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**SESSION HANDBOOK**

**UNIVERSITY OF MANCHESTER**

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## Plenary Presentation: Professor Jill Adler



Jill Adler is Professor of Mathematics Education at the University of the Witwatersrand (Wits). Jill was president of the *International Commission on Mathematical Instruction* (ICMI) 2017-2020 and held the Wits SARChI Mathematics Education Chair from 2010-2019. Jill's research focuses on teaching and learning in multilingual classrooms and teacher professional development. She is the recipient of numerous awards for her work in mathematics education, including the 2012 Academy of Science of South Africa (ASSAf) Gold Medal for Science in the Service of Society and the 2015 ICMI Hans Freudenthal medal in recognition of a major cumulative program of research.

### ***(Studying) A journey across problems of practice***

This talk traverses my research journey which began in the early 1990s with a study of mathematics teachers' knowledge of their practices in multilingual classrooms and then turned to teachers' professional development, including an exploration of mathematical knowledge for teaching. Each of these foci, in turn, was a function of on-the-ground problems of practice in post-apartheid South Africa, with the studies broadly framed by a sociocultural approach to mathematical knowledge, teaching and learning. I will briefly describe the foci and locational 'problems', and illuminate key 'results' that over time have accumulated into framework for describing teachers' on their interactions with resources, including language, as a function of 'relational transparency'

## Research papers, workshops and working groups

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

**Bamber, Sally**

[PRESENTATION]



***Collaborative Lesson Research as a Space for Expansive, Critical and Creative Pedagogy***

The potential for Collaborative Lesson Research (CLR) to facilitate transformations in mathematics classrooms is well understood in those communities that adopt this approach to professional learning. Expansive teacher education is often aligned with CLR, recognising the situated nature of both learning mathematics and learning to teach mathematics, integrating teachers' responses to contradictions that arise in practice. This paper proposes a way of understanding mathematics teacher professional learning within CLR that adopts a critical and creative lens informed by the notions of exploratory creativity and resistance. Using data from CLR and design research projects in England and Wales, questions are raised about the ethical, practical and political implications of CLR as a transformative model of professional learning in mathematics education.

**Black, Laura; Pampaka, Maria; Harris, Diane; Williams, Julian**

[WORKING GROUP]



***Critical Mathematics Education Working Group***

The CME Working Group (launched 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. Gender has been a key factor in discussions about differential outcomes in mathematics education both in relation to attainment/performance and emotions and attitudes. This working group session will: (i) discuss key findings from our two recent (systematic) literature reviews on gender differences in mathematics that include a review of affect, attitudes and aspirations in relation to Mathematics Education (5-14) and gender (funded by the Joint Mathematical Council, UK) and an extended review of Mathematics Anxiety (funded by the British Academy). (ii) provoke a conversation about how gender might be better conceptualised and measured in mathematics education in light of: i) the inadequacy of binary gender constructs, ii) the significance of intersectionalities with constructs e.g. race; iii) the need to avoid essentialising gender as a universal construct.

\*Boylan, Mark; Compton, Ashley

[PRESENTATION]



*Limiting mathematics and post-truth research reviews: school inspection and policy-based evidence in England*

Frequently and increasingly, debates about school mathematics curriculum and pedagogy reference evidence and research. One way policymakers and others seek to influence practice is through regulatory bodies such as inspection services, such as the Office for Standards in Education (Ofsted) in England. Ofsted sought to extend its already powerful influence on the classroom through inspection through a series of curriculum research reviews, including a controversial one focused on mathematics. We analyse the way Ofsted uses evidence and how this departs from accepted ways to synthesise research and infer implications for practice. The misappropriation of research leads to conflict between Ofsted's recommendations for school mathematics and both the findings of more rigorous research reviews and the National Curriculum in England. The lack of rigour and misdirection is illustrated by focusing on Ofsted's view of problem solving. Although Ofsted disregards usual scholarly norms of argument, citation, rigour, and quality, the Mathematics Review is an example of 'policy based evidence making' and 'post-truth' discourse. The reconstruction of problem-solving as the application of remembered knowledge to new tasks underlines the policy aim of limiting and restricting what mathematics is and how it can be learned.

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

[PRESENTATION]



*Spacing effect, working memory resources depletion hypothesis, and levels of element interactivity*

Experiment 1. Until May 2023, 30 Year-10 students (Spaced:  $N = 14$ , Massed  $N = 16$ ) participated in the experiment. The participants were novices in differentiation and Calculus. Learning materials included differentiating basic, trigonometric, and logarithmic functions. The post-tests were a cued recall test and six questions related to the principles. Preliminary results revealed neither spacing nor working memory resources depletion effects in low-element interactivity materials but working memory resources depletion effects occurred in high-element interactivity materials. Experiment 2. Fifteen Year-12 students who have learned to differentiate basic and trigonometric functions have been chosen to participate in this experiment. Experiment 2 used the same experimental design and procedures as in Experiment 1. The learning materials in Experiment 2 include rules to differentiate basic, trigonometric, and logarithmic functions and use product and quotient rules to differentiate functions. Besides, the post-test in the low element interactivity phase has been changed from a cued recall test in Experiment 1 to a free recall test in Experiment 2. At last, the number of post-test questions in the high element interactivity phase has

been increased from 6 questions to 8 questions. Preliminary results showed that the spaced group had higher scores in the post-test and working memory tests.

Chen, Ouhaio

[PRESENTATION]



***The imagination effect: Mental rehearsal during resting can improve learning despite depleting working memory resources***

Working memory resource depletion after intensive studying, and the subsequent positive effect of resting on the restoration of working memory resources has been used to explain the effects of resting on learning. In this study we investigated whether the process of internal rehearsal/imaging could provide an alternative explanation for the resting effect. Based on the assumption that students will naturally use rehearsal during rest periods when learning unless they are required to perform activities unrelated to the learning task. The results showed that engaging in rehearsal/imaging during rest depleted working memory resources but enhanced learning.

\*Evans, Tanya; Jeong, Inae

[PRESENTATION]



***Concept maps as assessment for learning in university mathematics***

Concept maps have become a popular learning tool in many educational settings. However, research has not fully explored the effectiveness of concept mapping as a learning tool nor analysed its utility as an assessment tool. This study reports on evaluation of a novel concept mapping assessment in a university mathematics course (N = 219). We investigated relationships between concept mapping performance and two major variables: academic achievement and assessment self-efficacy (a two-factor measure comprising Comprehension and Execution and Emotional Regulation). Hierarchical multiple regression showed that concept mapping performance explains a statistically significant amount of variance in both the final exam scores and the Emotional Regulation factor of assessment self-efficacy (ER) over and above other conventional coursework assessments. This suggests that concept mapping assessment can detect and evaluate learners' distinct capabilities that are not discerned by conventional assessments. Hence, concept mapping's potential to assess conceptual understanding warrants further investigations. Moreover, the association with the ER efficacy measure suggests that concept mapping as a learning activity involves more positivity about the ability to succeed in facing challenges than a typical assignment. This potentially indicates more perseverance and effortful learning while actively engaged in meaning-making and the type of relational reasoning elicited by concept mapping.

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

[PRESENTATION]



*'The new normal': emerging evidence for pandemic-related changes in opportunity to learn.*

There is widespread evidence that pandemic constraints resulted in reduced performance in standardised attainment tests, varying by age/stage and by socio-economic status. There is also evidence of (variable) 'recovery' from such 'learning loss'. However, following the pandemic hiatus, the nature of, and reasons for, emerging classroom practice and experience are less clear. We report on the 'new normal' in five secondary mathematics departments, fairly representative in several key characteristics, and four of whom we worked with pre-pandemic. In each school, a late 2022 two-day 'deep dive' visit included observations of lessons in a range of four classes in years 7-11, supplemented by student focus groups and teacher interviews for those 20 classes. We explored the experienced curriculum breadth and balance, its relation to recent high-stakes assessments, and in particular, the development of problem solving and reasoning, of mathematical communication and mathematics-related affect, the use of digital tools for learning mathematics - and the stability of that provision. We analyse pre-to-post pandemic changes in opportunities to learn in those areas, the reasons given for those changes, and how they appear to vary with department- or student-related characteristics. We identify important features of teacher-level capacity and (physical, emotional and cognitive) support as key in these schools to sustaining more ambitious learning experiences post-pandemic.

Helme, Rachel

[WORKING GROUP]



*Further Education Working Group*

The FE working group involves researchers and practitioners whose main area of interest is Further Education mathematics, whether that is Functional Skills or GCSE resits. All those involved who have an interest in the delivery to FE students (16-18) or adult learners (19+), or teacher education within FE, are invited, with the long-term objectives of drawing attention to the peculiarities of mathematics in a Further Educational context. In this session, there will be an interactive presentation based on GCSE resit mathematics learners' past experiences and current engagement with a mathematics course at FE college.

\*Howker, Emilia; \*Black, Laura

[PRESENTATION]



*Parents' Mathematical Identities in Marginalised Communities*

Supporting children's mathematics education is a well-documented site of anxiety for many parents, particularly in economically and culturally marginalised households where intergenerational struggles with schooling are more prevalent. This paper explores parents' relationships with mathematics through the concept of mathematical identity (MI). Focusing on two narratives, Jamie and Bianca, we investigate the MIs parents construct as they describe the nature of their engagement with the mathematics taught in school and their

use of everyday mathematics in homes and communities. This allows us to consider how parents' MIs are mediated by academic, economic and cultural experiences rooted in the home-school relationship. We highlight evidence of MIs that signal alienation from schooling that are significant given the important role parents play in mediating children's MI.

Iberi, Henry

[PRESENTATION]



***The challenge of teaching and learning Angles: a pedagogic intervention***

**Abstract** In the teaching of Mathematics, understanding the concept of angles in dynamic contexts is often difficult for pupils. Drawing on previous research and my own experience, I explored why this is the case and investigated why pupils struggled with angle problems. I present those findings in this paper and report on some effective pedagogic interventions to address them. This research, conducted by a Mathematics Mastery teacher at a West Midlands secondary school utilised assessment data from a large (n=142) cohort of pupils and small (n=6) focus group. The primary consideration for this study was to design a research framework that captures the most appropriate data and analysis to support improvements in the teaching and learning of angles. This paper provides a case study of how careful use of bespoke resources and modifying teaching strategies could lead to outcomes that are more positive. Findings indicate that pupils demonstrated a better grasp of angles when guided with a schema that helps them interpret problems and structure their thinking. It also showed that students learnt better when taught explicitly about angles in everyday situations. The conclusions from these results bolster the premise that these approaches are effective in the teaching of angles. Keywords: dynamic; static; angle; pedagogic; schema; domain.

Jacques, Laurie

[PRESENTATION]



***What to vary and how. What not to vary and why: Teachers' deliberate design choices for one-problem-multiple-changes procedural variation tasks***

Research suggests that teachers' mathematical example choices can be contingent and spontaneous rather than predetermined and deliberate. In a recent study, eight primary teachers collaborated to design one-problem-multiple-changes procedural variation (OPMC PV) tasks where they deliberately constructed a predetermined set of equations with which to promote pupils' mathematical inquiry. Qualitative content analysis of the work of the teachers during an iterative form of lesson study, framed by the principles of procedural variation (anchoring points of knowledge, pudian, potential distance and bringing convergence), was used to characterise the design principles associated with these types of tasks. Using the tasks designed by the teachers in this study, I will illustrate the principles, including the motivation for using the task to set the anchoring point of knowledge, the identification of an invariant structural feature of the prototype equation, defined by a

dependency relationship on which to bring convergence and the distinction between arbitrary and essential features of the equations to decide what is varied and what is kept invariant and in what ways, in order to manage the potential distance using pudian.

**\*Jacques, Laurie; \*Noyes, Andy; \*Brignell, Christopher;**

[PRESENTATION]



***The Mathematics Pipeline in England: Patterns, Interventions and Excellence***

The mathematics education pipeline in England is long and complex. It comprises several million students in tens of thousands of schools, colleges and universities. Throughout this pipeline, mathematical engagement, progress, attainment and post-compulsory participation are patterned in interesting ways; patterns which are often longstanding and stubbornly resistant to efforts to ameliorate them. In this session we share findings from the Mathematics Pipeline Project (2021-23) which took a system-level overview of the mathematics pipeline in England for all young people in schools from age 4 to postgraduate level. We were particularly interested in what we term the excellence stream; that part of the mathematics pipeline which includes students with the capabilities to progress to advanced level and university mathematics. This excellence stream diminishes over time across the phases of education and, importantly, with different rates for students from diverse backgrounds. By visualising the flow patterns of single cohorts of students we were able to take a 'helicopter view' of the whole pipeline and identify areas where well-designed interventions might be targeted to improve flow and diversity within the excellence stream.

**\*Jones, Ian; \*Hunter, Jodie**

[PRESENTATION]



***Professional Learning through Assessing Mathematical Writing***

We will present interview data on the potential professional development benefits for educators who engage in assessing students' mathematical writing. The participants were twelve mathematics educators in New Zealand who were experienced in assessing primary students' written responses to open-ended prompts covering a range of topics. The first stage of the interviews used a stimulated recall protocol that followed a comparative judgement procedure in which each participant was presented with three consecutive pairs of students' written responses and asked to decide which response they thought was 'better'. The second stage of the interview was semi-structured with questions about how participants made their comparative judgement decisions, and whether making judgements of writing improved their understanding of students' thinking. We conducted an inductive analysis of the interview data that focussed on (i) teacher knowledge required to assess understanding represented in mathematical writing, and (ii) associated professional learning and development opportunities. In this talk we will focus mainly on (ii) and present evidence



that assessing mathematical writing can provide educators with insights into students' representations, underlying ideas and learning trajectories, and can also provide stimulus for changing classroom practice.

**\*Marks, Rachel; Barclay, Nancy; Barnes, Alison**

[PRESENTATION]



***The DfE Textbook Funding Initiative in Primary Mathematics in England: Awareness, Uptake, and Attrition***

In 2016, as part of the drive to push a 'mastery' approach in England, Nick Gibb announced £41 million of funding for primary mathematics, a part of which was targeted at providing matched-funding for primary schools in England to purchase one of two DfE-approved textbook-based schemes (Maths No Problem! and Power Maths). As part of a wider study mapping the landscape and use of textbooks and curriculum resources in primary mathematics, we surveyed schools about their awareness of, and participation in, this textbook funding initiative. We found that less than half of primary schools across England were aware of this funding, with smaller schools and schools in a rural location even less likely to have heard of the initiative. Just a third of eligible schools took up the funding, with schools citing a dislike of textbooks, being satisfied with the resources they currently had, and being unable to meet the matched-funding or ongoing costs associated with textbook schemes (such as pupil workbooks), as reasons for not participating. Of those schools which did have DfE-funding and purchased one of the approved textbook schemes, we found that 37 percent have since largely or fully abandoned the scheme and a further 24 percent have continued to use it but only partially, no longer funding consumables (workbooks and subscriptions). We discuss the reasons for this attrition – including cost and adaptability issues – and outline the recommendations emerging from these findings.

**Meangru, Matthew**

[PRESENTATION]



***Diffraction Analysis: Investigating In-service Primary School Teachers' Engagement Utilising 3D Printing Pens as Co-construction of Meaning and Mathematising Through Making***

This presentation focus on the analysis of a current PhD study that observed a group of three in-service primary school teachers' utilising 3D printing pens to construct skeletons of 2D and 3D shape. The activity involves a design, play, and engage approach such that in-service teachers' construct 2D shape (i.e., circle, square, rectangle) and 3D shape (i.e., Triangular prism, Cube) using a flat surface or 3D printing pen silicon mat. I adopt the concept of diffraction as a methodological approach for understanding how bodies and materials interaction produces something meaningful. The data has been analysed using diffractive reading that is reviewing the video recording to observe primary in-service teachers' mathematical discussion and gesture using the 3D printing pens to construct their 2D and 3D skeleton shapes. The finding suggests that in-service primary school teachers' engagement with 3D printing pens can enable them to construct something meaningful and

mathematising through making. I conjecture that in-service primary school teachers' can employ 3D printing pens in a mathematical activity that allows primary school students to construct a 3D skeleton object and mathematising through making.

O'Brien, Kate

[WORKSHOP]

*Catalysing informal mathematical communities: Looking for momentum in the generative "glitch"*



Scholars have long called for approaches to mathematics education that embrace mathematics as a communal practice, one which extends beyond classrooms and into our homes and neighbourhoods. Concepts like ethnomathematics (D'Ambrosio, 1985) or funds of knowledge (Moll et al., 1992) have been developed to describe mathematical activity freed from explicit institutional endorsement. Yet the myth that mathematics is nothing more than a required school subject remains recalcitrant. What will it take for mathematical ideas to live and breathe more freely outside of state-sponsored curricula? This workshop tackles this big question by zooming in on small moments of "glitch" as they surface in making practices like weaving. Drawing on Legacy Russell's (2020) "Glitch Feminism" to think the glitch as a generative political act – one which challenges us to renegotiate the boundaries between mathematics and the real world, the classroom and the wider community – the workshop explores how slippages or sticking points in making might be one site from which to catalyse new, informal mathematical cultures. After examining data from a recent project on the mathematical practices of fibre artists, participants will experiment with concepts like texture, line, and shape on a tapestry loom. Drawing out surprises, strange encounters, and glitched events, we will explore how these experiences can support the production of mathematical communities that exceed the limits of school walls.

\*Palmas, Santiago; Sánchez-Rodríguez, Brenda Valery

[PRESENTATION]



*Mathematical Landscapes: A Sociolinguistic Perspective on Street Mathematical Practices*

This study is part of a broader research that describes the interaction between mathematical knowledge constructed in a specific event and mathematical practices in a situated context. The objective is to analyze the origin of these practices to discover aspects that socially and academically accepted discourses do not recognize. To do so, the New Literacy Studies (Baker, Street, & Tomlin, 2006) and ethnographic studies of walking (Ingold & Vergunst, 2008) are used as theoretical resources in order to describe how social practices shape mathematical contents. The case study of a 5-year-old girl and her reflections on signs, symbols, and mathematical practices while walking on a street in Mexico City is presented. This presentation allows for further analysis of the relationships between school

and social practices outside of it that involve mathematics. Lastly, the study provides a novel theoretical and methodological perspective to explore mathematical practices in a situated context, fostering a deeper understanding of the relationship between school and everyday life: the ethnographies of walking.

**\*Pope, Susan; \*Lawson, Jamie**

[PRESENTATION]



***A new qualification to increase post-compulsory participation: Higher Applications of Mathematics***

Higher Applications of Mathematics was designed to meet an increasing demand for mathematical and statistical literacy in life, work and across a wide range of academic disciplines. Now in its second year, we provide an analysis of its first cohort, and an exploration of how Higher Applications has been received and experienced by learners and practitioners. Data has been drawn from attainment and enrolment statistics for the 2022 cohort, and from two web-based surveys of learners currently taking the qualification and practitioners teaching it. The findings will contribute to ongoing refinement of the qualification, and broader discussions concerning the nature of mathematics available to learners.

**Rumbelow, Michael**

[WORKSHOP]



***Using AI to recognise and respond to students' arrangements of block manipulatives***

In this workshop participants will be invited to play with a prototype app that uses AI to recognise arrangements of block manipulatives such as multilink cubes on a tabletop via a webcam, and responds with audio and graphics in near-real-time. The aim of the app is to explore how AI object recognition may enable augmentation of hands-on play with blocks with sounds and imagery, for example to endorse mathematical pattern-making, with audio-only modes potentially obviating the need for a mediating screen. The workshop will consist of play with the app, and a short presentation contextualising its development, to prompt a discussion of the potential role of AI object recognition apps in mathematics education.

Saad, Usama

[PRESENTATION]



### *EAL Learners and Mathematical Word Problem Solving: A Meta-Analysis*

Mathematical word problems have long been acknowledged as a crucial component in bridging the gap between maths and real-life situations. Consistent research suggests that the difficulty in word problem solving is not solely due to the mathematical ability of the learners, but also depends on a requisite level of linguistic proficiency. This role of language proficiency raises critical questions about the construct validity of using this type of maths problems to assess the mathematical ability of English as an Additional Language (EAL) learners. The present study aims at quantifying the extent of this disadvantage and identifying potential moderating factors. Employing meta-analytical techniques, we systematically reviewed studies that: (1) compared the performance of EAL learners and English as a first language learners on word problems written in English, and (2) compared the performance of EAL learners solving word problems in their first language versus English. We extracted a total of 105 effect sizes from 47 studies, with over 280,000 participants. Our findings provide compelling evidence that EAL learners encounter significant challenges when attempting to solve word problems in English. We also identified a range of moderators that influence this outcome. During the presentation, we will elaborate on these findings and discuss their implications for research, instruction, and assessment.

Sharpe, Fiona

[PRESENTATION]



### *Relating mathematically – researching relationships in mathematical doings*

Mathematics curricula are often framed by content and skills rather than relationships. Yet all teaching and learning happens in the now, in the doing, with others, and involves the whole human being – embodied, emotional, and cognising. Content and skills can be allied to learning outcomes, and through standardisation and testing, show that teaching aims have been achieved. But how do we know what we know, and how do we know that we know it? Several mathematics educators have proposed a shift of perspective towards the pre-reflexive, and pre-language elements of learning mathematics (Gattegno, 1974/2010; Skemp, 1983; Tahta, 2007). For example, Gattegno suggested: “finding a way to make the learner aware of the powers of his mind — the powers he uses every day, those which allowed him to learn his native language and to use imagery and symbolism”. He also said that we can work to become aware of these powers of the mind in ourselves, so that we can educate awareness in our students. In my research, I try to cultivate awareness of awareness - both my own, and that of the non-specialist mathematics teachers with whom I am working. I have been working closely with one teacher over several months - offering his students an experience of rich tasks, co-teaching with him, and reflecting together. Being alongside him has allowed me to be involved in what he describes as “a very different and empowering experience”, and what I see as his changing relationship to mathematics.

**\*Smith, Kayla; Ingram, Jenni; Abbott, Ashley; Planas, Núria; Erath, Kirstin**

[PRESENTATION]



***Linguistic disadvantage in the mathematics classroom: teachers' challenges and practices***

The EsCo project is an international collaboration of linguistic and mathematics education researchers that collected interview data from experienced mathematics teachers in seven countries on linguistic challenges in their mathematics classrooms. This presentation focuses on preliminary findings of what we can learn from these teachers that could inform our practice as mathematics teacher educators and our research. Three challenges and three practices that add nuance and depth to theoretical research findings and recommendations on language in mathematics teaching are identified, which have the potential to develop these findings in more practical and accurate ways

**\*Williamson, Joanna; Carmen, Vidal Rodeiro**

[PRESENTATION]



***Performance in GCSE mathematics topics pre-and post-reform***

This research analysed the performance in maths items of approximately 250,000 candidates from the final three years of pre-reform GCSE mathematics (2014-2016) and the first three years of the post-reform GCSE (2017-2019). Our goal was to contribute new evidence on the impact of GCSE reform in mathematics, and, in particular, to complement the insights gained from previous qualitative studies with teachers and students. Our analyses used descriptive statistics and multilevel regression modelling to investigate performance in different mathematics topics and how this changed (or did not change) with the reform. A particular contribution was to explore candidate performance on sets of similar items (i.e., families of near-identical items spanning pre- and post-reform GCSE papers), to investigate whether there was evidence for changes in candidates' absolute levels of mathematical performance. The findings confirmed that candidates found post-reform GCSE assessments substantially more challenging, and that the proportion of marks achieved decreased more in some topics than others. Although the variation across topics was not statistically significant, it may nevertheless have affected teacher and candidate experiences of different mathematics topics, and perceptions of the reformed qualification.

\*Wright, Pete; Hilton, Caroline; Kelly, Joel

[WORKSHOP]

*Considering the efficacy of a quantitative survey in measuring socio-mathematical agency*



The Primary Maths and Social Justice research project was a collaboration between three lead researchers and six teacher researchers that took place in two schools over nine months (see [www.mathsocialjustice.org/research](http://www.mathsocialjustice.org/research)). The project aimed to explore how primary school teachers can pursue an interest in social justice issues in teaching mathematics. One of the data collection tools developed by the research team was a self-reporting survey designed to measure students' sense of socio-mathematical agency (SMA), defined as 'the ability to use mathematics effectively to argue collectively for social change'. The survey was administered twice to all students in six classes, near the beginning and end of the project. Students were invited to rank the extent to which they agreed with a series of statements on a 4-point Likert scale and then to explain their ranking. Particular consideration was given to the language used in the survey and the protocols for its implementation to ensure it was accessible to students ranging from ages 5 to 11. After a brief presentation of the survey and the accompanying statistical analysis, the workshop will consider its efficacy in assessing the development of SMA over the course of the project. We will discuss the following questions: - To what extent can quantitative surveys be used as a valid and reliable measure of concepts such as SMA? - To what extent can quantitative surveys be used to generate better understanding of theoretical concepts?