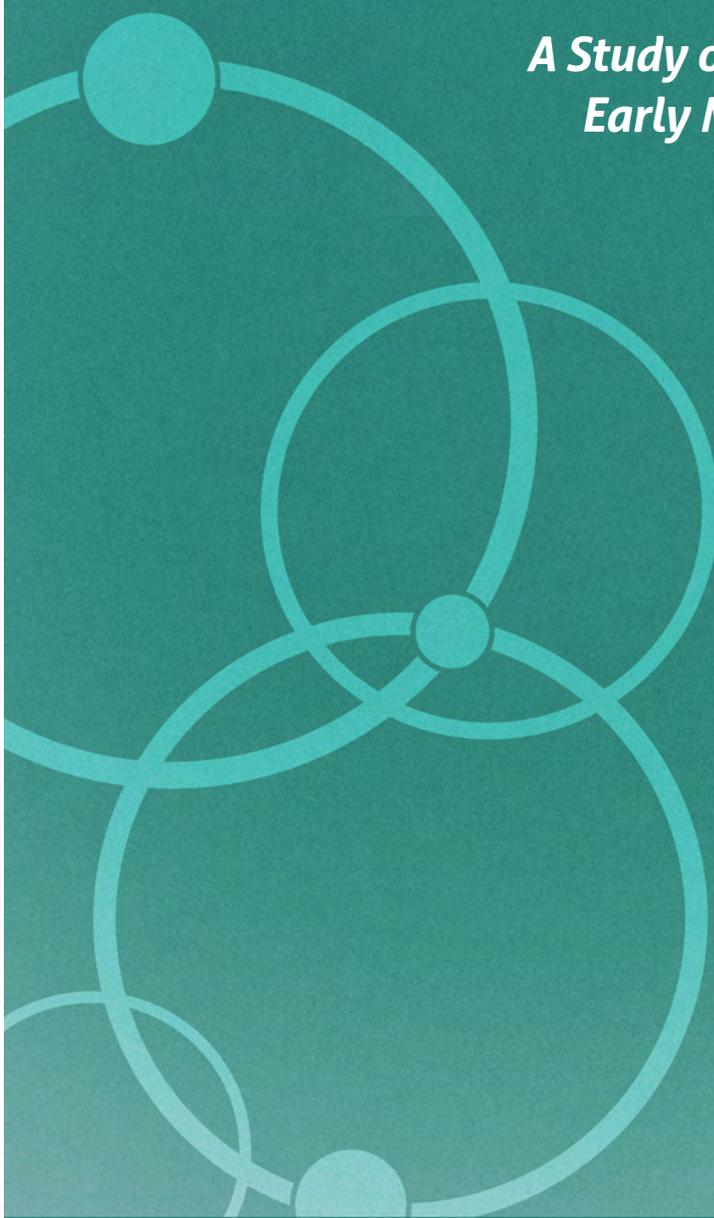


Executive Summary

Learning with PBS KIDS



*A Study of Family Engagement and
Early Mathematics Achievement*

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November 2015

WestEd 
WestEd.org



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Support for this grant was provided by:



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Executive Summary

There is an acute need in the United States to boost mathematics competencies in young children, particularly those from economically disadvantaged families, as early mathematics ability is a strong predictor of later academic achievement. Research has shown that family engagement can be effective in improving preschoolers' mathematics learning. During the summer of 2014, WestEd conducted a study of family engagement and early mathematics learning as part of the *Ready To Learn* (RTL) initiative with the Corporation for Public Broadcasting (CPB) and the Public Broadcasting Service (PBS). The study was designed to test the effectiveness of a school-based family engagement model in increasing preschoolers' knowledge and skills in mathematics, and in increasing parents' awareness of and ability to support their children's mathematics learning in the home environment. Additionally, the study focused on the feasibility of having teachers from participating schools facilitate parent meetings related to the intervention. The study also examined the relationship of socioeconomic status to learning outcomes and explored how key aspects of the model affect family engagement and learning.

Funded by the U.S. Department of Education, the CPB-PBS RTL Initiative has a goal of promoting early learning and school readiness among children ages 2 through 8, with a particular interest in reaching children from low-income families. The Initiative supports the development and delivery of high-quality, age-appropriate, educational content designed to increase the early literacy and mathematics competencies of young children.

The family engagement model was developed over the past three years, and earlier versions were tested in two previous studies (McCarthy, Li, & Tiu, 2012; McCarthy, Li, Atienza, Sexton, & Tiu, 2013). The latest study builds on these past two studies by developing a scalable model that can be implemented in different preschool locations and by assessing the feasibility of having local preschool staff facilitate its weekly parent meetings.

The Intervention

The family engagement model that is the focus of this report used the capabilities of PBS KIDS transmedia suites along with best practices in family engagement to increase parents' capacity to support their children's early mathematics learning. The intervention focused on two overarching mathematics concepts included in the transmedia suites: numbers and operations in base ten, and shapes. The intervention lasted nine weeks and prompted parents and their children to work together on PBS KIDS transmedia activities

for 30 minutes per day for four days per week, and encouraged parents to attend weekly parent meetings at their child’s preschool.

The intervention model included four days of activities for children at home. Parents of children in the intervention group received a weekly program of PBS KIDS transmedia activities to use with their children, as well as parent support materials consisting of hands-on home activities printed from PBS KIDS Lab and a binder including summaries of the specific assignments for the days of the week. During the week, intervention families accessed the intervention materials via Google Chromebooks they were provided with to take home for the duration of the study. A 3G data plan was provided for each Chromebook so that participants could access the Internet. The Chromebook browser and settings were configured such that participants had access only to the specific PBS websites included in the intervention.

During each week of the study, parents or other family members (such as grandparents, uncles, aunts, and older siblings) receiving the intervention met at their child’s preschool for one hour at the end of the school day. Parents were encouraged to attend a total of nine parent meetings, one for each week of the intervention. During each parent meeting, parents were encouraged to describe the activities they undertook with their children the previous week, including whether they felt their children learned from those activities and what challenges they encountered.

To explore the possibility of scaling the intervention to reach a larger audience, staff from the intervention preschools participated in six hours of facilitator training sessions to learn how to conduct the weekly parent meetings. The staff from the intervention preschools independently facilitated the nine parent meetings at their preschools. Parent meetings were conducted in both English and Spanish.

Study Design and Components

The study applied a combination of quasi-experimental design and qualitative observations to address several research questions. The study addressed two primary questions about the effectiveness the family engagement model:

1. Does the parent engagement model intervention increase children’s knowledge and skills in mathematics?
2. Do parents’ awareness and support of their children’s mathematics learning at home increase after taking part in the intervention?

In addition, the study explored the effectiveness of having preschool staff facilitate the parent meetings that are part of the intervention, as having teachers in this role could increase the possibility of scaling the intervention to reach a broader audience:

3. Is it feasible for teachers from participating schools to successfully facilitate parent meetings related to the intervention?

Another goal of the study was to explore the relationship of socioeconomic status and learning outcomes:

4. How did any changes in students’ knowledge and skills in mathematics relate to the students’ socioeconomic status?

Parents and children from nine preschools were recruited to participate in the study. WestEd recruited families from preschools serving economically and ethnically diverse communities in San Mateo County, California. Participants from three preschools received the intervention, as described above, and participants from the other six preschools served as members of a comparison group.¹ Comparison group families used business-as-usual mathematics games, videos, and supporting materials. These materials were not provided by WestEd researchers, but were educational materials that parents would normally have used with their children. Comparison group parents met twice throughout the study, once during the first week of the study and again during the final week of the study. At the first meeting, parents were given a list of suggested mathematics topics to engage in with their children. These topics aligned with the skills that intervention group children practiced in the PBS KIDS transmedia suites. At the last meeting, parents were encouraged to describe what activities they had done with their children and were given several educational books to use with their children as a gift for participating in the study.

Two tests were given to students in both the intervention and comparison groups before the intervention and again after the intervention was completed: the Test of Early Mathematics Ability, third edition (TEMA-3), a standardized, nationally normed achievement test of children's informal and formal mathematics knowledge² (Ginsburg & Baroody, 2003); and a researcher-developed assessment of mathematics skills related to the concept of shapes using eight items from or adapted from the Child Math Assessment (Klein, Starkey, Clements, Sarama, & Iyer, 2002). The eight items on this assessment showed good reliability on the pre-test ($\alpha = .84$) and on the post-test ($\alpha = .82$). TEMA-3 and the researcher-developed assessment were used to test the baseline equivalence between the intervention and comparison groups and served as covariates in the outcome analyses.

A parent survey, adapted from Home Learning Environment (HLE) survey (Starkey et al., 1999), and parent focus groups were used to gather more baseline information, such as the demographics of participants, and to gather outcome data, including parents' awareness of and support for their children's mathematics learning and parents' perspectives on the intervention. All families took the parent survey before and after the intervention, and 95 percent of families in the intervention group took part in parent focus groups.

Study Results

Children's Knowledge and Skills in Mathematics Improved

The quantitative assessment data (from TEMA-3) indicate that the intervention was positively associated with gains in children's knowledge and skills in mathematics. Adjusted mean differences on TEMA-3 scores show that the intervention group's scores on the post-test were higher on average than those of the comparison group (point estimate of 2.93; minimum detectable effect size [MDES] = 0.22), a difference that was statistically significant (at the 0.05 level) after accounting for differences in baseline test results and participant ethnicity. On the researcher-developed assessment focusing on the concept of shapes, the intervention group also improved more than the comparison

1 This study was approved by an independent Institutional Review Board (IRB).

2 The test is designed for use with children ages 3 through 8. It measures four categories of informal mathematics: Numbering, Number Comparisons, Calculation, and Concepts. It also measures four categories of formal mathematics: Numeral Literacy, Number Facts, Calculation, and Base 10 Concepts.

group. Prior to the intervention, the intervention group had significantly lower scores than the comparison group on this assessment, but after the intervention, the two groups (intervention and comparison) had similar mathematics scores related to shapes. Though only two weeks of the intervention focused on shapes, intervention group children grew in their understanding of basic and advanced shapes, including significant improvements in the number of children correctly recognizing circle, triangle, trapezoid, and pentagon.

All Socioeconomic Levels Improved in Mathematics

The analyses indicate that intervention group children at all income levels increased in their mathematics ability. A descriptive analysis of the intervention group data indicates that TEMA-3 scores increased on average more than six points for children identified as low-income and for those not identified as low-income.³

Parents' Awareness of Their Children's Mathematics Learning Increased

Analysis of quantitative data suggests that the intervention parents grew significantly in their awareness of their children's mathematics learning. To detect whether the family engagement model increases parents' awareness of their children's mathematics learning at home, researchers analyzed the composite sum score from the HLE survey items related to awareness of mathematics. The survey items ask parents about their knowledge of preschool children's mathematics abilities and skills.

Parents' Support of Their Children's Mathematics Learning Increased

Analyses of the quantitative data also suggest that intervention parents increased their use of activities and strategies to support their children's mathematics learning. Researchers analyzed the composite sum score from the HLE survey items related to parents' support for learning at home. The score includes 28 survey items about the availability and use of books, store-bought games, educational technology, and other educational resources in the home.

Themes from Qualitative Data Analysis

Researchers analyzed the qualitative data to generate themes, using a combination of grounded theory (Strauss & Corbin, 1998) and established methods for coding qualitative data (Miles & Huberman, 1994) to identify and categorize the participants' responses. Findings from qualitative coding help explain changes in parents' and children's knowledge and behavior.

Parents Reported Increases in Children's Knowledge and Skills in Mathematics

Analysis of qualitative data from the parent focus groups indicates that, over the course of the intervention, parents noticed growth in their children's understanding of the intervention's targeted mathematics concepts. Nearly all parents taking part in the 11 focus groups mentioned that they observed their children learning new mathematics content. The following quote is typical of the majority of intervention-group parents who participated in focus groups.

3 Possible experimental scores range from 0 to 210.

He learned a lot. He learned to add small figures, less than ten. Before, he didn't know any adding. He now knows the numbers up to 12 and he also identifies shapes.

Parents' Awareness of their Children's Mathematics Learning Increased

Analysis of qualitative data from the parent focus groups indicate that, over the course of the intervention, parents noticed growth in their children's understanding of the intervention's targeted mathematics concepts. Nearly all parents taking part in the 11 focus groups mentioned that they observed their children learning new mathematics content. The following quote is typical of the majority of intervention-group parents who participated in focus groups.

He learned almost all the shapes except he still gets confused with hexagon, pentagon and octagon. He only gets confused with those three, but he knows how to count the sides, he knows how many sides it has.

This [intervention] makes you think that even though they're so young, their minds are growing and they're really smart and they catch onto everything. [They are] building on everything.

Parents Refreshed Their Own Knowledge of Mathematics

Many parents mentioned that the intervention had refreshed their understanding of mathematics, helping them learn or re-learn mathematics concepts.

I didn't have a program like this when [my other kids] were younger, and I didn't do math at that age. It [the intervention] helped me a lot with math.

Parents Integrated Mathematics Learning Throughout the Day

Qualitative data also indicate changes in parents' level of interaction with their children around math.

We started counting everyday objects. When we go out, or we go to the grocery store, I say, 'Can you find me a thing of bananas that has five bananas on it, one for each of us?' She'll count the bananas and find the one for each of us. Stuff like that.

Parents Learned New Skills, Becoming Better Prepared to Support Their Children's Learning

The majority of intervention parents in the focus groups mentioned that they learned new skills and strategies from the intervention that allowed them to enrich their learning interactions with their children.

It [the intervention] was good because it helped me to consciously think more about asking her questions, about counting and colors and shapes and stuff like that. Which I did before, but I didn't consciously do it as often as I would do now. Like, everyday objects that pass us by throughout the day.

Another group of parents said participating in the intervention opened their eyes to the importance of supporting their children's mathematics learning.

It [the intervention] just made me think. It kind of opened a door for me, that I could teach them this and I could teach them that. Even though they're little, they're really smart and they catch on fast to everything, and you can take that further.

Parents Set Aside Time Each Day to Focus on Learning

About a quarter of the parents in focus groups said that the intervention motivated them to spend time with their children and focus on mathematics learning.

Now we put aside more time to our children. Before we didn't do it because we didn't have enough time and now we feel more interested in spending at least half an hour or more with them.

Parents Began to Target Learning Interactions

A majority of parents said they grew in their ability to focus learning interactions with their children on the specific areas of mathematics.

She likes it when I test her. I'll be like, 'You know, the counting by fives? Remember the fives?' We'll go back to the [game] and see what score she gets. I'll be like, 'Okay, I'm going to do a test. Go!'

Parents Worked Collaboratively with Children to Provide Context-Sensitive Support

Analyses suggest that many parents learned a new way to actively participate in learning activities with their children and provide support to their children when necessary.

For me, with my daughter, it was fun. The best thing for us was about doing the activities together, and to show her how to learn. I learned how to ask her more questions. It was fun because we found a way to learn together.

Parents Gravitated to a Learning Environment that Encourages Playfulness and Positive Affect

Another concept that emerged during analysis is that of playfulness and positive affect. Many parents reported they increased their use of fun, games, and playfulness to more deeply engage their children during learning interactions.

I would act like I didn't know, and he would do it fine, and he would laugh at me because he'd say, 'I beat you, you didn't know!'

Teachers Were Successful at and Enjoyed Facilitating the Parent Meetings

Data regarding fidelity and teacher interview data suggest that preschool teachers at the intervention sites were successful facilitators of parent meetings. Not only did teachers deliver intervention activities with fidelity, they provided parents with a deeper connection to the preschool.

Nearly all teachers reported they enjoyed the experience of teaching parents. In particular, they enjoyed seeing parents grow in their awareness of and ability to support their children's mathematics learning. One teacher commented:

If we have done anything, I think the most exciting is to see more awareness [in the parents] of math all around. If that is something we did, I think it was to at least open their eyes to see that there was math everywhere and that they can use it. You know, by being in the car and playing a simple game of counting cars. Just opening their eyes to that.

Families Responded Positively to Elements of the Intervention

Analysis of the focus group transcripts indicates that intervention parents particularly appreciated three elements of the intervention: its daily routine, its high-quality content, and the transmedia aspects of the intervention.

Conclusion

Overall, the study's findings suggest that the intervention model — using a family engagement learning experience that includes PBS KIDS transmedia content — is effective in supporting families, contributes to growth in preschool children's mathematics competencies, and can be scaled to reach a broader preschool audience.

Families taking part in the intervention appreciated the community-based environment with daily activities and playful, easy-to-access mathematics content. The PBS KIDS transmedia content appears to have contributed to the success of the intervention. Parents and children enjoyed the engaging games, videos, and hands-on activities, and parents mentioned that the content helped their children learn mathematics. They appreciated that their children could learn and practice concepts in various modalities, whether it involved playing a counting game using cards with a family member, or playing a digital game that supports children as they learn to count to higher levels. Parents also appreciated the quality of the PBS KIDS transmedia content, frequently mentioning that they could see that the content was well designed to support learning in an engaging format.

The results of the study also indicate that the current model is promising for boosting young children's mathematics knowledge and skills. This site-based transmedia family engagement model helps parents provide mathematics support to their young children. Additionally, training teachers at preschool sites to deliver the curriculum appears to be feasible. These results suggest that broadly scaling up the intervention to additional preschool settings could prove effectual and cost-effective.

The intervention was developed with funding from the U.S. Department of Education as part of the CPB and PBS *Ready To Learn* initiative, which supports children and family learning through the development and dissemination of multiplatform math content for preschool children, especially those from low-income families. CPB and PBS plan to make the materials used in the study available in 2016 to public media stations, educators, and other interested organizations. Titled the *WestEd/PBS KIDS Family Engagement Program*, the materials will be available on the PBS website.

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