BOOK OF ABSTRACTS

MCLS CONFERENCE 2023
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Table of Contents

PROGRAMME OVERVIEW 9

MONDAY 5 JUNE 13

Preconference Workshops, 2.00 pm – 5.30 pm 13
Data visualisation 13
Computing statistical power in R using simulations 13
How to make a research lab accessible 14

TUESDAY 6 JUNE 15

Symposia 9.00 am – 10.15 am 15
Learning arithmetic and literacy: Common dynamics and cognitive underpinnings in typical and atypical samples 15
Design and delivery of mathematics intervention in schools 18
Emotions, attitudes, and beliefs in math learning: new insights from implicit and explicit measures 20
Investigating home math environments: Looking beyond mothers' inputs in relation to children's math skills 23
ManyNumbers: A planned multi-lab investigation of the conceptual foundations of early number development 25

Symposia 10.45 am – 12.00 pm 28
Using real-time data of mathematical thinking and learning processes as a basis for adaptive cognitive and affective support 28
More than nothing? Empirical insights into children and adults' conceptions of "zero" 31
Assessing advanced mathematical understanding 33
Nothing works in isolation: How mathematics anxiety influences children's mathematics achievement 35
The impact of language experience on mathematical abilities: Evidence from deaf and hard of hearing children and adults 38

Poster session 1 (1.00 pm – 2.00 pm) 41
1. Parental mathematical talk in the home environment in the UK and Mexico 41
2. Spatial language in bilingual families across three activities 41
3. A month-long parent-led spatial intervention 42
4. Early numeracy and mathematics development: A longitudinal meta-analysis on the prediction nature of early numeracy 42
5. Math anxiety predicts aversion to social comparison in classroom mathematical contexts 43
6. Building word-problem solving and working memory capacity: A randomized controlled trial 43
7. A synthesis of pre-algebraic reasoning interventions for middle-school students with mathematics difficulty 44
8. Neural substrates for fast numerical and non-numerical magnitude averaging 44
9. Classroom peer effects on preschool children's mathematics learning 45
10. Fraction interventions for secondary students with mathematics difficulty: A research synthesis 45
11. Using books to improve mental rotation skills in 4- and 5-year-old children 46
12. Assessing young children's understanding of length measurement units 46
13. Assessing the association between math talk and math performance: A meta-analysis 47
14. The effects of caregiver involvement on early childhood mathematica Achievement: A research synthesis 47
15. What counts as math? How adults view the importance of children's everyday activities 48
16. Do preschool children use spatial coding for serial order in working memory: a replication study 48
17. Symbolic ordering task performance with retrospective reports and its relation to arithmetic skills in children 49
18. Semantic priming across domains: from language to mathematics 49
19. Effects of differing degrees of direct parental support during arithmetic problem solving on children's performance 50

20. Examining the interplay between the cognitive and emotional elements of spatial processing. 50
21. Reliability and validity of commonly-used measures of attention in preschool children and their associations with preschool and kindergarten math ability 51
22. Developmental associations of skills and self-concept of ability in reading and math across grades 1-9 51
23. Gender differences in parents' beliefs and engagement in home mathematics activities 52
24. The relationship between math performance and math anxiety: Insights from application of the quantile regression method to data from a large-scale international assessment 52
25. Collaborating with educators to co-develop an early years mathematics and executive function intervention: Steps taken and lessons learnt. 53
26. Conceptual interference in mathematics: Associations with mathematical competencies and inhibition processes 54
27. Learning opportunities for numerical skills in tabletop games identified from game and learning mechanics 54
28. A systematic review and meta-analysis of the relation between frequency of home mathematical activities and early mathematical achievement 55
29. Domain-general and domain-specific factors explaining the multiplication skill 55
30. Strategic use of quantifiers in reporting statistics 56
31. Perceptions of calculation mediate the relation between math anxiety and performance on SAT math problems 56
32. Associations of fraction number line estimation accuracy with gray matter volume: a voxel-based morphometry analysis 57
33. Diversity in bilingual proficiency development for math and cognition among Latine dual language learners in the U.S. 57
34. Exploring the causal relation between spatial skills and math competence through a game-based spatial skills training: A randomized controlled trial. (P) 58
35. Assessing the causal role of the home numeracy environment on children's mathematical skills. A pre-registered study of a familial intervention in preschool children. (P) 58
36. Ordinal and cardinal acquisition in children with Developmental Language Disorder. (P) 59
37. Neurocognitive mechanisms of fraction processing in primary school children in South Africa.(P) 59
38. The role of working memory in the relation between spatial abilities and math performance. (P) 60

Symposia 2.00 pm – 3.15 pm 61
Big ideas for little kids: Early conceptual foundations in mathematics 61
Numerical and mathematical cognition among neurodivergent children 63
How much and where: Conceptualizing and measuring different types of children's mathematical language 66
Mathematical brain before school entry 69
Look what you made me do: Registered reports on early mathematics interventions 71

Poster session 2 (3.45 pm – 4.45 pm) 74
1. COVID-19 infection and children's mathematics learning 74
2. "In math class, I am confident in solving word problems": Creating a strengths-based mathematics survey 74
3. Does executive function moderate and/or mediate the spatial-math link? 75
4. Children's gender stereotypes about the relative roles of effort and talent in math achievement 75
5. Frequency and adaptivity of children's subtraction by addition use: The role of conceptual knowledge 76
6. Family support professionals as models of early mathematical dialogue: More questions than answers? 76
7. Impact of manipulatives on 3rd-grade students' performance in math tasks: The case of money as a manipulative material in math education 77
8. A person-centered analysis of the relations between motivation, math achievement, and STEM career interests among Black high school students 77
9. Schema instruction for word-problem solving in the early grades: A research synthesis 78
10. The prediction of mathematical creativity scores: Mathematical abilities, personality and creative self-beliefs 78
11. A mathematics-writing synthesis: Kindergarten through 12th grade mathematics-writing efficacy and instructional methods 79

12. Development of Maths Whartels intervention programme using play as part of a neuropsychological approach to improve maths achievement in different cultural contexts of United Kingdom and South Africa 79
13. Children's use of the inversion principle in arithmetic problems 80
14. The impact of number length and numerical value on multi-digit number processing 80
15. A Novel task for measuring spontaneous focus on numerals among adults: A psychometric investigation 81
16. Two processes across two domains: Shared global-holistic and componential-analytical mechanisms in language and numerical cognition 81
17. Do children show spatial asymmetrical choice in an ordinal-spatial task with a landmark? A pilot study 82
18. Parent spatial talk complexity during spatial play is associated with toddlers' spatial relation comprehension 83
19. Investigating affective mimicry in math anxious individuals 83
20. Exploring the development of children's ordinality knowledge 84
21. Association Between Relational Reasoning and Mathematical Achievement: Mediating Roles of Arithmetic Principle Understanding and Word Problem Representation 84
22. Word problems, item difficulty and low performers 85
23. Need for better standardization of ANS acuity and 'mathematical ability' measures 85
24. Novel symbol learning and transfer to mental arithmetic problem-solving: a pilot study 86
25. Potential factors determining the small number bias in random number generation 86
26. Mathematics and emotions in young in 3-6 year-old children, what's the link? 87
27. Professional architects reveal a smaller distance effect than controls in the angle magnitude classification task, but none of them display an association between angle magnitude and response side 87
28. Effect of gender on math anxiety: Insights from the frAMAS study 88
29. Can individualized math instruction improve the social participation of students with special educational needs? 88
30. Crossmodal recognition of layout geometry in house cricket Acheta domesticus 89
31. Should self-efficacy align with one's actual math skills? The case of low performing children 89
32. Calibration effect on estimation in 7-year-old children and adults 90
33. Does the number of opportunities to learn mathematical language differ based on the representation of the quantity (e.g., symbolic vs non-symbolic)? 90
34. Game elements increase perceived self-efficacy in children with dyscalculia 91
35. Characterizing how the brain encodes symbolic and nonsymbolic numerical quantities; an fmri study. (P)91
36. Parent-based maths apps in the home learning environment: A randomised control trial. (P) 92
37. The association between gray matter volume and mathematical performance in 5-year-old children. (P) 92
38. Effects of multisensory input on numerical representations of diverse-SES preschoolers. (P) 93
39. Developing and Validating a Measure of Parental Knowledge About Early Math Development 93
40. Neural similarity between children and their mothers for reading and arithmetic. (P) 94

Symposia 4.45 pm – 6.00 pm 95
Exploring the underlying mechanisms of number processing and math cognition 95
Dyscalculia – early detection and prevention of neuromyths 97
Mathematical explanations 100
Measurement and impact of parent-child interactions for mathematical learning in the home environment 102
Equity-focused programs to measure and promote math learning and executive functioning 105

WEDNESDAY 7 JUNE 108

Symposia 9.00 am – 10.15 am 108
How is numerical syntax complex, and why is it hard? 108
Early algebraic thinking 110
Risk assessment for mathematics difficulties and disabilities 112
Children's strategies in arithmetic 114
Beyond the surface: Which features of instructional materials help or hinder mathematical learning 117

Open Submission Talks 10.45 am – 12.00 pm 120
Math attitude/anxiety & gender 120
Presentation 1: Math-attitudes intervention programs for school-age students: A meta-analysis and overview of the literature 120
Presentation 2: Doing well and thinking positively about it: The unbalanced bi-directional relationship between math attitudes and math achievement 120
Presentation 3: Field of study and gender modulation of the effect of personality and math anxiety on numeracy 121
Presentation 4: Gender differences in number line performance for 7- and 8-year-old students 121
Struggling learners & intervention 122
Presentation 1: Patterns of network connectivity associated with phonological memory, language, and numerical processing for multilingual first graders 122
Presentation 2: Identifying struggling students from in-game behaviours: A machine learning approach 122
Presentation 3: Counting-focused intervention effects for students with mathematics difficulty: A research synthesis 123
Presentation 4: Experience with equations in sequence enhances problem-solving performance 124
Numerosity perception & rational numbers 124
Presentation 1: Modeling the effect of color entropy and connectedness on numerosity perception throughout development with the diffusion model 124
Presentation 2: Examining the concurrent validity of extant measures of approximate number system as measured by the dot comparison paradigm 125
Presentation 3: Beyond integers: Understanding the cognitive mechanism and neural bases of rational number development 125
Presentation 4: Do playful math activities support fraction learning in first graders? 126
Early math skills & home environment 126
Presentation 1: Examining components of early maths skills and inequalities in mathematical development using large-scale secondary data 126
Presentation 2: Methodological considerations in number talk measurement 127
Presentation 3: Parents engage in home mathematics activities the least! Examining the frequency of four home learning environment subdomains 127
Presentation 4: Testing the early home environment as a mechanism underlying the effects of paternal education and math and social-emotional outcomes at age nine 128
Arithmetic & strategies 129
Presentation 1: Eye movements as an indicator of the strategies recruited to solve arithmetic problems: the case of subtraction by additions 129
Presentation 2: Inhibition is key: A cognitive approach to successful word problem solving 129
Presentation 3: Encoding and recoding activities for conceptual change 130
Presentation 4: Neural correlates of subtraction and multiplication in adolescents. 130

Poster session 3 (1.00 pm – 2.00 pm) 132
1. Look At It This Way: Equal Sign Position and Blank Position in Multiplication Problems Affect Reaction Time 132
2. The Effect of Problem Format on Arithmetic Problem-Solving 132
3. The Role of Creativity in Arithmetic Word Problem-Solving 133
4. Executive Function and Mathematical Skills Correlate Differently for Science and Non-Science Secondary School Students 133
5. Co-Development Among Math, Reading, Science, and Working Memory in the Elementary Stage: For Whom and What Triggers? 134
6. Symbolic and Non-symbolic Number Format Integration In Adults and Children Probed with Frequency Tagged EEG 134
7. Short-Term Storage of Working Memory Mediates the Relation Between Math Anxiety and Arithmetic Performance 135
8. Assessment of maths anxiety in early schooling: Emergence, stability and SES differences 135
9. Using cognitive predictors to predict poor mathematics performance in 7 and 8-year-old children: a feasibility study 136
10. Validating a measure of growing pattern understanding in preschool children 136
11. What do teachers in training know about children's conceptual understanding of arithmetic? 137
12. Worried about transitioning to secondary school? The influence of mathematical skill, confidence and anxiety. 137
13. Diagnosing specific learning disorder in mathematics in a multilingual education context 138

14. Do additional magnitude cues benefit children's number line performance? 138
15. Parents' attitudes and self-efficacy impact children's multiplication fact practice at home. 139
16. More is better: Language statistics reveal a bias towards addition....139
17. Cross-notation rational number magnitude comparison predicts math college entrance scores 140
18. The Significance of Symbolic Gestures and Pointing Usage in Early Childhood Mathematics Instruction 141
19. Frequency-tagging EEG reveals instruction-driven magnitude integration using the numerical distance effect 141
20. Place-value understanding in Brazilian children and its relationship to numerical transcoding and arithmetic operations tasks....142
21. Pupil Dilation during a Number Line Estimation Task 142
22. Categorical syllogistic reasoning longitudinally predicted mathematics achievement in school-aged children 143
23. Validity of the flexible attention to magnitudes task for young children 143
24. Parental math skills predict children's math skills and the effect is not mediated via home math environment (HME)....144
25. Gesture can influence what number you have in mind....144
26. A categorization of self-reported strategies in human numerosity estimation 145
27. Does the math anxiety-performance link depend on paradigm? 145
28. When children with developmental coordination disorder use finger-counting: behavioral and 3D motion analyses....146
29. Struggling with single-digit multiplications during primary school. Problem solved? 146
30. Concurrent predictors of toddlers' spontaneous math focusing tendencies during a picture description task 147
31. Finger counting, finger montring and their impact on early mathematical skills....147
32. Acquiring the successor function of symbolic numbers: longitudinal comparison of verbal number words and number gestures....148
33. Impact of home mathematical environment on early numeracy skills in Cuban preschoolers....148
34. HRV as an index of regulation and cognitive function to predict numeracy performance 149
35. Identifying general and maths specific anxiety levels in secondary school pupils in the UK....149
36. Students' use of unit coordination when solving school-based place-value tasks (P)....150
37. Neural representation of discrete and continuous ratios in the visual and parietal cortex: A preregistered report (P) 150
38. Design and evaluation of 'The Mathematical Strategies Development Test' (P) 151
39. NumRisk: number sense and financial decision making in dyscalculic adolescents (P)....151
40. Leveraging a Visuospatial Language to Enhance Quantitative Learning (P)....152
41. Studying how ANS numerosity representations are dynamically built (P) 152

Symposia 2.00 pm – 3.15 pm 154
Numerical development and applied mathematics – from kindergarten to primary school. 154
Integrating perspectives on adults' and children's math anxiety 157
Evidencing the approximate system - findings from different research perspectives....159
Parent language input, math attitudes, and family contexts in children's math learning....161
"Everything I know I learned after I was thirty.": the past, the present, and the future of Spatial-Numerical Associations 163

Symposia 4.45 pm – 6.00 pm 166
Foundational number skills and early assessment....166
The multiple aspects of dyscalculia and calculation difficulties....168
Algorithmic foundations of mathematical development....170
Gesture's role in numerical development....173
Numerical cognition in healthy and pathological aging....175

THURSDAY 8 JUNE 179

Symposia 9.00 am – 10.15 am....179
The role of perception in arithmetic cognition....179
Mathematics attitudes and performance: importance of self-concept and self-efficacy....181
Symbolic and non-symbolic number processing in dyscalculia 183

Data based individualization in mathematics for struggling learners 185
The role of inhibitory control in mathematics: Beyond correlations 188

Symposia 10.45 am – 12.00 pm 191
Automatic number processing: Features, measurement, and links to individual characteristics 191
Developmental pathways of mathematical abilities: Evidence from typical and atypically developing populations 193
Perspectives and influences on math engagement in early childhood: The role of family math 195
Number games in the real world: Factors influencing play-based interventions at home and school 198
Early math and motor skills: Evidence from around the world 200

Poster session 4 (1.00 pm – 2.00 pm) 204
1. Development and validity of the QIF-M, a scale assessing children's self-perceptions of their daily numeracy activities 204
2. Is spatial language an important predictor of early math knowledge? 204
4. Developing a Patterning Lens to Improve Early Numeracy Knowledge: A Pilot Study 205
5. Integrating Dynamic Mathematical Technology into the Classroom: The Cases of Three Teachers Teaching Geometric Similarity 205
6. The effect of short-term memory and magnitude processing in single-digit multiplication solving 206
7. Inhibition of the "add zero(s)" heuristic is needed to multiply by 10, 100, 1000 decimal numbers: a developmental conflict adaptation paradigm study 206
8. Mathematics Interventions for Secondary Students with Emotional and Behavioral Disorders: A Research Synthesis 207
9. Shared neural resources for math and reading in children and adults 207
10. Math Anxiety, Spatial Anxiety, and Spatial Language Experience 208
11. Stronger neural response to canonical finger-number configurations in deaf compared to hearing adults revealed by FPVS-EEG 208
12. Functional lateralization of number processing 209
13. Young Children’s Understanding of Symbolic Fractions: Do Part-Whole Labels and Active Subdividing Interventions Help? 209
14. The Development of a Math Anxiety Scale for Chilean Kindergarten Children 210
15. The role of maths anxiety and confidence in understanding performance on both the long and verbal versions of the Cognitive Reflection Test 210
16. Children's number line performance: The impact of directionality and modality 211
17. Conditionality of adaptiveness: Investigating the relationship between numeracy and adaptive behavior 211
18. The Preschool Classroom Library: Is There a Place for Mathematics? 212
19. Presemantic and semantic processing of digits in adults with developmental dyscalculia 212
20. Spatial working memory capacity moderates the association between fine motor skills and mathematics in preschoolers 213
21. How equal are equivalent fractions? 213
22. The direction of SNAs is modulated by task demands rather than stimuli rotation and visual perspective taking 214
23. Supporting the development of numerical cognition in preschool children: tablet-based vs. paper-pencil training 214
24. Evaluating Brazilian children’s early numerical concepts development using MARKO-Screening 215
25. The role of cultural support on commutativity at varying levels of abstraction 215
26. From Here to There and Beyond: Understanding Optional Challenge Seeking in an Educational Math Game 216
27. The effects of a symbolic number training intervention on children’s developing numeracy skills 216
28. The influence of phonological processing on children at risk of mathematical learning disability: An intervention study 217
29. Understanding and assessing young children’s mathematical learning potential. (P) 217
31. Individual differences in mathematical expertise: The effects of cognition, personality and domain-specific creativity. (P) 218
32. Understanding the relationship between procedural complexity in mathematics and spaced retrieval practice. (P) 218
33. The role of estimation strategies in human numerosity estimation. (P) 219
34. Does math anxiety influence how people process discounts? (P) 219

35. The role of home and preschool environment on maths development in the early years: Do differences in quality matter? (P) 220
36. Exploring the impact of an intervention on the relationship between the early maths abilities and executive functions: a network analysis approach. (P) 220
37. There is "order" and "order": Behaviour, electroencephalography, and age-related markers of learning novel symbols via sequential or non-sequential order information. (P) 221

Symposia 2.00 pm – 3.15 pm 222
Learning environments contributing to early numeracy and literacy skills 222
Post-stroke numerical deficit (Acalculia): Prevalence, impact, assessment and interventions 224
Word problems? No problem! School-based interventions for students with word-problem difficulty 227
Cognitive, affective, and developmental factors in the spatial and ordinal understanding of numbers 230
Understanding the interplay of attention, executive function and mathematics by embracing complexity: From theory, to diversity, to intervention... and back to theory again 232

studies could be categorised. These ranged from simple coding of the frequency of number words used to more complex coding schemes that considered different types of number domains, or the different types of utterances used by parents. We also conducted a meta-analysis for a subset of studies (n=26) that also reported children's mathematics skills. The correlation between parent mathematics talk and children's mathematics skills was 0.08. The type of coding category was not a significant moderator of the size of this effect. We will discuss the methodology and theoretical implication of this.

Equity-focused programs to measure and promote math learning and executive functioning

Chair: Geetha Ramani
University of Maryland, College Park

Disparities found in children's mathematical achievement are often due to unequal access to opportunities and resources. Therefore, providing rich, challenging, and evidence-based approaches for all students is critical for reducing differences in math outcomes. Targeting foundational underlying skills, such as executive functioning (EF), also could assist in reducing these inequalities found in math performance. This symposium includes four projects that are a part of the EF+Math Program, which supports multidisciplinary teams to develop methods and tools to measure and promote math learning by strengthening EF skills. The program centers students in grades 3-8, with a particular focus on Black and Latine students experiencing poverty in the United States. The symposium will present innovative methods and tools designed with a focus on diversity, equity, and inclusion to test and promote math learning and executive functioning. In the first presentation, Guo will discuss an active and playful learning approach to promote children's rational number learning and emotions. In the second presentation, Pahor will present a novel set of tools to measure and visualize math and EF skills using mobile app technology. In the third presentation, Buschkuehl will present findings from a novel web-based program to promote math fact fluency and EF skills simultaneously. Finally, Meyers will discuss a curriculum overlay for 3rd-5th grade students to improve EF skills, math identity, and math outcomes for Black and Latine students. Together, the symposium will present innovative approaches that could be used as resources and opportunities to enhance students' math outcomes.

Presentation 1: Impact of Fraction Ball Activities on Students' Mathematics Emotions

Siling Guo*, Lourdes Acevedo-Farag, Jesse Giovanni Sanchez, Daniela Alvarez-Vargas, LuEttaMae Lawrence, Andres Bustamante, Kreshnik Begolli, Katherine Rhodes, Lindsey Richland, Drew Bailey
University of California, Irvine, School of Education

Rational number learning is challenging for elementary students and may cause frustration and anxiety about mathematics. Fraction Ball allows students to actively learn fractions through embodied and playful activities that integrate teacher knowledge and the science of learning. The intervention consisted of six outdoor basketball games and six classroom lessons co-

designed with teachers. In a cluster randomized trial with 16 teachers and 360 students in fourth and fifth grade, we found the intervention improved students' overall rational number learning (Authors, 2023). We will present the impact of our intervention on students' self-reported emotions (e.g., happiness, boredom, and nervousness) toward math tests. The study was pre-registered at https://osf.io/kjqmz. Preliminary analyses suggest positive impacts ranging from .20 SD to .31 SD on positive emotions and negative impacts ranging from -.02 SD to -.33 SD on negative emotions. The estimates were robust to the mixed models with random intercepts by teacher and the model using Full Information Maximum Likelihood for missing data. In addition, students with higher negative emotions at pre-test demonstrated greater reductions in their levels of negative emotion after the Fraction Ball activities. Subsequent analyses will also examine whether classrooms showing larger effects on fraction learning also showed larger effects on emotional outcomes. These findings suggest that Fraction Ball represents an effective way to positively impact students' rational number learning and emotions related to mathematics. Implications for future interventions aiming to improve both learning and feelings connected to mathematics will be discussed.

Presentation 2: Developing a Low-Cost Mobile App to Reveal Excellence in EFs and Math Learning

Anja Pahor*[1], Susanne Jaeggi[2], Aaron Seitz[3], Geetha Ramani[4], Imani Goffney[4], Jacob Gardner[5], Dennis Barbour[6]
[1] University of Maribor, Department of Psychology [2] University of California, Irvine, School of Education [3] University of California, Riverside [4] University of Maryland, College Park [5] University of Pennsylvania [6] Washington University of St. Louis

Executive functions support math learning; however, executive functions also fluctuate daily and students are rarely given the opportunity to understand how this affects their learning processes. We developed a set of equitable tools to assess and visualize math skills, underlying executive functions abilities, and fluctuations in those abilities using mobile app technology (iOS and Android). In parallel, we are implementing machine learning algorithms to constrain a very short battery of tests that can be administered on a daily basis. It is hypothesized that an enhanced understanding of children's EF states will help educators to better determine individual students' strengths and needs, and to facilitate the use of this information to guide personalized instruction. A validation study involving 280 students in grades 4 and 5 is currently underway, along with a pilot multiple-session study to examine variability in executive function over time. I will present the results of these studies and discuss how using the shortened battery could be administered during lessons to guide instruction.

Presentation 3: ST Math Fluency+: The Impact of Combined Math Fact Fluency and Executive Function Training

Martin Buschkuehl*[1], Yi Feng[2], Geetha Ramani[3], Gillian Grose[3], Susanne Jaeggi[2]
[1] Mind Research Institute [2] University of California, Irvine, School of Education [3] University of Maryland, College Park

Math fact fluency describes the skill to solve relatively simple math problems accurately and quickly. Being proficient in math facts has many benefits, for example, early proficiency with math facts predicts subsequent math achievement. Executive functions (EFs) are cognitive processes that allow to control, supervise, or regulate thinking and behavior for goal achievement. There is a bidirectional relationship between EFs and math. On one hand, EFs

provide the mental workspace to acquire and perform math operations. On the other hand, procedural requirements such as keeping track of partial results during mental math provide opportunities to train EF skills. There is accumulating evidence that training EFs in a curricular context is beneficial. ST Math Fluency+ is a novel web-based program that strategically aims to train both, math fluency facts and EFs at the same time to specifically support math-related EFs. Preliminary intervention data indicated beneficial effects of Fluency+ on untrained measures of EF and math fact fluency, demonstrating the program's promise. Here, we will report the data of an ongoing curricular trial involving 12 different classrooms with more than 270 students from a diverse background to further establish the program's efficacy.

Presentation 4: Our Mathematical World

Amanda Mayes*[1], Caroline Byrd Hornburg[2], Tamika L. McElveen1, Sara A. Schmitt[3], Ma Bernadette Andres-Salgarino[4], Sarah R. Powell[5], David Purpura[1]
[1] Purdue University [2] Virginia Tech [3] University of Oregon [4] Santa Clara County Office of Education [5] University of Texas at Austin

Our Mathematical World (OMW) aims to improve executive function skills, math identity, and math outcomes for Black and Latine students and students experiencing poverty through a curriculum overlay that includes a sequential set of activities designed to center 3rd-5th grade students as strong math problem solvers who use appropriate EF skills to guide their process. The focus of the OMW team has been the co-ideation, construction, implementation, and refinement of a curriculum overlay that incorporates three strands: Math Stories, Executive Function, and Problem Solving. In response to limited teacher time during the pandemic, the OMW team implemented ways for educators to participate as time allowed, including the use of asynchronous feedback logs, independent readings, and online document editing. Asynchronous teacher recommendations were presented to the team for further ideation. Reflecting the cyclical nature of inclusive R&D, lessons were revised, piloted, and another round of feedback was sought. This process has resulted in a series of lessons and books that reflect district partner students' interests and identities and alignment with math curriculum and learning goals. The full 9-week curriculum overlay pilot study was conducted in Spring 2022 with 8 teachers and 119 students from two school districts. Teachers from both districts came together monthly with core members of the R&D team to discuss comments from their implementation logs and suggestions for revisions. Overall, the current, revised lessons being piloted in the 2022-23 academic year, are a result of the co-ideation and co-revision built from centering student and educator voices.