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TSG 3.1: Mathematics education at early childhood and primary level

Facilitating Parents' Math Involvement With A Literacy Program

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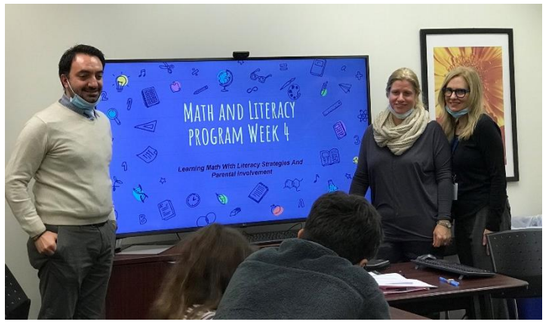
Abstract

Literature is abundant in programs preparing parents with better mathematical support skills. Such parental interventions also aim to enhance P-6 students' mathematical reasoning using literacy strategies. Having the same objective, in our study we implemented a five-session intervention with four parents and their children, during which we utilized literacy strategies to support parental involvement and children's mathematical development. Our preliminary findings showed some improvements in parents' level of assistance.

Rationale

- Research has established that parental involvement in education is an important factor in improving their children's motivation, engagement with school subjects, and overall achievement (Jeynes, 2005).
- Some studies (Jay et al., 2017) demonstrate that parents struggle in providing meaningful support for their children's mathematical difficulties at home, due to their limited understanding of formal school curricula and effective approaches to learning mathematics.
- Accordingly, in our study, we initiated a collaborative effort and designed and implemented a five-session intervention with parents.
- The following question guided our study: *How does a five-session intervention impact parents' assistance while facilitation their children to solve math problems?*



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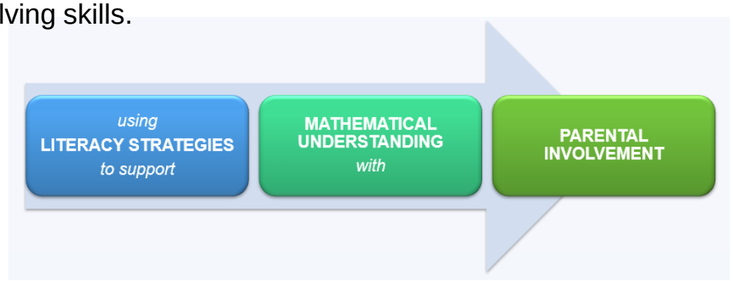
Theoretical Framework

- Parental involvement has been defined in many different ways. For some researchers, parental involvement means parents' presence at school, partnership, and communication with teachers (Lloyd-Smith & Baron, 2010).
- For others, the same construct was defined as parents' active participation in educational activities at home or in educational settings after school (Nye et al., 2006).
- For this study, we define parental involvement as parents' active engagement with their children in solving word problems and making sense of mathematical concepts.
- There have been several parental interventions and workshops initiated to help parents be more effectively involved in their children's school-based mathematical works (e.g., Santana et al., 2021; Takeuchi, 2018).
- Lehrer and Shumow (1997) provided video vignettes for parents to make sense of mathematics reform. They studied parents' scaffolding strategies while parents assisted their elementary-grade children with solving arithmetic word problems. Lehrer and Shumow found that parents were directive and controlling while scaffolding their children's mathematical work compared to their teacher's scaffolding methods.
- In their study, the researchers developed a five-level protocol to differentiate parents' assistance levels while helping their children with arithmetic problems. We modified this protocol for our research to categorize parental assistance with attention to students' problem-solving skills.



Levels of Parental Assistance	Description of Each Level of Parental Assistance
Level 6 ***Coaching***	The parent suggests the student perform a mathematical strategy and explains the student mathematical details and concepts within a mathematical representation or strategy when s/he cannot understand by themselves. The student solves the problem on their own after the coaching. The assistance focuses on a deep understanding of mathematical concepts. The interaction between the parent and the student is prompt and back-and-forth, focusing on mathematical sense-making.
Level 5 ***Directed Performance***	The parent collaborates with the student to solve the problem and provides operational answers or computations after the student is oriented/re-oriented to the mathematics problem independently. While the student observes their parent, the parent performs mathematical operations, computations, and strategies for the student to reach an answer for the problem.
Level 4 ***Specific Re-orientation***	The parent invites the student to rethink mathematically specific details in the problem statement that s/he did not think of the first time. The parent may also suggest the student try a different but mathematically specific strategy, especially if the student's first attempt did not allow them to accurately solve the problem.
Level 3 ***General Re-orientation***	The parent asks the student what to do next after their intermittent progress. Alternatively, the parent requests, assists, or guides the student to check their intermittent answer, finding, or solution. At this level, the parent's re-orientation is not mathematically specific to a particular part of the student's work.
Level 2 ***Specific Orientation***	The parent invites the student to attend to the mathematical details presented within the given mathematics problem and use strategies and tools (e.g., representations and manipulatives) that will contribute to the problem's solution. At this level, the parent may also request the student to explain or make sense of specific mathematical details in the mathematics problem or within the student's solution.
Level 1 ***General Orientation***	The parent requests the student to read and make sense of the problem. For that purpose, the parent may ask questions (e.g., what does the problem ask?) or read the mathematics problem to the student.
Level 0 ***No Assistance***	The parent solves the problem and/or finds the intermittent or final answers for the mathematics problem before letting the student work or make sense of it. Alternatively, the parent does not provide any assistance to the student.

Methods

- This study employs a basic interpretative qualitative design and a multiple case study methodology where each parent throughout our parental involvement intervention behaved as a unique case (Ary et al., 2010; Yin, 2013).
- We collected qualitative data from four parents and their fourth-grade children participating in our five-session parental involvement intervention.
- In the first table below, we present topical focuses of each parental session.

Sessions	Mathematical topics	Literacy strategies	Parental involvement
Session 1	Adding and subtracting numbers using invented strategies	Observing connections between mathematics and literacy in early grades	Underlying the importance of parental involvement
Session 2	Multiplying multi-digit numbers using invented strategies	Building and using vocabulary while solving mathematics problems	Linking mathematics to daily life
Session 3	Multiplying a one-digit number with a two-digit number using an area model	Determining important segments in word problems	Using questioning to promote students' mathematical reasoning
Session 4	Multiplying two two-digit numbers using an area model	Visualizing mathematical ideas	Letting students be the mathematics teachers
Session 5	Making sense of the distributive property of multiplication	Making inferences and judgments within given mathematical scenarios	Sharing different strategies to solve mathematics problems

Results

- In the following table, we present the distribution of each level and the total number of meaning segments selected from each parent-child dyad from each of the five sessions. In the second table we showcase the distribution of each assistance level for each session.

Parent	Session 1 (n = 38)	Session 2 (n = 39)	Session 3 (n = 43)	Session 4 (n = 96)	Session 5 (n = 96)
Parent 1 (Kurt)	10 (26%)	11 (28%)	8 (19%)	9 (9%)	48 (50%)
Parent 2 (Khrystyn)	10 (26%)	13 (33%)	22 (51%)	20 (21%)	5 (5%)
Parent 3 (Tyffani)	2 (5%)	8 (21%)	3 (7%)	16 (17%)	8 (8%)
Parent 4 (Taylor)	16 (42%)	7 (18%)	10 (23%)	51 (53%)	35 (36%)

	Session 1 (n = 38)	Session 2 (n = 39)	Session 3 (n = 43)	Session 4 (n = 96)	Session 5 (n = 96)
Level 0	4 (11%)	1 (3%)	7 (16%)	10 (10%)	9 (9%)
Level 1	6 (16%)	5 (13%)	8 (19%)	12 (13%)	8 (8%)
Level 2	6 (16%)	13 (33%)	6 (14%)	19 (20%)	13 (14%)
Level 3	8 (21%)	12 (31%)	5 (12%)	18 (19%)	21 (22%)
Level 4	5 (13%)	7 (18%)	15 (35%)	19 (20%)	22 (23%)
Level 5	3 (8%)	1 (3%)	0 (0%)	11 (11%)	7 (7%)
Level 6	6 (16%)	0 (0%)	2 (5%)	7 (7%)	16 (17%)

Exemplary Cases

Our analyses of session 1 transcripts revealed Khrystyn (Parent 2) was the only parent most frequently demonstrating Level 0 (No assistance).

Mathematics Problem 1.1:

Selena's family went on a trip. The total hotel bill was $659. The cost of the airfare was $633.

Selena solved the above problem as below:
659 + 633 is the same as 660 + 632.
600 + 600 = 1200
60 + 30 = 90
1292.

Do you think Selena is correct? Explain how she added the numbers.

Valeria (Student 2): Mommy, can you help me?

Khrystyn (Parent 2): Why would I help you? You know the answer.

Valeria: You are supposed to help me, Mom. How did you solve it?

Khrystyn: She is correct in what she was doing…

During our last session, we guided parents to ask their children to teach new ways of solving mathematics problems and work on them together to achieve higher parental involvement, which was demonstrated in the following exemplary interaction between Kurt and Klea during Session 5:

Mathematics Problem 5.1:

Oliver wanted to create a garden in his backyard to grow his vegetables. To fill with dirt, he needs to find the area of the space, which is 34 feet in length and 52 feet in width. How much area does Oliver need to cover with the dirt?

Below, Jessica tried to solve the area problem for Oliver by multiplying 34 x 52 using the "partial products."

$$34 \times 52 = (30 + 4) \times (50 + 2)$$
$$= (30 \times 50) + (4 \times 2)$$
$$= 1500 + 8$$
$$= 1508$$

Do you agree with Jessica's answer? If not, explain what she may have done wrong.

Kurt (Parent 1): Is that correct?

Klea (Student 1): 30 times 50 equals 1500, and 4 times 2 is 8. Yeah, it's correct.

Kurt: Just start with the problem; don't look at what she did. Write down what you would do, and then you can compare it to her after you're done… Maybe she did wrong.

Klea: She did, but I don't think I'm correct because when I look at this, and I did what she did, I got the same answer.

Kurt reviewed Klea's work and checked her answer (1768) by questioning each distribution component.

Conclusions

- Our preliminary findings support the benefits of our sessions on how parents are involved in their children's mathematical work.
- These results also demonstrate some similarities to the conclusions drawn by Shumow (1998).
- In our research, it is also possible that the parents may not initially have had the opportunity or feel the need to assist their children compared to later sessions where students struggled with more challenging mathematical concepts.
- Based on our findings, parental sessions could be conducive to guiding them about mathematics reform practices and further supporting their involvement in their children's mathematical work at school.

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