



PRACTITIONER RESEARCH IN MATHEMATICS EDUCATION (PRIME)

De Morgan House, 57-58 Russell Square, Holborn, London WC1B 4HS
Saturday 7 December 2019

PROGRAMME

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|--|---|--|---|
| 10:00 | Registration and refreshments | | |
| 10:30 | Introduction and welcome Room: Hardy | | |
| 10:35-11:35 | Keynote talk by Pete Wright 'Developing practitioner-led classroom inquiry into action research' Room: Hardy | | |
| Parallel Research Presentations # 1 | | | |
| | Room: Hardy Chair: Worthington | Room: Cayley Chair: Barnecutt | Room: Burnside Chair: Carvalho |
| 11:40 | Learning from variation: How Variation Theory might be relevant in fostering young children's developing mathematics sense <i>Williams*, Trundley*, Pulley, Dayment, & Magee</i> | What can we do to improve Year 6/7 Maths transition? <i>Palmer*, Spittal* & Beeby*</i> | Cultural Capital and primary mathematics <i>Turvill</i> |
| 12:10 | Exploring partner talk in primary school maths <i>Worthington</i> | Teachers in transition: The challenges of facilitating student-led Project-Based Learning (PBL) <i>Barnecutt</i> | Visible maths pedagogy: Making teachers' intentions explicit in a maths classroom <i>Carvalho* & Fejzo*</i> |
| 12:40 | Lunch and refreshments | | |
| CPD Workshops | | | |
| | Room: Hardy | Room: Cayley | |
| 13:40-14:20 | Interviews and video-stimulated reflection <i>Wright</i> | Writing for a practitioner audience <i>Foster & Williams</i> | |
| Parallel Research Presentations # 2 | | | |
| | Room: Hardy Chair: Tapper | Room: Cayley Chair: Ash | Room: Burnside Chair: Boli |
| 14:25 | Using reflective journals in mathematics in Key Stage 2 to develop deeper thinking and understanding of mathematical processes <i>Bobik-Dawes* & Majid*</i> | Solving mathematical word problems using passively received visualisation (PRV) and self-constructed visualisation (SCV): The case of primary school students with Attention Deficit Hyperactivity Disorder (ADHD) in Kuwait <i>Almuwaiziri</i> | Volunteers or conscripts? Investigating the impact of compulsory mathematics on students' maths motivation and attainment in a Further Education college <i>Norris</i> |



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|-------|---|---|--|
| 14:55 | Exploring how pre-teach interventions and assigning competence develop both pupil's self-efficacy and their learning behaviours to fully access maths lessons <i>Maquire</i> | Teachers' mathematical beliefs and knowledge and the use of multiple representations <i>Ash</i> | Building a pedagogical framework inspired by Socratic pedagogy to teach GCSE maths in Further Education <i>Boli</i> |
| 15:25 | Making the difference: Closing the gap in pupil attainment in Key Stage 2 Maths <i>Tapper</i> | Teaching Isometric drawings in a middle school class: A design-based research cycle <i>Saralar</i> | A preliminary enquiry into students' conceptions of the topic of quadratics <i>Hobson</i> |
| 15:55 | Completion of evaluation forms & Close of the event | | |

ABSTRACTS

Keynote talk: *Developing practitioner-led classroom inquiry into action research*



About the keynote speaker

Pete Wright is a Lecturer in Mathematics Education at UCL Institute of Education where he teaches on the PGCE Secondary Mathematics, PGCE Physics with Mathematics, MA in Mathematics Education courses. Prior to this, Pete taught for 12 years in comprehensive schools in London, Newcastle-upon-Tyne and Brighton, including 3 years as a Head of Mathematics. Pete also serves as the Book Reviews Editor for London Review of Education; the Online Communications Officer for the British Society for Research into Learning Mathematics, and as a member of the International Committee of Mathematics, Education & Society.

There has been recent renewed interest in 'close-to-practice' research involving practitioners and researchers working together to address problems in practice. The potential of such research to impact on professional understanding and to challenge established practice has been widely acknowledged. However, such research is often perceived as lacking rigour and being limited in scale. In this talk I will focus on how mathematics teachers involved in classroom inquiry can develop their practice into a systematic and rigorous form of action research. I will discuss how this can enable them to generate findings which are relevant to other practitioners and which are transferable to other classroom contexts. I will consider how working collaboratively with external partners can help to develop a critical understanding of existing practice and to bring about changes in practice that are informed by previous research. I will outline steps teacher researchers can take to ensure that their own classroom investigations are conducted in a robust and trustworthy manner. I will highlight how research methods, such as using reflective journals, student surveys, interviews and video-stimulated reflection, can provide evidence to support the rigorous evaluation of new teaching approaches and strategies tried out in the classroom.



Parallel research presentations

Almuwaiziri, Fatemah
University of Reading
PhD student and class teacher

Solving mathematical word problems using passively received visualisation (PRV) and self-constructed visualisation (SCV): The case of primary school students with Attention Deficit Hyperactivity Disorder (ADHD) in Kuwait

Based on Papert's theory of constructionism where the externalization (or the projecting out) of students' current understanding to the outside world is considered as a more effective way of learning, this intervention study sets out to test this theory by exploring the impact, if any, of Attention Deficit and Hyperactive Disorder (ADHD) students using self-constructed visualisation (SCV), which is here referred to as visualisation created by students, to help them solve word problems, in contrast to another strategy i.e. the passively received visualisation (PRV) which is here referred to as given visualisation that already comes with word problems. The current study adopted a sequential explanatory mixed-methods design with a sample size of 20 9-11 years old students (8 females and 12 males) across two special needs schools in Kuwait. Each student had 20 daily 30-minute one-to-one sessions. The study did not find any statistically significant differences in students' ability to solve word problems using either strategy, which brings the validity of Papert's theory into question. Moreover, no statistically significant difference was found in relation to the impact of using the SCV and PRV strategies on influencing students' ADHD behaviour.

Key words: *Attention Deficit and Hyperactive Disorder (ADHD); Self-Constructed Visualisation (SCV); Passively Received Visualisation (PRV)*
Relevant age range(s): *primary*

Ash, Andy
Our Lady of Pity Primary School (Merseyside)
Director of Teaching School / Maths Hub Lead

Teachers' mathematical beliefs and knowledge and the use of multiple representations

The reform of mathematics teaching is a well-established international effort that has struggled in many national school systems to have much impact on change in practice. In schools in England, a drive to develop reform-oriented practice in mathematics education known as 'Teaching for Mastery' includes the promotion of using multiple representations. However, issues highlighted within the literature suggest the use of multiple representations is problematic. A teacher's beliefs and mathematical knowledge for teaching seem likely to strongly influence the way in which they use multiple representations in the classroom, yet this is an area where there is little empirical research. This presentation reports on my pilot study with one primary school (Key Stage 2) and one secondary school (Key Stage 3) teacher, which focuses on the teaching of fractions and uses a mathematics knowledge activity plus classroom observation and teacher interview. The aim is to generate rich data to analyse how teacher's beliefs and mathematical knowledge for teaching are related to their use of multiple representations in the classroom. The findings from this will be used to inform future teacher professional development. The pilot study will inform my design of a larger multiple case study involving teachers in Key Stage 2 and 3.

Key words: *mastery; representations; fractions; beliefs; knowledge*
Relevant age range(s): *primary; secondary*



Barneclutt, Jessica
Oaklands School (London)
Assistant Head Teacher and Head of Maths

Teachers in transition: The challenges of facilitating student-led Project-Based Learning (PBL)

In this presentation, I will draw on the findings of my doctoral study, titled '*Teachers in Transition: The Challenges of Facilitating Student Led PBL*'. I will explore the findings of this study in the context of a statistical project taught at the study school, '*The Mathematics of Migration*', in which students work with a large data set. The school where this study was conducted was transitioning to teach with a hybrid of project-based learning (PBL) and teacher-led pedagogies, with the Year 9 mathematics students. The study adopted a qualitative approach. Data was collected from six teachers over a seven-month period through written reflective diary entries, in depth interviews, a focus group and an observation of a department meeting. A grounded approach was used, with simultaneous use of: theoretical sampling, categorising and coding, constant comparative analysis, memo writing and theory generation. The study found that in this school the teachers identified the biggest challenge, when teaching through PBL, as facilitating student-led learning. I will use *The Mathematics of Migration* project to highlight aspects that were perceived as limiting student-led learning and the strategies teachers used to aid student-led learning.

Key words: *project-based learning (PBL); student-led learning*
Relevant age range(s): *secondary*

Bobik-Dawes, Renata* & Majid, Nasreen*
St Joseph's College (Reading); University of Reading
Maths teacher; Lecturer in Primary Mathematics

Using reflective journals in mathematics in Key Stage 2 to develop deeper thinking and understanding of mathematical processes

The aim was to develop deeper levels of thinking concerning mathematical processes within Year 5 (24 pupils) and Year 6 (23 pupils). The project was inspired by recent work on metacognition and self-regulation by the Education Endowment Fund (EEF, 2018). Pupils completed mathematical journals every week for three terms. Pre- and post- project surveys of attitudes towards mathematics were performed to enable comparisons of feelings about learning and understanding mathematics. Pupils had a positive change in attitude once a routine of reflecting on mathematics was established. A review of written reflections, within and between year and attainment groups, showed increased awareness of mathematical thinking and demonstrated marked improvements in self-reflection and mathematical ability. Furthermore, a summative assessment at the end of the summer term indicated that 78.3% from Year 6 and 71.4% from Year 5 were working at a higher mathematical level compared with 70.8% and 58.3% for the autumn term. This indicates a clear link between increased capability to communicate and improvements in mathematics. The process also provided an opportunity to focus teaching for the class and individual pupils. Hence, writing journals helped pupils to improve their mathematics and their conceptual understanding of the subject.

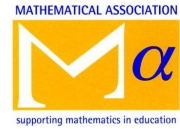
Key words: *Key Stage 2 mathematics; reflective journals; metacognition; self-regulation; thinking skills*
Relevant age range(s): *primary*



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Boli, Despoina
Westminster Kingsway College (London)
Mathematics lecturer

Building a pedagogical framework inspired by Socratic pedagogy to teach GCSE maths in Further Education

Teaching GCSE maths in Further Education can be a challenging matter. Pedagogical methods and techniques used in Secondary Education usually do not fit in Further Education (FE). Over the last few years, the need for developing students' problem-solving skills and engagement with the subject are matters under constant discussions. This research is focusing on the development of a pedagogical framework, inspired by the Socratic pedagogy, specifically designed for those cohorts in FE that re-sit GCSE maths. The first step in doing so is to examine the characteristics of those particular cohorts and understand how the educational environment of FE functions. To achieve the latter, online questionnaires and semi-structured interviews will be conducted in the academic year 2019-2020 in a FE college in central London. About 200 re-sit learners will be asked to respond on the questionnaire and a focus group will be selected for semi-structured interviews. Members of the teaching staff will also be interviewed to understand the teaching approaches used to help re-sit learners develop their problem-solving skills and engage with the subject. The findings of this research project and elements of Socratic pedagogy will be used to feed on the development of the above pedagogical framework.

Key words: *Further Education; GCSE Maths; Socratic pedagogy*
Relevant age range(s): *Further Education; post-16 Education*

Carvalho, Tiago* & Fejzo, Alba*
Stoke Newington School & Sixth Form (London)
Mathematics teachers

Visible maths pedagogy: Making teachers' intentions explicit in a maths classroom

Do students understand teachers' intentions? How does this determine the success of teaching progressive strategies in mixed attainment maths classes? Research suggests that students from disadvantaged backgrounds often misinterpret teachers' intentions when they employ more progressive teaching approaches. For the last two years, we have been developing strategies to make our pedagogy visible to our students as part of a small-scale action research project at Stoke Newington School (London). We use student surveys, audio-recorded interviews with target students and video-stimulated reflection of our lessons to evaluate the strategies and inform the next cycles of the project. In this practical workshop, we will model some of the pedagogies we use with our classes together with the strategies created to make them visible. We will be presenting our findings so far and explaining the impact this has on all students' engagement and success, particularly to those from disadvantaged backgrounds. This is an exciting moment in our project where we have been awarded a grant from Shine to disseminate and continue to develop our ideas.

Key words: *pedagogy; visible; social justice; equity*
Relevant age range(s): *early years; primary; secondary; higher education*

Hobson, Mark
Doncaster College
Lecturer

A preliminary enquiry into students' conceptions of the topic of quadratics

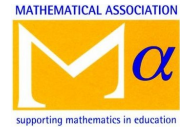
The ability to solve quadratic problems is a core element of mathematics study. Many studies have highlighted shortcomings in understanding fundamental principles in the topic, amongst both teachers and students. This



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short exploratory study reviews the depth of understanding of key points in quadratics through interviewing five students from GCSE, A-level and first year degree programmes. Qualitative analysis reveals surprising shortcomings but also demonstrates that with encouragement, especially through the use of technology, the potential for technical fluency in problem solving is possible. However, the demands of syllabus and time imply this technical fluency is at the expense of opportunities for deep understanding. Finally, the argument is that whatever the constraints placed on staff, properly supported and supervised action research might well be a route to ensure curriculum design will help promote expert performance.

Key words: *Quadratics; deep learning*

Relevant age range(s): *secondary; Higher Education*

Maguire, Carly

Sheringham Primary School (London)

Year 4 teacher and Maths Lead

Exploring how pre-teach interventions and assigning competence develop both pupil's self-efficacy and their learning behaviours to fully access maths lessons

Building on the work of the Babcock Project, this research sets out to answer: *To what extent can pre-teach interventions in maths support the development of pupil's self-efficacy and develop the required learning behaviours to fully access maths lessons?* Pre-teach interventions were facilitated once a week with two different groups of three children. They were 'assigned competence' in the following maths lesson by being publicly praised for using what they had been taught in the pre-teach session. Participants were observed, pre and post trial questionnaires were filled out by the participants and I filled out active participation rating scales, which show how active participants were in their maths lessons and to what extent they were demonstrating particular learning behaviours. Analysis of the responses and the observations showed that pre-teach interventions helped children access the following maths lessons, their confidence and self-efficacy towards maths increased and there is some evidence to suggest that over time their ability to explain their ideas improved too. The research also shows that even without the pre-teach intervention, children's self-efficacy can be improved by raising the status of children in the class, assigning competence and actively teaching specific learning behaviours.

Key words: *maths anxiety; self-efficacy; pre-teach interventions; assigning competence; learning behaviours*

Relevant age range(s): *primary*

Norris, Jennifer

City of Bristol College / University of Bristol

Maths Coach / Master's student

Volunteers or conscripts? Investigating the impact of compulsory mathematics on students' maths motivation and attainment in a Further Education college

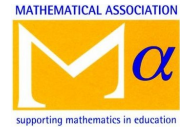
16 to 18 year olds continuing in Further Education without a grade 4 at GCSE are now required to continue studying maths in some form. This group of previously 'failed' students are widely acknowledged as demotivated, and pass rates for GCSE retakes remain persistently low. I have been investigating student responses to enforced maths study, comparing volunteers who willingly engage in maths courses with conscripts who feel coerced into taking the subject. The study used a questionnaire to gather students' opinions and attitudes (N=184), linking their responses to end-of-year examination results (N=136) and following up with one in-depth interview to add further insight into the complexity of students' motivations. In this presentation, I share findings from the study, which are both surprising and challenging, suggesting that there are many more volunteers than might be expected and that students are often more ambitious than we give them credit for. This session offers a critique over whether compulsory maths is achieving what it set out to do, along with a



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discussion about implications for college decisions on which post-16 pathways to offer, in the light of the diversity of students' responses and needs.

Key words: *post-16 mathematics; policy; motivation; student choice*

Relevant age range(s): *Further Education*

Palmer, Mari*, **Spittal, Janet*** & **Beeby, Stuart***

Settrington All Saints' Primary CofE; Scalby Secondary and Wykeham; Hackness Federation (North Yorkshire)
Head teacher & Director of North Yorkshire Coast Research School; Maths teacher; Head teacher

What can we do to improve Year 6/7 Maths transition?

We are a group of 30+ primary and secondary schools working together to try and improve maths transition. We have completed the pilot phase of our work, working with six clusters simultaneously, developing links between the schools. In this phase, we worked on sharing CPD together and each group produced a small 'product' e.g. a vocabulary list, visits from secondary teachers to primaries, work being taken to the secondary and beginnings of a joint representation policy. This showed huge impact on the staff. Prior to the project: *nearly 60% of 30+ teachers involved had not visited a classroom from the other Key Stage in the previous three years; 50% had not seen the National Curriculum from the other Key Stage; 86% had not shared CPD with staff from the other Key Stage; 100% said they had started to develop an academic plan for transition; 100% said they had started to consider a progression in skills between the two key stages.* We have not reached the point of measuring impact of the increased collaboration and joint CPD on pupils academic outcomes: we are going to move onto this this year and are being supported with this by Silke Gobel (University of York). This year, we are focussing on developing consistent vocabulary and representations.

Key words: *maths; transition; Key Stage 2; Key Stage 3*

Relevant age range(s): *primary; secondary*

Saralar, Ipek

University of Nottingham

Mathematics teacher & PhD student

Teaching Isometric drawings in a middle school class: A design-based research cycle

The researcher of this study is a qualified mathematics teacher who taught in a middle school for more than three years. Similar to many of her colleagues, she experienced difficulty in teaching objectives which require spatial thinking and making isometric drawings is one of these objectives. Hence, she attempted to solve this problem by designing a series of lessons based on the RETA principles which support *realistic, exploratory, technology-enhanced and active lessons*. The aim of the study was to see whether the RETA lessons are effective and engaging and to look for opportunities to improve them if they were found not to be. The researcher acted as an after-school mathematics teacher and enacted six lessons over six weeks (one lesson per week). The participants were eight seventh graders who volunteered for extra mathematics lessons. The data were generated through observations, interviews and worksheets and analyzed through thematic analysis and a rubric with all possible correct answers. The findings showed that the students experienced the RETA principles in the lessons mostly positively. All principles potentially affected students' isometric drawing performances, and the results suggested that students performed better after the lessons (Pre-intervention worksheets $M = 10.5$, $SD = 8.1$; Post-intervention worksheets $M = 16.9$, $SD = 4.2$).

Key words: *3D shapes, representations, middle school, design-based research, student experiences*

Relevant age range(s): *secondary*



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Tapper, Anna

Unity Research School (Suffolk)
Primary Maths Research Project Lead

Making the difference: Closing the gap in pupil attainment in Key Stage 2 Maths

I am currently leading an 18-month Strategic School Improvement Fund (SSIF) project to improve the quality of teaching maths in 15 primary schools across Suffolk with the aim of raising attainment of disadvantaged children. The need for the project was identified through data from the LA and from individual schools that there was an attainment gap between disadvantaged and non-disadvantaged children's attainment in maths. We also identified primary maths as an area where teachers lacked confidence and subject knowledge. We used the EEF guidance reports on maths and metacognition as our evidence base to inform the work we did in classes. We held 5 days of CPD for teachers and followed each session up through 1:1 coaching, team teaching and co-planning. We also worked with schools to support parental engagement in maths. We have tracked children's progress through standardised tests at the end of each term. In Year 4, we worked with 689 children of whom 169 were eligible for the Pupil Premium. In Year 5, we worked with 676 children of whom 203 were eligible. Overall, the average standardised score for Pupil Premium (PP) children in Year 4 had risen by 5.38 points compared to 1.39 points for non-PP children. In Year 5, the average standardised score had risen by 7.14 points for PP children compared to 1.65 points for non-PP children. We have learnt many lessons as the project has gone on about how best to support schools and parents and the challenges of working with 15 different schools which I will be able to share with delegates.

Key words: *metacognition; EEF; Key Stage 2; parents*
Relevant age range(s): *primary*

Turvill, Rebecca

Bosco Catholic Education Trust (West Sussex)
Director of Primary Maths

Cultural Capital and primary mathematics

In this session, I will draw on findings from my 2016 doctoral thesis exploring social inequalities in primary mathematics. Drawing on Bourdieu's key tools of cultural capital, habitus and field, I take a critical look at primary mathematics classrooms. Using an ethnographic approach of participant observation in two contrasting primary school settings, I examined the role of mathematics to reproduce social inequalities. In light of recent attention being given to cultural capital (Ofsted 2019), my data reveal how children continue to be positioned with primary mathematics classrooms by their habitus. The impact this has for children's outcomes is considered with reflection on the role schools play in reproducing and challenging inequality through mathematics.

Key words: *Cultural Capital; social inequality; primary maths*
Relevant age range(s): *primary*

Williams, Helen*; **Trundley, Ruth***; **Pulley, Leone**; **Dayment, Chris & Magee, Misa**

Independent consultancy; Babcock LDP; St Ives Infant School, Cornwall and Great Torrington Bluecoat Primary, Devon
Independent consultant; Maths Adviser (team lead); Class teacher; Class teacher; Class teacher

Learning from variation: How Variation Theory might be relevant in fostering young children's developing mathematics sense

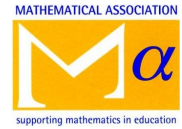
The research project was a winner of the British Curriculum Forum's Curriculum Investigation Grant for 2018/2019. Researchers Dr. Ruth Trundley and Dr. Helen J Williams, both experienced teachers, worked in



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collaboration with three teachers from two primary schools investigating how Variation Theory (Marton & Tsui, 2005) might be applied to the use of manipulatives to support understanding of early number. This project involved a case study of 12 Year 1 children (5-6 years old) selected by the teachers. The mathematical focus chosen was the move from 'counting-all' to 'counting-on', which research indicates is critical for numerical understanding (Nunes & Bryant, 2009) and yet difficult to establish reliably (Thompson, 2008). This project explored which manipulatives of four in common use in Key Stage 1 classrooms might be effective in highlighting the essential features of this mathematical idea. Data collection involved the researchers in three teaching sessions with trios of children, with assessment sessions to begin and conclude these, alongside on-going meetings with the teachers, whose explorations of a chosen aspect of the findings over the following term led to further findings. Through analysis of the teaching sessions, key sub-skills and understandings were identified by the researchers making a significant contribution to the understanding of counting-on.

Key words: *variation; number; manipulative; counting; understanding*
Relevant age range(s): *early years, primary*

Worthington, Johnny
Gallions Primary School (London)
Class teacher

Exploring partner talk in primary school maths

As increasing numbers of primary schools adopt a mastery approach to maths teaching, mathematical partner talk has taken an ever more prominent role. Given that communication, problem solving and teamwork are three of the most highly desired skills in the modern job market, the importance of student talk has never been greater. This action research aims to investigate partner talk in a series of maths lessons in a Year 5 class in an East London primary school. Building on existing scholarly research on talk, it asks: *what type of talk do students currently engage in and what strategies can be implemented to improve talk?* Three pairs of students were recorded solving a problem during three different maths lessons. Analysis of the conversations showed that partners did not always engage with each other's ideas and had difficulty in expressing certain concepts due to an inability to articulate their ideas coherently. Teaching strategies to improve student weaknesses were researched and implemented. On the basis of the results in this study, several strategies are recommended: the explicit teaching of talk in all subjects; providing students with opportunities to reflect upon their talk; establishing a whole school respectful learning environment, in which students listen attentively to each other.

Key words: *talk; oracy; communication; dialogic teaching*
Relevant age range(s): *primary*