



British Society for
Research into
Learning Mathematics

Plenary

Indicators and categories of secondary teachers' knowledge of rational numbers: a focus on the knowledge of topics.

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Recognising teachers' knowledge as one of the main factors influencing their practices and student learning, we aim to contribute to obtaining a better and deeper understanding of the specificities of teachers' mathematical knowledge. A case study involving one 8th-grade Chilean mathematics teacher is presented in the context of rational numbers. Using video and audio recordings of classroom practices, questionnaires, and an interview, we sought to characterise, and better understand the content of the Knowledge of Topics from the perspective of the Mathematics Teachers' Specialized Knowledge (MTSK) theoretical framework. The results reveal some critical aspects that teacher education should focus on, while also identifying lost opportunities and examples of "good" practices, thus contributing to the refinement of the MTSK conceptualisation. The conclusions can be considered in a broader perspective, with implications for teacher education in other contexts.

In this talk we will present and discuss the previous mentioned research and expand it with some examples of the research we have been developing from the given results focusing on the nature and types of tasks (conceptualisation of tasks) for improving (prospective) teachers' knowledge of the most problematic situations identified both in students and teachers knowledge.

*Research papers and workshops***Abbott, Ashley*****Using faded worked examples to reduce cognitive load in mathematics - a classroom-based intervention.***

Cognitive load theory details how instructional processes can be adapted to reduce unnecessary strain on working memory and improve academic performance. A main component of this theory, the worked-example effect, specifies how the use of worked-examples allows for greater learning gains compared to traditional problem-solving practices for students of low prior knowledge. This project explored the use of faded worked-examples in mathematics with two Grade 9 groups from South Africa. A participatory research approach was conducted with teachers from two schools of different socioeconomic standing. Faded worked-examples were used as the medium of instruction and results on subsequent isomorphic test questions were analysed to assess the efficacy of the intervention. Surveys were also used to explore student perceptions towards the use of faded worked-examples as a learning tool. The results suggest that all students can complete faded worked-examples; however, female students were able to do so more accurately than males. Female students also outperformed males in the post-test, regardless of prior knowledge level and socioeconomic status. Students from a low socioeconomic background also found the use of faded worked-examples more beneficial than their higher socioeconomic counterparts. Consequently, the use of faded worked-examples may improve the mathematics performance for female students and those of low socioeconomic status.

Alderton, Julie; Pomeroy, David; McLeod, Jeanette; Wilson, Phillip***Engaging the public in mathematics through craft: contesting the truth about mathematics?***

In recent decades, university maths departments have acknowledged the lack of diversity in their student intakes. Commonly efforts have focused on overcoming barriers, purportedly located in the aspirations of potential students from under-represented backgrounds. However, we argue that such strategies need to sit alongside the more difficult challenge of changing the features of university maths itself. To this end, we examine a case study of Maths Craft New Zealand, an outreach programme developed by two University research mathematicians combining their hobbies of fibre and textile crafts with their desire to change negative cultural attitudes to maths. Maths Craft is built on three underlying ideas: to make the maths involved in craft activities more visible; to use craft as a tangible context to help learners of maths to better visualise and understand concepts; and to exemplify the way research mathematicians do maths through creative processes that involve experimenting, making mistakes, playing, and getting stuck. Drawing on a series of interviews with the founders of Maths Craft, we analyse the possibilities that it offers to support more diverse students to “see themselves” in mathematics, and how university mathematics can become a more welcoming environment for such students. We are also interested in Maths Craft’s tensions and paradoxes; to what extent does its credibility rest on the status quo of mathematics as a powerful and exclusive subject?

Angier, Corinne

What inspires maths teachers to want to bring the world into their classroom?

There is a long tradition of equity and social justice approaches to mathematics education. The pandemic has reaffirmed the central role of mathematical literacy for active citizenship by drawing attention to, the impact of inequality, the limitations of modelling, and the inseparability of ethics and probability theory which underlie estimates of risk. My research is based in Scotland where both education policy and teachers' professional standards require maths teachers to engage with global citizenship. The professional development to support this is provided free by the network of five development education centres across Scotland. Maths teachers however have been very under-represented in projects focussed on global themes. I have begun to explore the motivation of maths teachers who *do* consider that bringing the world into their classroom is an important part of their role and practice. Drawing on the teachers' responses during online professional learning I discuss three ways of thinking that my (very early) findings suggest might be important: a personalised view of global citizenship, an expanded view of mathematics as a discipline, and a broader view of the purpose of maths education that extends beyond the acquisition of skills and qualifications. These may be necessary, but they do not appear to be sufficient. I suggest that the very rare combination of a motivated teacher, and an enabling school setting account for the negligible contribution that maths teaches are currently making to this aspect of Scottish education policy.

Archer, Rosa; Morgan, Sian; Swanson, David

A mathematics lesson on carbon footprints.

In this session we will reflect on a mathematics lesson taught to Year 7 secondary school pupils. The lesson aimed to incorporate the idea of carbon neutrality into mathematics education by giving pupils the fictional task of making a fictional school carbon neutral. We will share findings from the research of the lesson that drew on the pupil voice. We will also invite discussion of other ways of incorporating climate issues into mathematics education. There is evidence in the literature that engaging learners in using mathematical modelling in order to solve a real-life problem aids their problem-solving skills and engagement (Archer, Morgan, Swanson 2020). However here we are also interested in how the mathematics can bring to life existential social and cultural problems. The lesson was designed by ITE students together with their tutors as part of their PGCE course. In order to reflect on this lesson, we used a lesson study approach. We jointly planned the lesson, drew on observations and evidence from the students and the teacher. Together we reflected on the lesson during a post-lesson discussion. We previously reported on student teachers' experiences of lesson study (Radovic et al. 2014) here we report the student teachers' perceptions of and lessons from their experience of a cross curricular environmental lesson.

Baldry, Fay

Mathematics in the eye of the beholder: A comparison of lesson observation protocols.

Observation of lessons is a critical part of understanding the mathematics classroom, and a range of observation schedules has been developed. However, building on the work of others is far from straightforward; many approaches require significant observer training and there are relatively few opportunities for different researchers to analyse the same data sets from alternative theoretical perspectives. This presentation draws on the Orchestration of Mathematics Framework (OMF), developed as part of a small-scale video study, and offers a comparison of a lesson analysis following

the OMF and the recently published OECD (2020) protocols. It is hoped that this can provide insights into both the lesson and the respective theoretical frameworks.

Bamber, Sally; Bokhove, Christian

How can we engage mathematics ITE students with research?

This paper reports on the design of two UK case studies that form part of a wider Erasmus+ teacher education project that aims to promote and facilitate research informed teaching. In the Research in Teacher Education (RiTE) project, student teachers are stimulated to use evidence from educational and scientific research to experiment and innovate their teaching and learning processes. Each case study is informed by Engeström's expansive learning cycle, which has been interpreted in the context of Initial Teacher Education (ITE) in the two UK projects. The first case study reports on the design and implementation of materials designed to enhance student teachers' critical review of literature in the context of the post-graduate study that is incorporated within their teacher education. The second case study presents the design of collaborative lesson research that aims to foster authentic connections between school-based learning (teaching practice) and research that informs mathematics teaching and learning. We will discuss the aims of research-informed mathematics teacher education at each site, demonstrate some of the approaches and materials that we utilised, and address tensions within the design and early implementation of these projects.

Barrow, Ellen; Golding, Jennie; Grima, Grace

Mind the gap: Mathematics teaching and learning in Power Maths primary schools in a pandemic Autumn.

We report on findings from a 2019-2021 study of a mastery-oriented primary (R-year 6) mathematics resource. The study follows 40 classes of 2019-21 Power Maths-using (initially) year 1,3 and 5 children and their teachers over two years, exploring teacher and pupil use and the impact on mathematics learning. In late Autumn 2020 we solicited 45 interviews and surveys from teachers of years 2,4, and 6, and school maths coordinators, across a fairly representative sample of schools. We explored how teachers were adapting to that stage of the pandemic. Teachers reported that new classroom guidelines restricted carpet and group work and use of manipulatives. They pervasively referenced identification of gaps in children's prior learning, and approaches schools were using to address those. While most teachers expressed concern about the continuing impact on mathematical development, they observed that children usually still responded positively to their opportunities to learn. Teachers were also, however, transparent about the reduction in confidence many pupils had experienced, though suggested that during the Autumn this was slowly developing. Following our earlier evidencing of impact of the initial home schooling period, these subsequent data show different schools and teachers responding to Autumn mathematics recovery challenges in very different ways, with a range of creativity, of solution-focus, and of alignment with the Power Maths-promoted mastery approaches.

Casha Sammut, Melanie; Jones, Ian; Foster, David

The Development of Conceptions of Mathematical Giftedness.

Perspectives, policies and practices related to gifted education have differed across the globe and changed substantially over time. This literature review surveys the development of conceptions about mathematical giftedness from the beginning of the twentieth century until now. We will outline the main debates and most pertinent challenges within this area, and structure our review according to three common conceptions of giftedness: general intelligence, mathematics-specific,

and talent development. The main methods of identifying 'gifted' students continue to be IQ, aptitude and achievement tests. However, we argue that there is a pressing need for a clear definition of 'mathematical giftedness'. This would facilitate academic debate and research, and the development of better instruments to identify students whose needs are not currently being adequately catered for within the school system, so that effective interventions might be developed.

Chancer, Libby

A fine-grained focus exploring Secondary School pupils' attempts at formulating mathematical equations.

This research aims to explore some of the tasks and pedagogies that support pupils in making a cognitive shift between operational and structural thinking. This aspect of the research focuses on the 3rd lesson in a larger classroom design based project. Pupils were given tasks that required them to formulate equations for given worded problems and relationships. Previous studies have shown that the translation of a worded problem into a mathematical structure can cause difficulties for pupils. Pupils have to abstract during the translation. This research provided tasks that were explicitly designed to explore pupils' abilities to formulate mathematical equations. Pupils were supported in moving towards viewing mathematical relationships as objects rather than instructions to calculate. This research explores pupils' engagement with these specific tasks and has a fine-grained focus looking at examples of pupil work and possible thinking.

Crisan, Cosette; Bretscher, Nicola; Clark-Wilson, Alison; Geraniou, Eirini

Learning from the pandemic: Capitalising on opportunities and overcoming challenges for mathematics teaching and learning practices with and through technology.

This new Working Group (WG) is open to all and aims to build understanding of how practitioners responded to teaching mathematics online and the evolution of their related practices. The WG will discuss the theoretical and methodological challenges faced by the mathematics education field when the prevailing boundaries of the classroom shifted; alongside the changed nature of the classroom interactions between the humans (teachers and students) and the chosen technologies. Starting with the assumption that technology resources are being used, the WG will explore the nature of these tools and their affordances, i.e. what they offer to mathematical teaching and learning. Our work will be framed by the following three pedagogic activities, which are proving to be particularly challenging: Introducing and developing understanding of new mathematical topics Managing interaction and communication in mathematics Assessing mathematics - both formatively and summatively. Three case studies of teachers' practices will be used to initiate discussions with respect to these challenges and to highlight some existing theoretical and methodological frames. The working group will meet again in Summer and Autumn 2021 to share case studies of experiences that build on the ongoing research in this theme with a view to future research presentations and possible publications.

Fujita, Taro; Kondo, Yutaka Miyawaki; Shinichi Kumakura; Hiroyuki Kunimune, Susumu

Pupils' geometrical understanding in 3D shapes: Case of plans and elevations of 3D shapes in geometry.

It is important for students to have sound understanding about 2D representations of 3D geometrical shapes because they are a means of representing various 3D solids as well as being useful in everyday situations. However, it is reported that many students have difficulties in working with such representations. The purpose of our study is a) to identify what challenges might exist

among students in their problem solving with 2D representations of 3D geometrical shapes, and b) to design and implement learning activities for supporting pupils' problem solving in 3D geometry. Our main focused topics are 'oblique parallel projections' and 'plan and elevations', which are commonly used in geometry curriculum in schools. In this presentation, we mainly report our preliminary findings from a survey from Japanese G4 to G9 pupils (age 10-15), conducted in February 2021. The survey questions mainly focus on questions related to plans and elevations in 3D shapes, which represent 3D shapes from front, side and top views. While plans and elevations are highly important not only in geometry but also architecture, computer graphics, etc., few research studies have been conducted so far into students' understanding of plans and elevations from the perspective of mathematics education. Our findings will be useful to enrich our knowledge of pupils' geometrical thinking with 3D shapes.

Ghosh, Suman

Decolonising school Mathematics: where to start?

The CME Working Group 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. Decolonisation of school mathematics is not be a simple matter of addressing the level of content but a challenge which needs to be explored through the philosophy of mathematics education. Whilst historically, mainstream mathematics education does not have a tradition of critically examining issues of unequal political and cultural power (Apple, 2000), mathematics is essentially a creative human endeavour which is changing and fallible. It is bound within the cultural contexts and values of its makers (Ernest, 1991). This is an opportunity for researchers and educators to engage in discussion about starting points related to decolonising school mathematics. Apple, M. (2000). Mathematics reform through conservative modernization? Standards, markets and inequality in education. In J. Boaler (Ed.) Multiple perspectives on mathematics teaching and learning, (pp. 243-259) Westport, CT: Ablex. Ernest, P. (1991a). The Philosophy of Mathematics Education, London: Falmer Press.

Hatisaru, Vesife

A new view about flexibility in equation solving: The mathematical connections established in solving equations.

Recently, making connections across with mathematical, and other, learning areas has been a focus of school curricula across the world, although the desire for connections in mathematics goes back to the 1980s. This desire has lasted throughout the years because students develop key competencies as a result of experiencing connections in mathematics. Algebra learning plays an important role for students in college level studies. Students need to know both symbolic manipulation and algebraic reasoning to be successful in any quantitative field (McCallum et al., 2010). Algebra involves various activities including representational, transformational, and generalizing activities. Transformational activities are chiefly about collecting like terms, factoring, expanding, substituting, simplifying expressions, and solving equations (Kilpatrick et al., 2001). Fluency [or flexibility] in these activities is important. Several researchers have proposed conceptualizations on flexibility in equation solving. One of the most relevant conceptualization is the one proposed by Star and Seifert (2006). This paper makes a reflection about flexibility in equation solving that contributes to the extension of the definition of Star and Seifert. Examples are

used as a context for the reflection. The need for another aspect in the definition, the aspect of making connections, is discussed to deepen the investigations of the flexibility in students.

Helme, Rachel

Learning to listen in new way: Using a Social Identity map to examine the impact my positionality when working with the narrative of a student from a mathematics resit classroom.

Researcher positionality within field work is said to be a mode of seeing which both informs and constrains what one notices and concludes, and certainly within critical research, it is important to locate oneself within the research process (Day, 2012; Foote & Gau Bartell, 2011; Jacobson & Mustafa, 2019). However, explicitly examining one's own positionality, or more specifically the social identities that contribute to positionality, is an uneasy and messy process, but the opportunity can be afforded to recognise the impact of one's subjectivities and learn to listen to participants in new ways. This session reflects on the impact of introducing a Social Identity (SI) map (Jacobson & Mustafa, 2019) to examine my own researcher positionality within a study that examines identity work in the context of low prior attainment. The interview narrative of one student was analysed using an enhancement of the Listening Guide (Gilligan et al., 2006) and this voice-relational method states that as part of the process the researcher should be explicit about their own subjectivities. The SI map was used to be reflexive about both 'where I have been' in terms of facets of positionality that I brought to the study, and 'where I am' to understand the impact within the specific study. It became evident that my assumptions around anticipated findings, as well as issues of control, were influencing my ways of listening within the interview and analysis cycle.

Ineson, Gwen; Gifford, Sue; Marks, Rachel

Early Years and Primary Mathematics (EYPM) Working Group 10th meeting.

This will be the tenth meeting of the Early Years and Primary Mathematics (EYPM) Working Group. It will be an informal meeting where we will be: Sharing updates since our last meeting in November 2020, particularly in light of the challenges presented by the ongoing Covid-19 pandemic; Discussing what is meant by 'catch-up', and how research could be used to inform this debate. Feedback from our last working group meeting was that participants valued the opportunity for informal discussion about EYPM research-related matters, so our intention is to include small and full group discussion about these topics. We look forward to welcoming both previous and new attendees to our meeting.

Ingram, Jenni; Smith, Kyla

Connections made when teaching quadratic equations.

Mathematics is a coherent and connected discipline but for many learners it can be a set of disparate concepts, procedures, and representations. One role of teaching is to support students in making these connections, whether these connections are between representations, between topics, or between contexts. In this session we will explore the connections teachers made when teaching quadratic equations using data from eight countries that participated in TALIS Video Study.

Izard, Blair; Staples, Megan

Study Abroad as a Catalyst for Change in Mathematics Teachers' Intercultural Sensitivity.

Teacher preparation has entered a new era of intense focus on issues of equity and access. A pressing issue is ensuring that future teachers have the requisite cultural competence (Moss,

Simmons, Izard & Marx, 2021) to effectively support the diverse group of students in their classrooms. Research has shown that participation in an education abroad program can develop students' cultural awareness and capacity to work across cultures. In this presentation, we report on a study of a semester-long education abroad experience in England designed specifically for preservice mathematics teachers. We used the Developmental Model of Intercultural Sensitivity (DMIS) (Bennett, 1986) to provide a framework and measure of students' intercultural competence. The DMIS establishes a continuum of ways to respond to cultural difference ranging from monocultural to intercultural. We share details of the mathematics-focused education abroad program, the DMIS framework, and DMIS pre-post results for cohorts participating in the program. We also examine key features of the experience and consider possibilities for incorporating similarly impactful experiences into the work we do 'at home' throughout our teacher preparation programs.

Jackson, Colin

Teachers introducing, developing and maintaining all-attainment mathematics while convincing others.

'Ability grouping', which is almost universal in English secondary schools nowadays, limits access to mathematics for many children. Thus it is a social justice issue. In this paper, I draw on my doctoral thesis, a small scale qualitative study, into all attainment teaching in secondary mathematics departments. Here I focus in particular on my findings in relation to the question How do mathematics teachers introduce, develop and maintain all attainment teaching in the current educational environment?

Jones, Ian; Kinnear, George; Sangwin, Chris

A research agenda for computer-aided assessment of university mathematics.

Over the past year we have worked with colleagues from around the world to develop a shared research agenda for computer-aided assessment of university mathematics. To do this we followed a methodology (adapted from Alcock et al., 2016) in which mathematics education researchers, assessment developers and university teachers convened in a series of meetings, including as a BSRLM working group in November 2020. In the meetings, colleagues worked together to identify and iteratively refine those research questions that need to be addressed in order to advance the field of computer-aided assessment of university mathematics. The outcome was a list of 55 research questions across a range of themes. In this talk we will summarise the methodology used and present an overview of the 55 questions, with a detailed focus on a subset of the questions related to specific themes

Alcock, L. et al. (2016). Challenges in mathematical cognition: A collaboratively-derived research agenda. *Journal of Numerical Cognition*, 2(1), 20. <https://doi.org/10.5964/jnc.v2i1.10>

Kwamina Awortwe, Peter; Wake, Geoff

Using dynamic geometry software to provide deeper insights into geometric constructions and deeper understanding with beginning teachers.

This presentation reports new ways of constructing geometric figures used with beginning teachers working with dynamic geometry software. The aim of the research is to understand how we might improve teacher education in this area. The research question considers how explorative tasks support beginning teachers and researchers can develop insight into new ways of constructing geometric figures. Methodologically, design-based research was adopted for the study. The

traditional method of teaching geometry, based on deductive approaches rather than the inductive approaches used in the research, results in beginning teachers becoming used to procedural approaches for constructing geometric figures with little understanding. In this presentation, we present a modern way of using dynamic software to teach geometric constructions, that centrally involves inductive approaches and pedagogies, that aims to support a deeper understanding of geometry. We will present data that provides evidence that the approaches used are potentially successful in realising our aims.

Mackrell, Kate; Johnston-Wilder, Sue

A case study addressing mathematics anxiety in an adult learner, drawing on mathematical resilience and self-determination theory.

This presentation brings together Self-Determination Theory (SDT) (Ryan and Deci, 2017) and mathematical resilience (MR) (Lee & Johnston-Wilder, 2017). The focus of SDT, on meeting basic psychological needs to enhance wellbeing and prevent harm, provides a grounding for much of what is considered good practice in mathematics education and specifically for the work in MR. We illustrate this with a case study. The tools of MR go beyond what is currently proposed in SDT research; we also illustrate the ways in which these tools can specifically facilitate learner emotion regulation, leading to greater wellbeing, learning, and a release from mathematics anxiety.

Makramalla, Mariam

Uncovering classroom power dynamics through student drawings.

Underpinned by the "Draw a science teacher" framework, in this session I share the findings of a study conducted post-revolution at an Egyptian school. Students were asked to engage in a self expression drawing activity in response to the question: "Draw your mathematics teacher". Findings reveal sub-conscious stereotypical gender associations that students had to mathematics as a subject matter and the mathematics teacher as a practitioner.

Nardi, Elena; Biza, Irene Moustapha-Corra; Bruna Papadaki; Evi Thoma, Athina

From student scribbles to institutional script: towards a research and reform commognitive research programme for mathematics education.

Commognitive studies have tended to offer a nuanced lens on datasets that evidence micro-level accounts of mathematical experience, and are now starting to explore the theory's capacity to support the design, tracing and dissecting of discursive shifts in the medium/long term. We present two examples of the latter. Both focused on the design, implementation and evaluation of interventions embedded in established courses (an in-service mathematics teacher education and professional development post-graduate course in Brazil; and, a Biology undergraduate course in Norway). The Brazil-based study explored the conjecture that engaging teachers with activities which feature mathematical practices from the past (history-focused tasks) and in today's mathematics classrooms (activities of the MathTASK programme at UEA) can trigger changes in teachers' narratives about how mathematical objects come to be and how their emergence can be negotiated in the mathematics classroom. The Norway-based study explored the conjecture that engaging Biology students with Biology-themed Mathematical Modelling activities can challenge deficit narratives about the role of mathematics in their discipline and about their mathematical competence and confidence. We present how the commognitive conflicts orchestrated by these medium/long-term interventions generate new narratives about mathematics and its pedagogy, de-ritualised participation in mathematical routines and, ultimately, meta-level learning.

North, Marc; Dalby, Diane; Joubert, Marie; Wake, Geoff

Measuring Mathematics Self-Efficacy and Perceptions of Pedagogic Practice in Mathematics for Further Education College GCSE-Resit Mathematics Teachers and Students

This presentation will explore teachers' practices and students' self-efficacy and attitudes towards mathematics in GCSE-resit mathematics classrooms in Further Education College settings. Data will be drawn from pre- and post-intervention surveys conducted with teachers and students as part of the research programme in the Centres for Excellence in Mathematics (CfEM) initiative. The student surveys were used to measure students' self-reported beliefs and confidence about being able to solve a series of 22 pure and applied mathematics problems, their attitudes towards mathematics (including measures of disposition and identity), and their perceptions of their teacher's pedagogic practices. The teacher surveys were used to measure the teachers' self-reported views, attitudes and beliefs about mathematics and their teaching practices when working with GCSE-resit groups. In the presentation we will discuss our methodology and the survey design process and present some initial findings from the survey data. Findings indicate that students' attitudes towards mathematics were more positive and confident than perhaps expected, with a prevalence of more transmissionist over connectionist teaching practices being used in GCSE-resit settings. Implications of these findings for future CfEM activities and GCSE-resit classrooms will be discussed.

O'Brien, Kate; Kathotia, Vinay; Solomon, Yvette

Developing a style: Teachers' appropriation of RME training as a resource for change.

Establishing the impact of Continuing Professional Development (CPD) on teacher practice is difficult because accounting for change in the dynamic space of classrooms is not straightforward. Research can cast teachers as hemmed in by a system that inhibits change, or portray them as unable or unwilling to transform themselves. In this paper, we take a different view in exploring of the impact of a CPD programme that sought to develop Realistic Mathematics Education (RME) pedagogy. A key aim of RME classroom practices is to support students in building on their own informal understandings of meaningful contexts, allowing mathematical concepts to emerge through the progressive mathematisation of these scenarios. Applying this RME approach to our CPD activities, we focus on what teachers sense, know, and value in their emergent practice (Adiredja, 2019). Through two case studies, we explore what teachers appropriate from RME training and how it acts as a resource for both deliberate and more unexpected changes. Identifying the tensions between an emphasis on free-agency and the goal-oriented nature of classroom teaching, we reinvent the concept of 'a style' (Sauvagnargues, 2016) as a lens that can eliminate the 'blame game' from our analysis of how classrooms change. We discuss some implications of 'a style' as a tool for thinking about mathematics classrooms and CPD as spaces of possibility and surprise, even when guided by a specific mathematical or pedagogical horizon.

Peters, Adam

Towards a framework for anticipating Instructional Coherence.

East-Asian countries continue to outperform Western countries participating in the TIMSS study for mathematics outcomes (IAEEA, 2020). Despite the increasing trend of pupils attaining higher levels of achievement, the UK remains behind their East-Asian counterparts in the pursuit of improving mathematics education outcomes. The teaching of mathematics in England has been heavily scrutinised, with the government drawing on practice from Singapore and Shanghai. Amongst these practices, lies the idea of 'Coherence'. Despite an agreement that coherence is important for

curricular alignment (Schmidt et al, 2002), its multi-faceted nature requires the term itself to be further delineated. In addition to this, the NCETM (2020) define coherence as lessons consisting of 'small, connected steps' which 'gradually unfold a concept'. As a result, teachers in England may interpret coherence as an end point that can be achieved through lesson planning and delivery, however this falls at odds with trends within the literature (Honig and Hatch, 2004). Based on a review of the literature, this presentation will consider the distinctions in terminology surrounding the term coherence as well as consider a framework for which coherence can be observed throughout the instructional process. Ideas for how a teacher's beliefs of their own coherence play out within their actual practice will also be considered with the aim to provide a framework for anticipating coherence within the classroom.

Young, David; Reilly, John; Pope, Sue

Higher Applications of Mathematics; how to teach statistics effectively.

In Scotland, numeracy is a key area of the Curriculum for Excellence so learners develop essential analytic, problem-solving and decision-making skills. The SQA Higher Applications of Mathematics was developed for young people to learn these skills, with statistics as one third of the curriculum. The emphasis is on the application of statistics to real-life data, and interpretation of results. Working with big data requires skills in appropriate use of accessible, validated statistical software. Minitab or R Studio are used for the analysis of real data with learning skills focussed on the application of statistical methodology and clear interpretation of results in context. Ensuring learners are confident in statistical literacy requires teachers' sound knowledge and understanding of how data can be managed and processed in a meaningful way, as real-world data rarely conform to textbook assumptions for analysis. In collaboration with the Scottish Funding Council, the University of Strathclyde has developed an SCQF level 7 award in statistics for those teaching the new Higher. It covers the Higher curriculum and the use of both software packages, so teachers have the statistical skills to teach this new and innovative qualification in Scotland.

Syyeda, Farhat

What matters in a Mathematics classroom? Examining adult learners' experiences of re-engaging with Mathematics to understand re-formation of Mathematical Identities.

Learners' experiences of engaging in a mathematical context contribute towards the construction of strong and robust or fragile and bruised Mathematical Identities (MI). In this doctoral research, I examined the learning journeys of twenty-one participants as they returned to formal education and re-engaged with Mathematics in an adult education college in the Midlands region of England. Employing an identity framework, this study aimed to understand the affective and cognitive aspects of learners' relationship with Mathematics and explored the different factors which influenced their MIs at different stages of their lives. This study was undertaken from an interpretive and social constructivist perspective and adopted an ethnographic-narrative methodology. To observe the research setting from within and to gather data, I performed the dual role of a learning support assistant and participant observer with five different cohorts of learners. The primary source of data for this research was life story interviews, which were analysed inductively using a holistic and categorical content and form approach. The findings of my research highlighted different personal, familial, and institutional factors which influenced learners' relationship with Mathematics. However, this paper will focus on the institutional factors only and discuss the impact of pedagogical

approaches, classroom environment and the role of teachers in enabling or impeding the development of positive MIs.

Tiflis, Ozdemir; Saralar-Aras, Ipek

STEM Education Programme for Teachers.

The potential of STEM education for student understanding and motivation in teaching mathematics is stressed by many researchers (Abramovich, Grinshpan, & Milligan, 2019; Pantziara, & Philippou, 2015). Studies argue that maths teachers' beliefs and understanding of this potential have an effect on their teaching methods and thus their beliefs influence whether and how they use STEM scenarios in mathematics lessons. Recently, researches also showed that teachers need to learn more about the ways to integrate STEM scenarios into their lessons (Papadakis, & Stavrakis, 2020; Stuiyks & Burbaita, 2018). Therefore, the aim of this study is to investigate the effectiveness of a STEM webinar programme series, which aimed at improving teachers' understanding of STEM education and scenarios. This series included specific webinar sessions on STEM education in general, STEM scenarios with 5E, problem-based scenarios and project-based scenarios. Data is collected through surveys prior to and after the webinar and webinar recordings which include teachers' questions on STEM, which is used as a way to investigate their understanding of STEM. In this paper, we present our literature review findings which created the basis of our study for revealing the differences between 5E, problem-based and project-based scenarios.

Wallis, Rachel

Evaluating the learning of number concepts through measures: A design-based research project.

Tasks involving measure concepts such as length, capacity and volume provide rich opportunity for learning number, and some curricula have been developed with measure as the foundational context for all early number learning (e.g., the curriculum devised by Davydov and Elkonin in Russia and the Measure Up project in Hawaii). In this presentation, I will outline the first enactment phase of a design-based research thesis which aims to explore the learning of the multiplicative relationship through measures with learners in Wales, where learners have not learnt number explicitly through measuring contexts previously. In particular, I will consider the methods used to evaluate the extent to which measuring tasks, and the way in which they were implemented, afforded opportunity for learning the multiplicative relationship with a group of Year 2 learners. The evaluation of tasks and the analysis of learning lead to methodological and pedagogical design implications for future phases of the research.

Yılmaz, Ebru Büşra; Ev Çimen, Emre

Pre-service Mathematics Teachers' Experiences of Lesson Plan Preparation and Application in Online Education.

This research aims to examine the pre-service elementary mathematics teachers' experiences and opinions on preparing and implementing a lesson plan suitable for the 5E model in online education environment. The research is expected to set an example for teacher training about preparing and implementing lesson plans in mathematics teaching in online education environment. In the research, the case study design, a qualitative research model, was used. The research group consisted of eight pre-service teachers (1 male and 7 female) from the elementary school mathematics education department at a public university in Turkey. The research data were obtained from the task forms, the peer assessment forms, the self-assessment forms, the lesson plans prepared by the pre-service teachers and video recordings of the implementation of the lesson

plans. Analysis of the data was done by the content analysis method. As a result, it was found that in line with the revised suggestions offered by the researcher about the lesson plans, most of the pre-service teachers brought the lesson plans to a sufficient level after revision, but they could not show the same competence while implementing the lesson plans in the online education environment. Consequently, it is recommended that in addition to the computer courses, pre-service mathematics teachers should also take online education courses and that the undergraduate mathematics curriculum be revised accordingly.

Zerafa, Esmeralda

Intervention for Mathematics Learning Difficulties: A Pedagogical Model.

Mathematics Learning Difficulties (MLD) may have a severe impact on a child's learning trajectory, however intervention strategies for supporting children with MLD are still limitedly researched when compared to those for literacy difficulties. This paper session will present findings from six intervention case studies with primary-aged children experiencing MLD. Based on Vygotsky's theories, the qualitative research methods adopted, shed light on key factors necessary for the provision of effective intervention for MLD. During the session, a pedagogical model developed through the thematic analysis of the data collected from the intervention sessions, will be presented. The model illustrates the impact of the learner's profile on the progress registered for each learner. Moreover, it demonstrates how a symbiotic relationship between More Knowledgeable Other (MKO)-driven, Tools-assisted, and Learner-driven strategies is necessary for the successful implementation of an intervention programme. The pedagogical model presents how each type of strategy is linked through social interaction and dialogue, the engagement in multisensory experiences and the MKO's use of cultural tools to facilitate learning within the Zone of Proximal Development (ZPD). Finally, an exemplification of how the model could be applied to one of the intervention sessions will be shared and discussed.