



British Society for  
Research into  
Learning Mathematics

**BSRLM AUTUMN DAY CONFERENCE 2022**

**SESSION HANDBOOK**

**Saturday 5<sup>th</sup> November 2022**

## Research papers, workshops and working groups

[Where there are multiple authors, \* Is used to identify presenters]

**\*Adams, Gill; Boylan, Mark**

[PRESENTATION]



### ***Mathematics education policy: a horizon scan***

The Royal Society's Mathematical Futures Programme, launched in 2020, aims to support the Society's work in education policy. In this presentation, we share findings from research commissioned as part of this programme, a horizon scan of policy and change in international jurisdictions that contributed to landscaping mathematics education policy. We draw on evidence from 'high-performing' jurisdictions and those with similar PISA outcomes to UK nations, supplemented by interviews and workshops with international experts. We report practices and policy initiatives organised around five themes: curriculum and pedagogy, qualifications and assessment, resources and technology, teacher preparation and professional development, and evidence-informed policy development. These include case studies of selected innovations. Factors that either promote or inhibit policy development are identified. Features of effective policy development include clarity of purpose, consensus, feasibility, coherence, systemic alignment, piloting, sustained attention, and collaboration. Analysis demonstrates considerable divergence in England from international innovations in policy development. We argue that innovation in England is more likely to be successful if a parallel approach is adopted, with innovations being developed in parallel with policy developments. Further in-depth reviews are needed, informing developments, guiding investment and supporting consensus building across stakeholders.

**\*Barmby, Patrick; Jones, Ian; Foster, Colin; Kelly, Joel; Milinkovic, Jasmina**

[PRESENTATION]



### ***Comparative judgement of problem-solving skills of primary pupils***

A study was carried out to examine the validity of assessing the problem skills of primary school pupils using comparative judgement. To this end, an assessment was carried out with primary schools in England in April/May 2022. 9,133 Year 5 pupils from 203 schools participated and 2,220 teachers judged on the task. Following the assessment, the participating schools were requested to ask their judging teachers to complete an online questionnaire regarding their views of the assessment process. 277 responses were obtained (a 12% response rate from judges). In addition, during visits to two of the schools involved, pairs of judges were asked to make a series of judgements on the pupil scripts whilst discussing reasons for their choices. Screen recording software was used to record the discussions between teachers, used to exemplify the kinds of considerations made by judges during the assessment. In this presentation, the results obtained from the comparative judgement assessment and the results of the teacher questionnaire are summarised. Based on these results, we consider the validity of the comparative judgement approach for assessing problem solving skills for primary pupils.

\*Casha Summut, Melanie; Foster Colin; Jones Ian

[PRESENTATION]



### *Teachers' Perspectives on Mathematically Gifted and Talented Primary Students*

In this session, I will present my reflexive thematic analysis of six semi-structured interviews with Year 5 and Year 6 (ages 9-11) teachers in Malta. The interviews focused on teachers' understanding of gifted and talented children in mathematics and issues of identification and intervention practices currently in place within state and non-state (independent and church) primary schools in Malta. The data collected provides an insight into the ongoing practices in primary schools such as enrichment opportunities within and outside the classroom, and mathematics tournaments. Results from this analysis reveal factors hindering identification of mathematically gifted and talented students, and provision of support in the mainstream primary class. Addressing diverse abilities at the same time, the lack of professional support in class apart from that of the class teacher, the lack of professional development on gifted and talented education and the lack of awareness on resources and programmes were outlined as the main challenges.

Cave, Peter

[PRESENTATION]



### *Exploring Variation in First and Second Grade Japanese Elementary Mathematics Classrooms*

This presentation explores the use of variation in the content and practice of first and second grade mathematics lessons observed over several months in two small cities in Japan. The analysis focuses on three categories of variation: concept variation, varying the problem, and discussion of multiple solutions. The first two of these were frequently identified in all classrooms observed, while the third was used by some teachers more than others. The presentation will suggest that based on this analysis, variation pedagogy is a potentially valuable framework within which to investigate the content and practices of Japanese mathematics education, since it makes good theoretical sense of well-studied practices such as the use of discussion in structured problem solving lessons, yet can go further by also making sense of other important features of mathematics education such as textbook task design. The study suggests the importance of attention to systems for designing and producing teaching materials, and provides further evidence of the potential of variation pedagogy as a theoretical framework for understanding mathematics education.

\*Chan, Kai Yin; Chen, Ouhao; Jay, Tim

[PRESENTATION]



### *The effect of working memory resource depletion on the spacing effect*

The spacing effect occurs when learning with rest periods, named as spaced learning, is superior to learning without rest periods, named as massed learning. Cognitive load theory has explained the superiority of spacing effect by working memory (WM) resource depletion, under which resources are depleted when handling some cognitive activities for some time but restored after resting. Two experiments were conducted to provide evidence on how the working memory resource depletion hypothesis can explain the spacing effect. Experiment 1, using more complex learning materials, obtained both the spacing and WM depletion effects for learners with less knowledge, for whom the learning materials was high in element interactivity. For Experiment 2, more knowledgeable learners

were tested using the same learning materials. Both the spacing and working memory resource depletion effects disappeared, for whom the same learning materials were lower in element interactivity. The results argued that WM resource depletion and replenishment might be more sensitive to materials high in element interactivity and suggested that it was only one of the multiple causes of the spacing effect.

**Chen, Ouhao**

[PRESENTATION]



***The Interleaving Effect Is a Variation of the Variability Effect***

The interleaving effect indicates that students learn better from multiple areas that are interleaved rather than blocked. Two experiments tested the hypothesis that the effect is due to interleaving facilitating comparisons between areas and is a variation of the variability effect that increases intrinsic cognitive load (i.e., depletes more working memory resources). Experiment 1 used an interleaved design with two obviously different topics and found no interleaving effect. Experiment 2 used a similar design but used topics that were more difficult to discriminate between, resulting in a clear advantage for the interleaved group associated with an increase in cognitive load (i.e., depletes more working memory resources). These results support the hypothesis that the interleaving and variability effects are closely related and possibly identical.

**Coles, Alf**

[PRESENTATION]



***Towards a socio-ecological psychology of mathematics education***

In this session, I aim to provoke debate about what socio-ecological psychology might offer for classrooms and research. In brief, a socio-ecological psychology is one that does not take the environment as a fixed background for more cognitive or developmental concerns. I consider what the perspective might imply for mathematics students, for mathematics teachers and for mathematics teacher educators - and how it might be of particular significance to education on a warming planet.

**\*Drury, Helen; Crosbie, Claire**

[PRESENTATION]



***High attainment and high quality maths education - can primary schools do it all?***

Where pupils in schools – particularly schools in disadvantaged areas – achieve high levels of success in Standard Assessment Tests (SATs) in the final year of primary school, what are the characteristics of the maths education those pupils have experienced? In this session, we will review research evidence relating to raising attainment in primary mathematics. We will propose a methodology for gaining greater insight into the school and classroom practices that lead to high attainment in primary mathematics, particularly for pupils in areas of disadvantage.

Foulkes, Megan

[PRESENTATION]



***Concrete features do matter when teaching mathematical concepts: A study of manipulative use in the Early Years.***

Manipulatives can be defined as objects that children and practitioners can interact with to represent mathematical ideas and are commonplace in classroom environments. Despite their popularity, there is conflicting evidence regarding the features associated with different manipulatives and whether they help or hinder children when learning mathematical concepts. Researchers often argue that concrete manipulatives with extraneous features (e.g., bright colours, prior knowledge) should be avoided as they distract children. However, more concrete, interesting manipulatives have the potential to be useful in more naturalistic contexts. This study aimed to find out what manipulatives Early Years and Year 1 teachers use in their settings, how and why, via semi-structured interviews and a subsequent online survey. Teachers indicated that concrete, interesting manipulatives do play an important role in early mathematics teaching in UK classrooms. The extraneous features associated with more concrete manipulatives were said to help engage children's attention and facilitate the creation of additional learning opportunities. The potential for distraction was also acknowledged, with teachers managing this through various instructional strategies and tactical introduction of manipulatives at different stages in children's learning. These findings will be discussed and used to highlight how incorporating teacher views can provide valuable considerations for future research.

\*Fujita, Taro; Yutaka, Kondo; Hiroyuki, Kumakura; Shinichi, Miawaki;  
Susumu, Kunimune and Kojiro, Shojima

[PRESENTATION]



***Identifying Japanese students' core spatial reasoning skills in solving 3D geometry problems***

Taking the importance of spatial reasoning skills, this paper aims to identify 'core' spatial reasoning skills which are likely to contribute to successful problem solving in 3D geometry. 'Core' spatial skills are those which might be particularly related to students' successful problem solving in 3D geometry. In this paper, we take spatial reasoning skills are malleable and can be improved with teaching/interventions with mental rotation, spatial orientation, spatial visualisation, and property-based reasoning. To achieve the study aim, we conducted a survey for in total of 2303 Japanese Grade 4-9 students (10-15 years old). We take the following stages of the procedures in this paper: 1) Descriptive statistics; 2) 2PLM analysis; 3) Experiments with the Pearson correlation coefficient. As a result, we identified that a set of a few tasks can be used to check if students have 'core' spatial skills in 3D geometry. For both primary and secondary, rotating given representations mentally, and imagining and drawing 3D shapes are important, and for secondary schools, property-based reasoning is also crucial for further problem solving skills. Our findings and methodological approach have implications for mathematics education research and practice as our results provide clear, and promising principles for task/units/curriculum design for spatial reasoning in which more robust teaching intervention is necessary.

\*Golding, Jennie; Redmond, Benjamin; Grima, Grace

[PRESENTATION]



*Primary children's perspectives on the roles of reflection, challenge and explanation in resource-rich classrooms.*

We report on primary children's views on their mathematics learning, in Spring 2022. Data are from a 2019-22 study of teaching and learning using DfE match-funded 'mastery' resources, Power Maths. We collected termly data from twenty broadly representative primary schools. In Spring visits (except in 2021), for each of two study classes we observed whole lessons, interviewed class teachers, and held a focus group with a range of children. Nine schools extended participation to 2021-22, when visits, with year 6 and year 2/4 study classes, gave access to teachers' and children's views on their 'new normal'. We focus on children's responses to two Power Maths pedagogical devices, 'Reflect' (designed to support lesson-synoptic conceptual grasp) and 'Challenge' (an end-of-lesson task drawing on deeper target learning); also their thoughts about mathematical explanations, which are frequently demanded in Power Maths. In at least seven of the nine schools, children usually responded positively, articulating the learning potential of wrestling with such tasks. In two schools where teachers had invested heavily in knowing the linked teacher-educative support materials, the children's quality of mathematical explanation, and of written response, was outstanding. While our data also show pandemic-related learning loss persists, we suggest that use of well-structured curriculum resources can still support high quality thinking that augurs well for children's mathematical development.

\*Grimes, Paul; Dooley, Therese

[PRESENTATION]



*Professional pedagogical vision of classroom interactions in mathematics: Making sense of pupil and teacher moves in a script writing exercise*

We present a novel approach for investigating pre-service primary teachers' (PSPTs') professional pedagogical vision of pupil-teacher interactions in mathematics lessons. Professional pedagogical vision describes how teachers identify and interpret important classroom events and activities, and how they develop, use, and reinterpret educational artefacts as material representations. We examined the scripts written by four PSPTs who had engaged in an exercise in Lesson Play. As part of the Lesson Play, PSPTs were required to write a script of an imagined classroom interaction between them (in the role of teacher) and a group of pupils. Using Brodie's notion of teacher "follow up" moves, we examined the utterances of teachers and pupils that were presented in the scripts. This allowed us to characterise how these PSPTs envisaged classroom mathematical interactions. Initial analysis indicates that PSPTs tended to position a pupil as the chief facilitator of sense making interactions. Based on this analysis we make claims about the PSPTs' professional pedagogical vision. We discuss the affordances and challenges of this approach. We also discuss the implications for teacher education.

Hopkinson, Sarah

[PRESENTATION]



***Verbal teacher praise and feedback: influencing students' self - concept and self - efficacy beliefs in mathematics classrooms.***

Low self-beliefs hinder students' learning (Bong & Skaalvik, 2003) and consequently their life chances (Teach First, 2018). This study focuses on the self-beliefs of self-concept and self-efficacy within the mathematics classroom, as both constructs act either to encourage or limit learning (Bong & Skaalvik, 2003). The study explores the influence of increased verbal praise and feedback (VPF) on students' mathematics self-beliefs and whether this influenced their classroom learning. VPF is praise coupled with feedback implemented in a sincere, concise, and task-centred way to help students understand their successes and how to improve in future. An intervention took place across two lower attaining Year10 classes, where teachers increased their use of VPF. Questionnaires data were numerically analysed through descriptive statistics, while interview data were thematically coded. The study found that increased VPF positively influenced students' self-beliefs, with self-efficacy displaying the greatest shift and thus indicating greater malleability than self-concept. The classroom learning particularly influenced were response to failure and perseverance, both demonstrating the greatest positive shifts. Thus, increased VPF helped raise students' self-beliefs which positively influenced their mathematics learning. Consequently, teachers could consider implementing VPF within their everyday practice to help support students' self-beliefs and mathematics learning.

Ineson, Gwen; Adams, Gill; Chen, Ouhaio

[WORKSHOP]



***BERA Mathematics Education Special Interest Group***

There has been a special interest group (SIG) in the British Educational Research Association (BERA) representing mathematics education researchers for a number of years. The SIG remit is to develop, extend and enhance scholarly discussion and research capacity in mathematics education and to improve networking. Closely linked to BSRLM, the SIG runs a successful annual Practitioner Research in Mathematics Education (PRiME) event. This participatory workshop explores possibilities for future Mathematics Education contributions to BERA, providing opportunities for BSRLM members to help set out a programme for the next two years.

**\*Jones, Ian; Francome, Tom; Chen, Ouhaio; Foster, Colin; Lortie-Forgues, Hugues; Shore, Chris; Strauss, Jacob; Woollacott, Beth**

[PRESENTATION]



***The questions teachers ask – and the questions researchers answer***

We explored the extent to which the questions that mathematics teachers want to know match those that education researchers actually investigate. To do this we used a survey to ask teachers what research questions they would most like answered, and we also collected all research questions published in the nine leading mathematics education research journals over a three-year period. In order to compare the two sets of research questions (301 from teachers, 1202 from journals), we coded them using adapted keywords and topics from Marks et al.'s (2021) recent analysis of the Proceedings of the British Society for Research into Learning Mathematics. We found similarities and differences across the two sets of research questions. For example, a greater proportion of the questions in journals focused explicitly on mathematical topics, whereas a greater proportion of teachers' research questions focused on policy, assessment and curriculum, and roughly similar proportions across the two sets focused on technology. Our analysis is in progress, and in the presentation we will share the comparative data and invite interpretation and conjecture from colleagues.

**\*Jones, Martin; Compton, Sally; McMorrow, Matilda**

[PRESENTATION]



***To what extent is student understanding of IGCSE and A-Level abstract mathematical concepts strengthened by a collaborative, interdepartmental approach to supporting students with English as an additional language?***

This research project is to investigate how we might improve the learning of higher order mathematical concepts for our students for whom English is not their main language. While the departments of Maths and English as an Additional Language (EAL) liaise informally, it is apparent, anecdotally, that while students are successfully learning English for conversational and academic purposes, language barriers continue to hinder their mathematical understanding of concepts at the deeper levels. Using Cummins distinction between basic interpersonal communicative skills (BICS) and cognitive academic language proficiency (CALP) and the work of Setati et al using the metaphor of a journey to describe how learners move from informal, exploratory talk in learners' main languages to discourse-specific talk and writing in English, we plan to introduce activities, located in the school library as a 'third space', to facilitate this journey. We are viewing the creation of a 'third space' in line with Jobe and Coles-Ritchie's description as an emancipatory place where students who are typically non-dominant in the classroom culture can gain individual power and access new learning. This presentation is to outline the research proposal and the current plans for the activities and the research process.



**\*Kimber, Elizabeth; Smith, Cathy**

[PRESENTATION]

***Extending discourse on gradient: Given and New***

***Elizabeth Kimber is the winner of the BSRLM 'Researcher Award' and has been invited to present this paper at our Autumn Conference.***

Classroom discourse on gradients develops from gradients of straight lines to gradients of curves and the gradient function. We can then ask: what are particular features of teachers' language when talking about gradient in public discussions, and what might their role be in developing the discourse on gradient? Systemic Functional Linguistics (SFL) offers tools to analyse linguistic choices, such as the Thematic and Information structures of teachers' speech. I will talk about SFL analysis of classroom data from a lesson in which the teacher used the context of speed to introduce the idea of changing gradients of curves. Our analysis revealed certain linguistic features in the teacher's speech and distinctive use of speed in the Information structure. I will also share some preliminary findings from analysis of students' exit ticket tasks from the lesson.

**Koyuncu, Mehmet Kasim**

[PRESENTATION]

***'Whys' and 'Hows' of using the newspaper preparation method to teaching the philosophy of mathematics.***

This study aims to suggest a new method to enrich the standard of the Philosophy of Mathematics course. The newspaper preparation method was applied in the same author's study about the History of Mathematics course, and successful results were obtained. It is clear how much the history and philosophy of mathematics courses have in common. In this respect, the idea of trying to teach the philosophy of mathematics course with the same method. Since this research is a work-in-progress study, its sample consists of (approximately) forty undergraduate students studying mathematics. It is planned that the research will be conducted with a qualitative paradigm. Since the research is in the data collection stage, the conclusion, discussion, and suggestions will be written after the study is completed.

Çelik Demirci Sedef; Baran Kaya, Tuğba; \*Kul, Ümit

[PRESENTATION]



*Pre-Service Mathematics Teachers' Pedagogical Content Knowledge About Using Algebra Tiles*

It is of great importance that pre-service teachers should become competent in using manipulative objects, which play an important role in their teaching of algebra. Teachers with previous experience with manipulatives were the ones using them more in the teaching. This study is aimed to reveal the pedagogical content knowledge of pre-service mathematics teachers regarding the use of algebra tiles. This study is conducted with using case study method. 29 pre-service teachers enrolled in mathematics education program were participated. The data of the research were collected through videos and interview. According to the results, pre-service teachers stated that the most important issue when using algebra tile is to introduce the tiles to the students before starting the modelling process. In addition, they pointed out that the colouring of the tiles and the selection of appropriate sizes are also important. The participants, who stated that they could use algebra tiles most during the exploration phase of the lesson, stated that their purpose in using the tiles was to concretize abstract mathematical expressions. In addition, the difficulties of the pre-service teachers were in not being able to associate the models they made with the tiles with algebraic concepts and making sense of the negative tiles. It is also among the findings that they are not accustomed to using the tiles due to their own learning styles and that they cannot immediately decide how to make the models.

Mackay, Sandy; Golding, Jennie

[PRESENTATION]



*How can guided reflection help GCSE resit students develop their problem-solving skills?*

This research aimed to explore how GCSE Mathematics resit student engagement during a guided reflection intervention could contribute to their problem-solving skills and confidence. The fieldwork was in two phases and for three GCSE mathematics classes. Students were involved in individual problem-solving tasks followed by group discussion and reflective journaling. Themes emerged from a grounded approach to the analysis of the qualitative data and led to the theoretical grouping of students with similar levels of engagement. The fully engaged students were able to demonstrate positive behavioural and appropriate emotional engagement, leading to cognitive engagement resulting in positive outcomes supporting the literature. They demonstrated that they had metacognitive skills in the episodes of fieldwork by using their acquired knowledge in a flexible and strategic way. There was evidence in the student journals that the partially engaged participants were aware of the thinking abilities of their peers and that this could lead to an understanding of how to use their own acquired mathematical knowledge and skills in more flexible and strategic ways. The disengaged students did not appear to develop their abilities to solve problems or to be better prepared for the examination. Their observed negative behaviour, including infrequent attendance or minimal participation, maintained their barrier to progressing their understanding of mathematics.

\*Makramalla, Mariam; Tilley, Emmanuella

[PRESENTATION]



***Cultural Perceptions to the teaching of problem solving: A case study of a curricular transfer experience between UCL and New Giza University***

Situated in an academic collaboration, the Engineering Design Practice (EDP) program has targeted the integration of problem solving skills as a vertical pillar that extends across the various study fields on a learner's journey to become an engineer. The EDP module has been developed by consultants, stationed at University College London to be implemented at New Giza University. In this session, the two authors come together to present their experiences of this curricular transfer experience, highlighting challenges and affordances in bridging the gap between curricular envisioning and curricular implementation. The data triangulates desk based study of the learning outcomes with classroom observations of the course implementation and student focus group reflections on the course implementation, thereby capturing the student side, the instructor side and the curriculum writer side. The findings of the study indicate a varying perception of the nature of problem solving across both cultures and ways to make use of this variation to further develop the program in a way that is inclusive and sustainable.

McIvor, Nick

[PRESENTATION]



***Can lesson observations alongside stimulated response interviews provide insight into some of the way in which skilled mathematics teachers improvise during lessons?***

This presentation assumes that expert teachers of mathematics often adapt their plans while teaching to address the emerging needs of their students. The idea of that teachers improvise while teaching not a new one – in 1989, Borko & Livingston identified a number of ways in which expert practitioners do this, and even used the term 'improvisation' to describe the practice – what is novel about the approach taken here is the decision to use a framework developed in the theatre to identify instances of improvisation in the mathematics classroom. It would be unreasonable to suggest that simply imposing some theatrical terminology on a teacher's actions offers direct insight into their practice, however, this session will propose that by observing, then interviewing those teachers shortly after the lesson, giving them space to describe their experience of apparent 'improvisation' in their own terms, it may be possible to gain a better understanding of the mechanisms involved. The session will share some early findings from a PhD study which draws on observation and interview evidence from a London secondary school to make some tentative suggestions about the relationship between improvisation as understood in the theatre, and kind of responsive teaching that is often associated with expert practice.

Meangru, Matthew

[PRESENTATION]



***Investigating In-service Teachers' Mathematical Discourse When Employing 3D Pens in a Mathematical Modelling Activity***

This study explored the mathematical discourse of five in-service teachers as they engaged with 3D pens in a mathematical modelling activity. The Communities of Practice (CoP) is the overarching

theoretical framework employed in this study. To investigate the content and manner of in-service teachers' mathematical discussion, a learning dimensions framework is used to examine four components: engagement, intentionality, innovation, and solidarity. The mathematical modelling activity entailed in-service teachers to use a 3D pen to design 2D shapes (circle, rectangle, and triangle) and 3D shapes (cube and triangular prism). This experience allowed participants to touch, feel, and hold the physical 3D models that they produced using the 3D pens. Data collection in this study consisted of audio and video recordings of in-service teachers' engagement in the classroom. The data has been analysed through a narrative lens. Following a careful review of the transcript of classroom activities, findings suggest that this mathematical modelling activity prompted in-service teachers' mathematical discourse in two primary ways, (1) through their engagement using the 3D pens and (2) through their intentional thinking and innovation about how they see 3D pens being employed in their primary school classrooms.

**\*Rossi, Serena; Xenidou-Dervou, Iro; Cipora, Krzysztof**

[PRESENTATION]



***Emotions and mathematics: Anxiety profiles and their influence on arithmetic performance***

Mathematics Anxiety (MA), General (GA) and Test Anxiety (TA) are all forms of anxiety which affect students' mathematics performance. However, little is known about how different anxiety profiles (i.e., individual configurations of anxiety forms) influence the relationship between MA and mathematics performance in University students. To the best of our knowledge, studies that have categorized participants based on their anxiety profiles and investigated how such groups differ in mathematics performance have been conducted only with children and adolescents. Using Latent Profile Analysis (LPA), we identified five different anxiety profiles in UK university students (N = 328) based on their MA, TA and GA levels. Beyond extreme anxiety profiles (high or low levels in all forms of anxiety), we also found groups characterized by more specific anxiety forms (MA profile, TA profile, and High anxiety with low MA Learning profile). Despite similar MA levels, these profiles differentially influenced arithmetic performance (but not the performance in a non-mathematics task), and some individual factors, such as self-concept and self-efficacy. These results can inform the design of interventions tailored to individuals' unique anxiety profiles to help them not only increase their chances of a successful future career but also improve their everyday life well-being.

**Shearman, Jennifer**


[PRESENTATION]



***Meanings of Mastery - Implications for teaching and professional development***

This presentation reports on a Doctorate project which investigated diversity in views teachers hold about mastery in mathematics. The research used Q methodology (likened to a 'card sort') to quantitatively evaluate the subjective opinions of 45 specialist mathematics teachers. The findings identified a set of mastery pedagogies, which combine progressive educational aims with traditional educational practices, that could fulfil the aim of 'all children achieving a deep understanding of mathematics'. The research revealed four distinct teacher viewpoints, or factors, labelled 'travel far, travel together', 'know your subject, follow the teacher', 'create a curriculum for interconnected understanding' and 'variety in teaching, learning and assessment'. A teacher's view of mastery depends on their combined beliefs in student potential and how much a student's learning journey

should be explicitly crafted by the teacher. The teachers' competence and confidence in mathematics, and their previous experiences in teaching and professional development were distinctly different across the factors. Acknowledging the existence of these varied viewpoints in a landscape of low mathematics teacher retention will be of interest to leaders of teachers in mathematics teacher training and development organisations, and leaders of school and trust mathematics departments.

**\*Smith, Kayla; \*Abbot, Ashley; Erath, Kirstin; Ingram, Jenni; Planas, Núria;** [PRESENTATION]   
***Experienced teachers' approaches to linguistic challenges in mathematics classrooms***

Learners of mathematics who are linguistically disadvantaged for a variety of reasons, including impoverished socioeconomic status, continue to be educationally disadvantaged and at considerable risk of school failure and early dropout. While much has been researched on linguistically disadvantaged groups of learners in the disciplinary fields of sociology and general pedagogy, little is known about the classroom teaching of subject content in language-responsive ways for all learners in school. The EsCo Project is an interdisciplinary collaboration of researchers across seven countries: Germany, India, Malawi, Norway, South Africa, Spain, and the United Kingdom. The international team are conducting interviews in different languages with experienced teachers of both mono- and multi-lingual learners experiencing linguistic disadvantage. In this session we will discuss emerging findings from the project: what linguistic challenges do experienced teachers identify in their mathematics teaching? What approaches are these teachers using to support learners with these challenges?

**Stacey, Jennifer**

[WORKING GROUP]



***Further Education Working Group***

The FE working group was established at the last conference in Nottingham. Its aims and objectives are to encourage and support researchers and practitioners working in the FE sector, to form an overview of current research and practice. Two long-term objectives of the group are ambitious! They are to develop enough recent material for a special issue of the RME journal through its members and other researchers, and to contribute to a cross-FE publication for use by researchers, practitioners and those involved in ITE/ITT (Initial Teacher Education/Training). Everyone, whether working in this diverse sector or not, are welcome to attend, either to contribute, or to hear about the range and depth of work currently in progress. Agenda: 1) Update on current research projects and projected timescales; 2) Update on any new projects and other developments in the sector; 3) Any other business.

**Thouless, Helen**

[WORKING GROUP]

***'SEND and Maths' Working Group***



The SEND and maths Working Group is open to all and aims to promote research that looks at the intersection of SEND and maths. This working group has four goals: 1) to connect researchers who have an interest in this topic; 2) raise awareness of the topic; 3) bridging the gap between theory and practice; and 4) bridging the gap between the fields of mathematics education, psychology, and special education.

**\*Tiflis, Ozdemir; Bikner, Angelika**

[PRESENTATION]



***Interpreting inverse proportionality in an experiment on momentum***

Ratio and proportion is an important mathematical topic that is frequently used in daily life situations, the basis of advanced mathematical topics with wide usability in others. However, students seem to have specific difficulties in distinguishing between proportionality and inverse proportionality (Irfan, Nusantara & Sisworo, 2019) and hence, in building formulas based on inverse proportionalities. Although it has received attention from mathematics education research, there are few research studies on teaching and learning inverse proportionality and applying it to daily life (Arican, 2015). This study aims to investigate whether STEM-based teaching is an appropriate approach for high school students to understand inverse proportionality and build formulas with it. We will design STEM-based lesson plans to teach momentum formula and investigate during the instruction how students explain and interpret variables, their relationships, and how they build a formula, or a conjecture for it. In our theoretical approach, we will use the concept of 'views on formula' (Schou & Bikner-Ahsbabs, 2022) to investigate these processes. For that, we will collect qualitative data consisting of audio data (audio and perhaps video recordings), worksheets with students' task solutions and field notes from participant observations. In this paper, we will present a literature review and an outline of the study design on inverse proportionality based on a STEM approach.

**\*Tiflis, Ozdemir; Saralar-Aras; İpek**

[PRESENTATION]



***Implementing a STEM Education Programme***

Numerous academics have emphasised the potential of STEM education for student comprehension and motivation when teaching mathematics. Studies indicate that mathematics instructors' attitudes about and knowledge of this potential influence their instructional strategies, and as a result, their attitudes affect whether and how they incorporate STEM lessons into their curricula. According to recent studies, teachers also need to learn more about how to include STEM learning scenarios into their classes (Papadakis & Stavrakis, 2020). To better instructors' comprehension of STEM education and scenarios, this study aimed to examine the efficacy of a STEM education programme for instructors. Specific learning sessions on STEM education in general, STEM scenarios using the 5E, problem-based scenarios, and project-based scenarios were included in this programme (see Tiflis & Saralar-Aras, 2021), where 489 instructors attended. Data was collected through surveys prior to and after the programme, including open-ended questions on their perspectives of STEM and the programme and session video recordings. The findings showed that the programme was found to be effective for those who have some prior knowledge and experience of STEM education, while it can

be facilitated for those who do not have such experience. This research brings an important instructor perspective to the field of STEM education at a time when the government supports integration of STEM in K-12 and higher education.

**\*Voutsina, Charis; Stott, Debbie**

[PRESENTATION]



***Exploring changes in young children's conceptions of written numerals in the world around them***

We will present findings from a study that examined preschool children's conceptions of the meanings and social uses of written numerals in everyday contexts. 33 children and their families participated in three cycles of data collection. In each cycle, with their family's support, children played a Number Spotting game, taking photographs of written numbers in their everyday life. These photographs, alongside other photographs of numerals on everyday objects selected by the researchers, were used in individual photo-elicitation interviews with children. We collected data on children's interpretations of a range of written numbers denoting order, measurement, quantity, and numbers used as labels/identifiers. The data have been analysed with a combination of a phenomenographic approach to analysis (cycle 1) and framework analysis (subsequent cycles). In this presentation, we will share our preliminary observations about changes in children's conceptions of written numerals across cycle 1 and cycle 2 of data collection. We will discuss examples that illustrate the kinds of knowledge that children draw from, to make sense of and communicate the meanings and purposes of written numbers around them. The findings can inform pedagogical activities that aim to develop children's awareness and understanding of the uses of numerals in everyday life.

**Weber, Christof**

[PRESENTATION]



***Conceptualizing algorithmic thinking for mathematics education: what aspects do we need?***

Algorithms and thus algorithmic thinking are central to our mathematical culture. Accordingly, they shape school mathematics at all levels. However, their value for learning is sometimes questioned, for example when they are denied the potential for understanding-oriented teaching and learning. At the same time, universities complain that students are becoming less proficient in mathematics. Moreover, procedural knowledge seems to be moving back into the focus of mathematics education, especially when it comes to understanding mathematics. Last but not least, algorithmic thinking might also gain importance in the course of digitalization, namely as an area of that could contribute to "computational thinking." Nevertheless, there is a lack of a theoretical conceptualization of algorithmic thinking to which mathematics education could refer. In our talk we will present and discuss first aspects.

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[PRESENTATION]

***How can technology help? A review of research on arithmetic learning supported by technology***

The use of technology broadens the way we can deliver knowledge and creates a new genesis of the learning model. It is obvious that the number of studies which focus on applying technology in mathematics education thrived in the last 20 years. Among those, geometry- and algebra-related studies are dominant in the field of digital mathematics learning. On the contrary, the study about the use of technology in arithmetic learning is relatively underdeveloped in both quantity and diversity. This study reviewed 15 articles, which specifically investigated the technological use in arithmetic learning, and classified those objectives into three main categories: knowledge acquisition, cognitive skills, and motivational and behavioural change. Although most of the reviewed studies showed positive results among these categories, the investigations mainly focused on knowledge acquisition and motivational and behavioural change. Furthermore, this study revealed that the major computer-supported learning method in arithmetic learning was digital games. This finding might implicate the possible research gaps in this area since the way we learn through games naturally leads to higher motivation for the repetition of practices. To use a variety of technology for deep procedural learning and cognitive skills training, we need to further develop and integrate the framework of mathematical thinking and instrumented action scheme for designing arithmetic-related digital learning environments.