key words: *primary education; mathematics anxiety; affective factors*
Session type: *Research paper*
Duration: *30 minutes*

Küchemann, Dietmar
mietmau@gmail.com

Enlarging a tangram … Do the pieces still fit? An account of an interview and its use in the design of a lesson on multiplicative reasoning

In this session, I will report on an interview with three Year 8 (Grade 7) pupils in which they each attempt to enlarge one piece from a simple tangram drawn on squared paper. I will also discuss how the interview informed the design of an Increasing Competence and Confidence in Algebra and Multiplicative Structures (ICCAMS) lesson on multiplicative reasoning.

Key words: *enlargement; scaling; proportional reasoning; multiplicative reasoning*
Session type: *Research paper*
Duration: *30 minutes*

Lee, Stephen*; **Saker**, Chris & **Baldwin**, Claire
Mathematics in Education and Industry, University of Essex, Mathematics in Education and Industry
stephen.lee@mei.org.uk
@MEImaths

Universities as a driver of AS/A level uptake: The case of Mathematics and Further Mathematics

We are at a crossroads. New, harder, GCSE Mathematics qualifications were taken for the first time in Summer 2017 and that cohort of students have gone on to begin studying the all new linear (rather than modular) AS/A level Mathematics and Further Mathematics. At time of writing, there are not any official figures for uptake of those that began AS/A level study in September 2017, but there is indication from teachers that numbers doing Mathematics, and particularly Further Mathematics, may have reduced considerably.

This paper reports on three different aspects of analysis, which together highlight just what an important role universities can play in helping to maintain entry numbers to AS/A level Mathematics and Further Mathematics during this time of considerable change. The areas explored include: a review of recent data on entries to AS/A level Mathematics qualifications; analysis of unpublished UCAS data to show which universities and subject areas students with Mathematics A levels go on to study; analysis of entry requirements from over 650 degree courses to establish what prior Mathematics qualifications they require.

Key words: *A level; university; entrance requirements*
Session type: *Research paper*
Duration: *30 minutes*

Oakes, Dominic
Further Mathematics Support Programme (FMSP) in Wales, University of Swansea
drgo69@yahoo.co.uk
@IntegralEduc

Connections: Deepening A-level Mathematics through curriculum design and support. How best to develop and research?

The Further Mathematics Support Programme (FMSP) Wales is creating a Scheme of Work for the new Welsh Joint Education Committee (WJEC) Mathematics and Further Mathematics A-levels for which I am the Coordinator. The philosophy behind this Scheme of Work includes: teaching Mathematics rather than teaching to the exam; build with connection in mind; focus on mastery; put proof at the heart of the syllabus. A component of

our work has been creating a spreadsheet with learning objectives for all topics together with prior knowledge and dependent topics. This has been used to create a mind map showing all the connections. The scheme of work is a living document. We intend to develop a variety of Programmes of Study, taking account of different contexts and investigating new ways of covering the material using the principle of connection. In this session, we will look at our connection documents and at an area that connects number, algebra, calculus and probability. We will discuss how to adapt Programmes of Study to encourage and support greater connection in delivery as well as Continuing Professional Development (CPD) implications. I am an experienced practitioner, but a new researcher so finally we will look at how best to research the impact of our work.

Key words: *curriculum; connection and depth; CPD; Key Stage 5; research methods*
Session type: *Research workshop*
Duration: *60 minutes*

Özdemir, Ahmet Şükrü & **Ergene**, Özkan*
Marmara University (Turkey), Sakarya University (Turkey)
ozkanergene@sakarya.edu.tr

Investigation of prospective elementary mathematics teachers' knowledge about convergent series by harmonic series

The purpose of this study is to investigate prospective elementary mathematics teachers' approaches to convergence and divergence of series by using harmonic series concept in the context of theory and application. The sample of the study consists of 50 prospective elementary mathematics teachers who study at one of the state universities in Marmara region. Semi-structured interviews were conducted with four randomly chosen prospective elementary mathematics teachers. In this study, qualitative method was used and research design of the study was determined as the case study. Test which consists of two questions and one real life problem about convergent/divergent of series and harmonic series was administered to prospective elementary mathematics teachers. Descriptive analysis technique was used to analyze the data. Almost all prospective elementary mathematics teachers explained the convergence of series and they stated divergence of series as "series which are not convergent are divergent". In addition, they expressed the convergence and divergence of harmonic series with mathematical proofs and verbal expressions. More than half of the prospective elementary mathematics teachers gave incomplete-incorrect solution to the problem about harmonic series. Moreover, it was observed that in the solution process they confused sequences and series concepts. At the end of the research, it was concluded that prospective elementary mathematics teachers have theoretical knowledge about convergence and divergence of series but they have some problems in application of this knowledge to the real life.

Key words: *series; harmonic series; convergent; divergent; theory-application*
Session type: *Research paper*
Duration: *30 minutes*

Parish, Alison
University of Warwick
alison4maths@gmail.com

Teachers and digital technology: A view from the past

It is now over 35 years since computers were introduced into schools in the 1980s. For many years, Ofsted and others have highlighted the lack of digital technology use by mathematics teachers. Teachers of mathematics were some of the earliest to engage with the technology, some becoming the first advisory teachers for IT. With virtually no educational software, or national curriculum, teachers were freer to innovate and write programs for use in their classrooms and to share with others, giving rise to programs such as, the Association of Teachers' Slimwam and 'L', those of SMILE and Newman College and from MIT, Seymour Papert's Logo. What was it like for mathematics teachers who wished to use IT in these times? As a teacher who was worked in secondary and primary schools in the 1980s, this presentation tells the story from a personal perspective and includes part of the work for my thesis on mathematics teachers and use of digital technologies. I looked to the past for clues about the lack of engagement of teachers for teaching mathematics in schools and I considered whether opportunities

were missed and whether barriers and constraints teachers have led to this position.

Key words: *teachers; digital technologies; historical issues*
Session type: *Research paper*
Duration: *30 minutes*

Ramirez, Paola
University of Bristol
pr15367@bristol.ac.uk

Does a mathematical modelling task change the behaviour of the student and teacher in a lesson?

This workshop presents transcripts of the behaviour within mathematics lessons of Grade 8 students (aged 13-14 years) and a teacher in a school in Chile. The students are studying in their usual way through mathematics tasks involving word problems, exponents and powers, rational numbers, squares and percentages, and through a mathematical modelling task that is new to them, given the addition of modelling to the Chilean National Curriculum. In order to promote discussion, I will provide several examples of transcripts observed from the patterns of interactions of teacher and students through observation, video recording and interviews for participants to analyse. To finalise, I will show what has emerged from the transcripts for me, from an enactivist perspective.

Key words: *mathematical modelling; mathematical task; Enactivism; learning behaviour*
Session type: *Research workshop*
Duration: *30 minutes*

Tasara, Innocent
University of Leeds
i.tasara@leeds.ac.uk

A commognitive analysis of a teacher's mathematical discourse on the derivative

Research on the teaching of the derivative (and limit) is still not as extensive as the research on students' learning of calculus. This presentation introduces a discursive framework and examines the discourses of a teacher and his class through the commognitive framework (Sfard, 2008). The commognitive framework is built on the premise that thinking is a form of communication and communication with oneself. Discourse is the core unit of analysis, and mathematics is seen as a form of discourse. Discourse is made distinctive by four commognitive constructs of word use (vocabulary and syntax), visual mediators, endorsed narratives and routines. These commognitive constructs are the key components of the discursive lens for the analysis of mathematical discourse. This presentation reports on a commognitive analysis of discourse on an introductory lesson about tangents, gradient and differentiation to a Year 12 class in England. Data sets included two audio-recorded interviews with the teacher and one video-recorded lesson observation. The teacher was interviewed first, before teaching the observed lesson on differential calculus and secondly, after teaching the lesson.

Key words: calculus; commognition; derivative; discourse
Session type: *Research paper*
Duration: *30 minutes*

Tuna, Selin & **Akkoc**, Hatice*
Prof. Muharrem Ergin Ortaokulu (Secondary School) (Turkey), Marmara University (Turkey)
hakkoc@marmara.edu.tr
@haticeakkoc

Exploring mathematics teachers' practices of technology integration from a socio-cultural perspective: A Zone Theory approach

The aim of this study is to examine mathematics teachers' technology integration experience throughout an in-service training on technology-enhanced mathematics teaching at upper-secondary level. Four mathematics teachers participated in the study which lasted about a year. Data consist of one mathematics teacher's transcripts of four lesson videos and four interviews. Data were analysed using the Zone Theory. Findings were obtained about how mathematic teachers coordinated and correlated Zone of Proximal Development (ZPD), Zone of Free Movement (ZFM) and Zone of Promoted Action (ZPA), and how they organized ZFM and ZPA according to their new experience with technology.

Key words: *mathematics teachers; professional development; socio-cultural approach; technology-enhanced mathematics teaching; Zone Theory*
Session type: *Research paper*
Duration: *30 minutes*

White, Wendee
University of Dundee
whitewendee@gmail.com

The relationship between an affective instructional design, mathematical attitudes, and learning for early years

This session explores the relationship between an Affective Instructional Design (AID), children's attitudes toward mathematics, and mathematics learning. The Affective Instructional Design (AID), adapted from Kort et al.'s, (2001) affective learning model, could be one route to supporting educators in establishing quality learning environments that promote positive attitudes and meaningful learning in mathematics. The instructional design has been organized to promote affective and cognitive development and is rooted in a social-constructivist framework. Affective development can be attended to in two ways: through environmental affect and core affect. The classroom environment provides stimuli that impact a learner's affect states, which in turn impacts the quality of learning. Core affect is linked to attitude formation and cognitive processing. Its orientation can be positive, negative, or neutral, and its intensity can be long lasting or short in duration (Russell, 2003; Storbeck & Clore, 2008). According to Russell (2003), "the more positive core affect is, the more positive events encountered or remembered seem" (p. 149).

Key words: *affect state; core affect; environmental affect; mathematics learning; attitudes towards mathematics; affective instructional design*
Session type: *Research paper*
Duration: *30 minutes*

NOTES