BSRLM Summer 2021 Abstracts: New Researchers Day, Friday 4th June 2021

British Society for Research into Learning Mathematics

Keynote 1:

Dr Jennie Golding, UCL Institute of Education

Stressed and remote: conducting and reporting research through a pandemic

Remote, or constrained, data collection has been forced on many researchers over the past fifteen months. The pandemic has brought not only the usual issues associated with remote data collection, but additional conundrums of ethics, of the research questions that can be answered, of timeliness, sampling, participant inclusion and retention, trustworthiness, and reporting. Jennie will draw on a variety of real examples of such challenges and suggest ways to harness them so as to still achieve rigorous, trustworthy, and sometimes unexpectedly fruitful, outcomes.

Jennie is her home department graduate tutor, active in mentoring a range of postgraduate research students and supervisors. Her research is largely 'classroom'-close, focused on the enactment of age 4-18 curriculum policy in mathematics.

She is happy to be contacted about the issues discussed in this session: j.golding@ucl.ac.uk

Keynote 2:

Jeremy Hodgen, Professor of mathematics Education, UCL Institute of Education

Designing, conducting and writing up literature reviews in mathematics education

The literature review is an immensely important aspect of research. Yet, in the past, little attention has been devoted to this aspect of research in doctoral training programmes. Drawing on a number of studies, Jeremy will discuss different purposes for, and approaches to, conducting a literature review, including how to ensure that the methodology and methods are sufficiently sound and robust. Jeremy will outline ways in which these approaches and methods can be used in carrying out and writing up a literature review.

Presentations and Workshops

Alafaj, Maryam

Investigating the difference of typing vs. handwriting mathematical responses. (Presentation)

Students are increasingly moving away from paper submission of assignments to working online, a trend accelerated in 2020-21 by the global pandemic. Online submission includes both automated online assessment and online submission of written work for human making. At a technical level the traditional ``essay questions'' provide a way to capture students' free-form expression but traditional essay questions are impossible for automatic assessment. Human marking is needed for essay questions in which students have to show their work in reasoning and their deeper understanding in which they must express their work in longer argumentation and derivations by either type or hand-write and upload their responses. Typing mathematical symbols or equations can be very difficult and this is not an issue isolated to just assignment applications. However, writing long mathematical responses in pen and paper style might be easier for students to freely explain their reasoning and draw sketches. The aim of this study was to explore any systematic differences that may be introduced between typing and uploading handwritten mathematical responses. Participants responded to an online task containing equivalent typing and uploading handwritten items. These were then marked by two markers, such that every marker marked every script exactly once. The students' reactions immediately after the task were obtained. Factors explored included number of steps or "units" and overall score awarded.

Alburai, Hanaa

The Impact of comparison-based intervention on Mathematical conceptual understanding, Procedural Fluency and Aesthetic Appreciation. (Presentation)

The practice of comparing multiple solution methods has been considered as an influential pedagogical strategy in mathematics education. However, a few studies have investigated its effectiveness in regular classroom settings. This research aims to evaluate whether, and to what extent, implementing comparison between contrasting solutions can have a positive impact on students' procedural fluency, conceptual understanding and aesthetic appreciation in classroom mathematics. Maintaining a deep understanding and fluent performance of mathematical procedures are cardinal constructs of mathematical competence (NCETM, 2016; Kilpatrick et al., 2001). Additionally, aesthetics appreciation is the main dynamic intuitive motive that leads to students' mathematical originality and innovativeness (Sinclair, 2011). An intervention will be conducted on solving systems of linear equations simultaneously among year 10 and year 11 students. After the intervention, two tests will be applied, one to evaluate students' conceptual understanding and the other to evaluate their procedural fluency which, based on the literature, consists of three main components which are: accuracy, efficiency, and flexibility. Also, Pre-post questionnaire, in-depth interviews in addition to classroom observation are to be held with students to elicit their perceptions of the aesthetic dimensions of mathematics (connectedness and fruitfulness).

Birkhead, Amy

Exploring the identity negotiation of early career mathematics teachers. (Presentation)

Becoming a mathematics teacher is a period of intense identity negotiation. In England, early career teachers' work is specified through detailed teacher standards and monitored and audited through

performance management systems. Such high-stakes assessment of teachers' practice means many early career mathematics teachers have to make difficult choices between pleasing the cultural gatekeepers of the school and their own ideals about effective mathematics teaching and learning. In this way, the school culture coupled with workplace opportunities and constraints on pedagogical choices impact on an emerging professional identity. This study aims to understand how secondary mathematics teachers negotiate their identities during their first two years of teaching by exploring the internal forces that shape their understanding of being a mathematics teacher while navigating the social and cultural conditions of schools. In this presentation I will provide an overview of the design of this study and how teachers' stories will be captured to develop a narrative inquiry. Through exploratory interviews, written personal reflections and the collection of artefacts, the teachers' histories, beliefs about mathematics and the context in which they work will be examined. This allows further exploration of any tensions that teachers face as they are socialised into their school settings, and which can contribute to an emerging professional identity.

Brougham, Rachel

Adults Students' Perceptions of Constructivist Learning, Control-Value Appraisals, and Achievement Emotions in Further Education Mathematics (Presentation)

The current research aimed to explore the links between students' perceptions of cognitive constructivist principles in learning and their achievement emotions in mathematics. The relationships between perceptions of four constructivist-informed classroom practices, students' appraisals of control and value, enjoyment, and anxiety were investigated using a sample of adult students (N =103) of level 2 mathematics in Further Education. Multiple regression analyses revealed that perceptions of investigation learning related positively with control appraisals, value appraisals, and enjoyment, and negatively with anxiety. Perceived involvement in learning was negatively, and cooperative learning positively, related to anxiety. Appraisals of control and value positively related to enjoyment, with intrinsic value yielding the strongest relationship. Control appraisals negatively related to anxiety. Implications for research and practice are discussed.

Flack, Alison

Maths anxiety amongst pupils in a pupil referral unit. (Presentation)

Mathematics anxiety has been shown to exist amongst students of all ages. Anxiety can impede the use of working memory required in performing mathematical calculations and so may hinder a student's progress. This research looked to assess the prevalence of mathematics anxiety amongst students at a pupil referral unit. It explored the perceptions of mathematically anxious students with respect to how their anxiety came about and how it manifests itself. Students were first screened for mathematics anxiety using a questionnaire designed for this purpose. Five students scored highly for mathematics anxiety and the three highest scoring students were selected for interview. The interviews were analysed for themes and the overarching conclusion was that mathematically anxious students find taking the next step in their learning particularly daunting. It is hoped that with a greater understanding of mathematics anxiety, it might be possible to develop strategies to enable these students to make progress in mathematics that leads to an increase in confidence.

Jacques, Laurie

Analysing video data from micro-teaching lesson studies: A content analysis approach (Presentation)

In this session I will share some outcomes from an initial analysis of data from my doctoral work that addresses the following research question: "How do primary teachers in England construct 'procedural variation' in their mathematics task design and pedagogy?" In this session, I will share my recent dilemma in choosing the most useful qualitative analytic approach to answer my research question and, using data collected from micro-teaching lesson studies, illustrate how the approach I settled on, content analysis, appears to be the most appropriate for my needs.

Kimber, Elizabeth

Functions, graphs and change: linguistic analysis of online mathematics teaching videos. (Presentation)

This study uses techniques from linguistics to analyse mathematics teachers' discourse of functions, graphs and change. Describing behaviour of functions, including those with variable rates of change, presents challenges for teachers. These include moving between everyday language of change and descriptions of change in the mathematical register and introducing new mathematical objects such as the gradient function. I will outline related literature and describe the design of a pilot study involving techniques from functional linguistics to analyse teachers' language and gestures in online videos. I will also describe some ethical issues raised by this use of open access online videos in research. I hope to share some initial findings of how teachers combine language and gestures when teaching about functions, graphs and change.

Machino, Natheaniel

A student teacher's mathematical and pedagogical knowledge seen in teaching Area and Circumference of the Circle to Further Education (FE) GCSE students. (Presentation)

Many studies (e.g., Rujeki & Putri, 2018) show that students get confused with area and circumference of circles; the main reason being teachers emphasize memorizing formulas rather than understanding concepts. In this presentation, I report findings of the analysis of an episode of a lesson on 'Area and Circumference of the Circle' taught by Job to an FE GCSE class. The analysis employed the Knowledge Quartet (KQ) (Rowland et al., 2005), a framework for the analysis of mathematics teaching, with focus on teacher knowledge. Data were collected during a lesson on Teams recorded with Job and his students' consent. Analysis identifies the different aspects of the KQ dimensions: foundation, transformation, connection, and contingency. Findings demonstrate Jobâ's strong and less strong areas of overt knowledge of the topic. Jobâ's use of terminology is not always consistent and mathematically precise. Also, his approach relies on procedures with little attention to conceptual understanding. In terms of transformation, especially teacher demonstration, although it seems Job does not attempt to connect concepts, he shows some good recognition of conceptual appropriateness. No sign of contingency was observed as students either did not contribute or their contributions were directed to the teacher making it difficult to see if any teacher action was a result of the students' contributions.

Riding, Katie

Can GeoGebra's Augmented Reality tool provide a 'looking glass into a mathematical wonderland'? (Presentation)

GeoGebra has been well researched within the mathematics education community; however, the majority of this literature does not examine the recent edition to the GeoGebra family, GeoGebra 3D Calculator with Augmented Reality (GeoGebra 3D/AR). Due to the pandemic, my master's study was conducted virtually. At the conference I will report on the findings from two 'Zoom workshops' which examined nine primary school students constructing dynamic AR manipulatives, then creating AR environments to model familiar household objects. Participants' interactions were analysed through Bruner's enactive-iconic-symbolic framework. Despite having to navigate a GeoGebra's 3D graphics view, all participants in this young age group identified ˜real-life objects (enactive mode), constructed virtual objects in GeoGebra 3D/AR (iconic and symbolic modes) then 'augmented' these AR manipulatives alongside real-life artefacts (all modes). The constraints of conducting the workshops virtually propelled an additional technological tool/environment to the fore; teaching, learning and researching within the 'Zoom classroom'. The secondary focus (albeit unplanned), adopted the lens of TPACK in an attempt to evaluate the impact of teaching, learning and researching within a virtual learning environment (VLE). I will highlight how student-centred orchestrations such as 'spot-and-show' and 'sherpa-at-work' were extremely challenging to replicate within the VLE.

Saad, Usama

Role of Reading Comprehension and Maths Computation in Word Problems Solving: A Comparison of Arabic EAL and English-Native Adults Learning Maths in the UK (Presentation)

To investigate the role of reading comprehension and maths computation abilities in successful word problems solving, 40 adult participants (Arabic and English native speakers who have previously studied maths in the UK) have been recruited. They have been tested on three subtests (WRAT V for reading comprehension & maths computation, and PISA for word problems) to measure their skills in reading comprehension, maths computation and word problems. The results suggested that reading comprehension and maths computation were significant predictors for Arabic-native speakers' performance in the word problems subtest, but maths computation was the only significant predictor in English-native speakers. The relation between these different factors has been analysed in terms of performance accuracy. Different perceptions of the language and maths components between the two groups have been analysed and discussed. Educational implications & future research have been explored.

Shah, Safdar

Informal and Formal Proof (Presentation)

The review focusses on the philosophical and educational aspects of proving in mathematics. The philosophical aspect defines informal and formal proofs as distinct in that formal proofs are rarely observed in mathematics due to solely being defined by syntactic and formal language. Informal proving on the other hand may not contain specifically formal statements and proofs may skip steps, be defined through appealing to background knowledge and argued through semantic means. From the educational perspective formal proofs are viewed as a mixture of informal argumentation combined with logical syntax, mathematical language, and syntactic arguments. Informal proof

educationally appeals to arguments which aid better understanding and can include diagrams, example usage, and other ad hoc methods aimed at explaining why the proof is correct or not. The review tackles the process of formalisation as well as objections to this view. The paradigmatic stances of Frege, Lakatos and Kant aid in providing alternative views in mathematical proof. The characteristic of proof is explained; its explanatory, convincing and contextual nature, informal proofs providing a 'tool-box' which leads to the synthesis of new methods, tools, and strategies for mathematical proving. Diagrams and mathematical language are analysed for their usefulness in proving. Mathematical rigour is defined as well as its criticisms and the review finishes with proof from the educational perspective.

Stewart-Brown, Andrew

Improving problem-solving skills with prompt videos. (Workshop)

Action Research: The United Kingdom Mathematics Trust provides one of the most reliable sources of enrichment for secondary Mathematics teaching in the UK. Their Challenges began to be used in our school in 2004 and we have tried in many ways to raise students' enthusiasm and improve performance in the Challenges. Teaching problem-solving is not straight forward. Maths Clubs or mentoring schemes are perhaps the best ways to develop the skill, but take up much time. A set of prompt videos co-ordinated with past challenge papers was developed for use within the school. After friendly communications with the UKMT, we were given copyright permission to use their problems Latterly we have been able to build a website to house the expanding resource. challengeprompts.co.uk Our session will consist of a brief introduction to this work, a visit to the website, an outline of intended future developments and an open discussion with participants of promising possibilities. Such an open discussion will be welcome as we have largely been working out on a limb. Finally, it had better be admitted that we are weak on theoretical perspectives unless Pragmatism counts as one. In this general process over the years, we have been looking for 'what works' measured rather crudely by Challenge scores. The Department has also been able to nurture some very committed and enthusiastic young mathematicians. That, of course and happily, has not been a mechanical process.

Smith, Kyla

Investigating the teacher self-efficacy of mathematics teachers in Canada. (Presentation)

Teacher self-efficacy refers to a teacher's perception of their capabilities on specific tasks related to teaching. This presentation will explore mathematics teachers' self-efficacy related to instructional strategies, classroom management, and student engagement, using in-progress data from a study of science and mathematics teachers in western Canada.

Sonni, Aicha

Developing mathematical resilience while addressing mathematics anxiety (Presentation)

Recent international studies are alarming about mathematics anxiety (MA) levels and mathematics performance In French schools. As a mathematics teacher in disadvantaged areas in France, I observed avoidance and passivity, symptoms of MA. As a researcher, I focus on developing mathematical resilience and coping skills. I surveyed students from disadvantaged areas in France aged 10-15 years about MA and teachers (N=185) about students' attitudes toward mathematics. Using a design-based approach, I designed a whole-class intervention, based on 3 tools: hand model of the brain, relaxation response and growth zone model (Johnston-Wilder et al., 2020). I measured the impact on MA, using pre- and post-intervention surveys (N=120). A quarter of participants

declared high MA. Visible symptoms, avoidance and passivity, were observed by most teachers surveyed. This study, based on the affective domain, adds ways of developing mathematical resilience while addressing MA. The intervention proved effective, especially for students declaring high MA. Other studies are needed in other parts of the world as this study can help mathematics education become more effective and inclusive.

Wang, Ziyan

Exploring the relationship between preschoolers' pattern awareness and mathematical understanding. (Presentation)

Mathematics has always been seen as "the science of pattern". The awareness of the mathematical pattern that developed in preschool could predict preschoolers' future mathematical performance. However, the mechanism by which patterning teaching contributes to mathematical performance is still unclear. This study analysed data from Thouless and Gifford's pattern project to address two research questions: (1) Whether preschoolers' awareness of the mathematical pattern and structure and mathematical understanding influence each other? And why? (2) Whether the improvement of children's awareness of pattern leads to the advancement of their mathematical understanding? The results indicated that there is a correlation between children's pattern awareness and mathematical understanding. However, children's mathematical understanding has less influence on their pattern awareness, while children's pattern awareness has a more noticeable impact on their mathematical understanding. These findings also suggest that the improvement of pattern awareness would lead to the advancement of mathematical understanding, and pattern awareness could be improved by training. However, the practice of pattern awareness should be targeted and provide children with enough experience. Meanwhile, not all improvement in pattern awareness would lead to progress in mathematical understanding.

Yeung, Sze Man; Fujita, Taro

How to make practice more perfect? How to make practice more productive? (Presentation)

According to National Curriculum in England (Department for Education, 2013), the main objectives of mathematics learning are achieving procedural fluency, conceptual understanding and critical thinking. Among these, practice is a crucial component for promoting procedural fluency (Department for Education, 2020). However, practice is always stereotyped as mechanically repeating steps and being over-simplified to 'More practice makes perfect'. Moreover, the recent practice-related studies are mainly from phycological or behavioural aspect, but rarely discuss the fundamental design of practice from the mathematical point of view. This phenomenon might result from the incomplete definition of conceptual and procedural knowledge (Star, 2005). Based on the finding in the literature review, this study aims to explore and reposition the role of procedural learning by introducing deep procedural learning which refers to the cognitive understanding of the computational processes and flexibly use different computational strategies. A series of purposely designed practices, namely productive practices, will be introduced in this presentation. Productive practice aims at developing higher-order thinking and understanding when practising essential procedural skills (Wittmann, 2019). This relatively new approach of practice can effectively provide greater motivation to the students for skills training, thinking mathematically and adopting strategies flexibly.