

Formula for Success: Engaging Families in Early Math Learning



Global Family Research Project* | August 2017

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Global Family
Research Project

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Formula for Success: Engaging Families in Early Math Learning

Early math ability is one of the best predictors of children’s later success in school.¹ Because children’s learning begins in the home, families are fundamental in shaping children’s interest and skills in math. The experience of learning and doing math, however, looks different from the instruction that was offered when most adults were in school, and many parents harbor anxiety about math. For this reason, families need guidance, inspiration, and motivation to support their young children’s mathematical development effectively.

This compilation of articles written by researchers and program developers offers important lessons about engaging families in children’s learning of mathematics anywhere, anytime. Taken together, they show that

- math is part of our everyday lives, and as such, is conditioned by relationships, culture, and values;
- math can be an enjoyable parent-child experience; and
- digital media can be harnessed to promote math learning—for children and parents.

We invite you to share this issue with interested friends and colleagues. We also hope you’ll [send us](#) what you are doing to support family engagement in early math.

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¹ Duncan, Greg J., Chantelle J. Dowsett, Amy Claessens, Katherine Magnuson, Aletha C. Huston, Pamela Klebanov, Linda S. Pagani, Leon Feinstein, Mimi Engel, and Jeanne Brooks-Gunn. 2007. “School Readiness and Later Achievement.” *Developmental Psychology* 43, 6: 1428-1446.



Math Is Everywhere, When We Know What to Look For

Taniesha A. Woods

These scenarios might seem familiar to you:

- *A 1-year-old tugs at her mother's leg, demanding, "Up! Up!"*
- *A group of 3-year-olds receive unequal amounts of cookies, prompting them to emphatically point out who has the most.*

These examples are amusing because we can all imagine young children advocating to be picked up or wanting more cookies, but it's important for families and educators to recognize these interactions for what they are: opportunities for children to build on their foundational mathematics knowledge as it is connected to their lived experiences.

Young children's math development begins in infancy and continues throughout the early childhood years and beyond. And children learn math anytime, anywhere, even before they go to preschool. For this reason, families are critical to supporting children's mathematics development. They can provide this support directly by using objects for counting, stacking, and recognizing shapes. They can also provide support indirectly, by connecting their children to math learning environments outside of the home (e.g., in libraries, museums, early childhood programs). But to do so, families need access to information about what math development is and how to support it, which is often not clear or readily available.

What do young children need to know about math?

Generally, families and educators recognize that number concepts are important for children's math development (for instance, knowledge of how many items are in a set, knowledge of the ordered list of number words apart from counting objects, knowledge that one object is paired with exactly one number word and that number symbols represent quantities). However, this is not the only area that should be supported. Specifically, geometry and measurement also represent important areas young children benefit from learning about in their homes and community settings.

Core geometry concepts include shape (two-dimensional and three-dimensional objects), spatial orientation (where one is in space and how to get around), and relationships (where objects are in relation to one another). Young children are also ready to learn about measurement beginning with activities where they use rulers in addition to practicing with nonstandard units, such as a piece of string.

What do math-rich environments look like?

Families can support children's math development by providing environments that are rich in learning. Families can teach children to see and name small quantities, count, and point out shapes.

For example, going back to the earlier scene about cookies, explaining that you have three cookies and they are the shape of a circle is a math lesson that children will be interested in and eager to know about. Families can also ask open-ended questions, which give children the opportunity to explain their thinking. For example, asking “Why?” “How do you know?” “Where do you see this?” and “Tell me how you figured this out” provides children the chance to explore and articulate their math thinking. Families are perfectly situated to ask children about these ideas and support their thought processes through the use of open-ended questions that lead to “math talk.” And this “math talk” can happen anywhere children and families are—at home, in the park, in the grocery store.

How can families use print and media to support children’s math development?

Reading together is an important experience that can be used to teach about many subjects, including mathematics. Examples of high-quality storybooks include *The Very Hungry Caterpillar*, *Mouse Count*, and *Inside Outside*, all of which families can use during story time. Young children are also exposed to many forms of technology, including television, online programming, and app-based experiences. Given children’s inability to escape technology, families can take advantage of it to support children’s mathematics learning.

The articles in this series clearly point to important lessons for both practitioners and families:

- **Families matter for children’s math development.** When families are engaged in their children’s math learning—for example, by telling entertaining math stories, playing digital media games, and doing hands-on mathematics activities at home—children’s understanding of math concepts and math competencies increase.
- **Mathematics learning starts in infancy and happens everywhere, all the time.** For this reason, families are critical to supporting math learning, and research from this series shows that families can do it in unpressured and socially positive ways. For example, reading all kinds of books with math content that is either implicit or explicit can lead to enjoyable parent–child conversations.
- **Families and educators must share responsibility for supporting early math development.** Families need guidance and ideas for how to support early math development. Educators in a variety of settings (such as teachers, home-based providers, and librarians) can provide families with tips and ideas to encourage math learning. Similarly, educators need to understand the cultural nature of mathematics, and incorporate family and community practices into their teaching practice.

The free, developmentally appropriate research and programs provided throughout this series are relevant to children and families from diverse cultural and linguistic backgrounds, and they provide families and early childhood educators with rigorous math activities that are fun for the whole family.



Reading Interactive Math Storybooks

Herbert Ginsburg, Colleen Uscianowski, Victoria Almeda, Cassie Freeman

Parents and their children often read together, bonding as they explore reality and fiction, the everyday and the fantastic. Children can learn about nature, animals, monsters, trucks, letters, and words. Books can also help children learn about different math topics, including number, operations, shape, space, and measurement. Book reading is a safe way for parents anxious about math to engage their children in a warm, unpressured math activity, and for both to learn that math can be fascinating and a source of intellectual excitement.

We like to think about three categories of math books:

- Some books teach math directly. Counting books involve determining the number of objects on a page. Shape books may define the figures, saying explicitly that a triangle has three sides.
- Other storybooks, like *Elevator Magic*, ground the concepts in a cohesive narrative in which characters explore math ideas and solve problems, like which button to press if the goal is to make an elevator go from the 10th floor to another floor five levels down.
- A third category of storybooks includes math “implicitly.” On the surface, *Goldilocks and the Three Bears* is about a young girl who goes for a walk in the woods and finds herself alone in the bears’ home, where she gets into trouble. However, beneath the surface important math concepts of size and order support the narrative. Papa Bear has a big bowl of porridge and Baby Bear has a small bowl. Mama’s bed is both smaller than Papa’s but larger than Baby’s. The story makes no sense unless the child understands the relative sizes of the bears and how they relate to the bowls of porridge and beds.

Good books, implicitly or explicitly, can cultivate an interest in reading and in math. While reading, parents can engage their children in stimulating math discussions. “Which bed is smallest? Why do you think it belongs to Baby Bear?” Parents can use storybooks to engage their children in thinking and talking about math.

A new kind of book category: interactive storybooks

We have been working with a relatively new kind of book, the interactive storybook, which resides on a touchscreen device (a powerful computer) like an iPad. Our goal was to create exciting stories that explicitly involve math ideas and encourage productive interactions among child, parent, and book. Interactive math storybooks can help the child to understand the math and the parent to appreciate and foster the child’s mathematical thinking.

In the interactive math storybook *Monster Music Factory*, children learn different mathematical concepts and strategies as they pack instruments for the greatest monster music band ever, The Whirling Wailers. Figure 1 shows a scene in which children are invited to count the tambourines (which shake and sound when touched) and then press the written number to indicate the total. If the response is wrong, the monster Tigga shows how to check the answers with a meaningful strategy, namely, by touching and counting each tambourine once and only once. Other appropriate strategies are used in other scenes. The storybook helps young readers to engage in an interactive narrative that promotes meaningful math learning and language.

What we're learning

We are conducting several kinds of research to understand how parents and children behave when they read interactive math storybooks. We observe parents reading in order to identify the useful things they say and do to help their children learn the math in the story. We observe children to learn whether they are engaged in the story, how they respond to assistance, and whether they in fact learn math. Here are some effective strategies we've seen parents use:



Figure 1: A scene from *Monster Music Factory*, an interactive storybook that promotes mathematical concepts.

- **Read Together:** It's important that parents find opportunities to read *with* the child. Storybooks alone will not guide children's learning. Storybooks are not Apps for children to use on their own. It's the parent-child interaction that facilitates learning.
- **Ask Questions:** Parents should pause at appropriate points and ask questions like, "How do you know?" and "How can you make sure?" and "Why is that the right answer?" Children need to learn to explain and justify their thinking.
- **Support the child's learning:** Parents can also support and reinforce children's learning. For example, in our study a father was reading *Monster Music Factory* with his young son when three tambourines emerged from the machine. "How many tambourines?" the father asked, prompting his son to practice counting the instruments. Although the father could have been satisfied with the correct answer "three," he instead took the opportunity to reinforce the three-ness of the tambourines. "Want to touch them and hear the sound?" As the child touched each tambourine, one at a time, the father counted along, "One, two, three."
- **Extend the child's learning:** Another good strategy is to help the child transfer learning to new examples. For instance, in the example above, after the father and son counted tambourines, the father went on to point to the three-eyed, three-armed monster. He asked, "How many eyes does that guy have?" The goal was to draw connections between different representations of three. His son was learning that the concept of three can characterize not only tambourines but *any* three distinct items: three parts of a larger whole, such as eyes, or three sounds, such as the shakes of the tambourines.

Math books vary in quality. Some are dull, with poor illustrations and uninspiring prose. If the book is not interesting, don't read it, even if it seems to have math content. Instead enjoy an exciting book in all its aspects, math and other. By spending time immersed in good books, your child can learn to read and to do math, too.



Q & A with Laura Overdeck of Bedtime Math: Helping Families and Children Cuddle Up to Math

Margaret Caspe

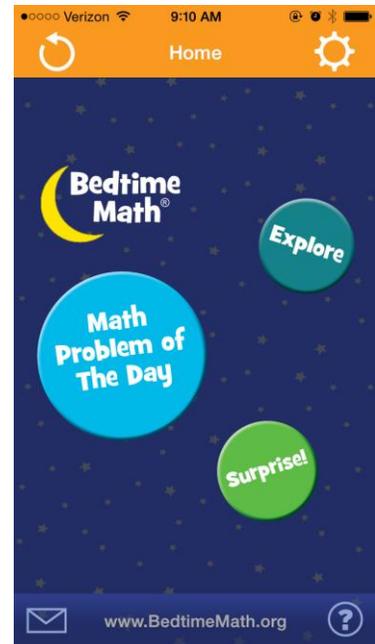
Bedtime Math is a nonprofit organization that strives to help kids love and appreciate math in their everyday lives. [Bedtime Math](#) provides families and children fun math stories and problems they can share together, and offers afterschool instructors and librarians a curriculum for running math clubs.

Q:

Tell us a little bit about the inspiration behind Bedtime Math.

A:

People who are good at math, and who love math, think and talk about it and tinker with it everywhere, all the time—not just in school. Unfortunately, we live in a society that associates math with school. This is problematic, because math education in schools right now is limited. Schools often rely too heavily on work sheets instead of hands-on learning experiences. And learning in schools is not very personalized, so children who struggle with math early on often don't have opportunities to catch up. Math is also not very well integrated with other subjects. Because of this, students are learning math in isolation from other subjects and struggling to see its relevance to their lives. Until schools can do a better job with creating hands-on, personalized, and integrated math education, those of us outside of school have a role in making sure it happens. So, in a rather unpremeditated way, my husband John and I began to tell math stories to our young children at night after we read them a book, and little by little, this grew into Bedtime Math.



Q:

How does Bedtime Math work?

A:

In essence, Bedtime Math is a [series of daily math problems](#) that are embedded within funny stories, riddles, or facts about the real world that families and children can share and solve together before bedtime. Families can access the problems by signing up for free daily emails, downloading the free [Bedtime Math mobile app](#), or by simply going to the Bedtime Math website. We also have a series of books with many of the same problems. Each math story has three levels of challenge tailored to fit three approximate age groups: wee ones (2–5), little kids (6–8), and big kids (9 and older).

People often tell me, “I know to read to my kids, but it never occurred to me to do math with them.” Bedtime Math fills this void, and gives families a way to get involved in their kids’ math learning in a fun way. It’s important to emphasize that these problems are not quizzes or workbooks. Although we provide families with the answers, they are intended to be fun ideas to get families and children taking a journey to talking about logic and finding solutions. For example, we created a nationwide math activity for preschools and families to get involved in called [March of the Stuffed Animals](#). We are asking children to bring their favorite stuffed animals to school and take a census of them. We want math to be something exciting to all students—everywhere, all the time—and for schools to be a partner to help get this idea out there.

Q:

In addition to your Bedtime Math program that is focused on math in the home, you also have the Crazy 8s Club. Tell us about that.

A:

We want kids to enjoy math and see it everywhere, even older kids who might have outgrown having a parent read to them at night. So [Crazy 8s](#) was started as an afterschool math enrichment program to get kids excited about math through hands-on fun activities. The program comes in a kit, and it is designed as a series of eight weekly one-hour workshops where students can get involved in everything from glow-in-the-dark geometry to toilet paper Olympics! We see it being used by afterschool providers and librarians in diverse economic settings and it’s all free—we just ask that in return providers promise not to use it during school hours.



Q: We know that data are important to your work. Can you talk about the types of data that you collect and what you are finding?

A: We're really excited here because researchers at the University of Chicago recently conducted a randomized control trial of our app and found that [using the app increases math achievement](#) among first graders across the school year. What was really exciting was that even using the app as little as once a week makes a difference. We also found that the app makes a difference especially for children whose parents have anxiety about math. We speculate that what Bedtime Math is doing is giving families and children comfort in talking about numbers and awareness of how math is in everything, and that, in turn, is changing the types of conversations that are happening in the home. Because remember: Our app is not about instruction about math per se. It just offers short math problems.

In addition to the external impact studies, we also collect data using a variety of metrics to help us improve what we do. We're always interested in the types of content that families and children are most likely to read—anything about vehicles, animals, and food is always a big hit—and we find that videos are a big draw. For Crazy 8s, we look at retention of kids across sessions and to understand from coaches what some of the challenges are to holding math clubs. Some of the most common challenges are finding space and working out scheduling.

Q: What recommendations would you offer families who want to get more engaged in their children's math learning?

A: It's so important that families have a mind-set that math is casual. It's something that happens as part of our everyday lives. For example, baking, carpentry, playing sports—they all involve mathematical reasoning, and it's important for parents to feel comfortable and empowered to talk about math as they use it every day.



I also think it is important for families to wait for children to struggle with math problems. We often tell the coaches in the Crazy 8s program that it is good to let kids wrangle with a question and try to derive their own solution. They need time to figure out why answers are what they are because that is what math is. If possible, parents can also take a step back and help connect what's happening in real life to things kids might come home with in school. For example, if you've just doubled the recipe you are baking with, you can specifically point out how this might relate to multiplying fractions on a work sheet.

Finally, and maybe most importantly: Don't say you hate math! You need to be aware of how you talk about math.



“Daddy Says This New Math Is Crazy”

Becky Smith-McCarthy

Teaching cases are valuable tools in preparing educators to engage effectively with families. They involve real world situations and consider the perspectives of various stakeholders, including teachers, school leaders, parents, students, and other community members. Through case-based discussion, students enhance their critical thinking and problem-solving skills and consider multiple perspectives. “Daddy Says This New Math is Crazy” is a teaching case that illustrates the mismatches that can occur in the teaching and learning of math. The case is followed by Marlene Kliman’s commentary about ways to collaborate with families in the development of children’s math abilities. See the appendix for case discussion questions.

Room 101: 8:30am

Forty-five minutes before the beginning of the school day, Beth Martin, an energetic, second-year, fourth grade teacher at Winner Elementary School was busy preparing for her first-period math lesson. While gathering materials around the room, she noticed a familiar face peering in the window of her classroom door. As Beth quickly waved one of her fourth graders into the room she noticed the welling tears in the little girl's eyes. Embracing Lena in a comforting hug, Beth gently asked, “What's wrong sweetheart?”

Lena wiped her eyes and breathed a slow, calming breath before explaining. “Last night I was trying so hard to get my homework done, but I couldn't remember how you taught us to do our two-digit by two-digit multiplication. So I asked my daddy to help me out and when I tried to explain to him what you had taught us about multiplication he said it sounded crazy. He said he had a better way to do the problem, but when he showed me, it just didn't make sense. He had me multiplying and adding all sorts of numbers up and down and diagonally. When I had to write my explanation of how I did the problem I didn't even know where to begin! Ms. Martin, I am so confused. Daddy says the way you are teaching us sounds crazy, but yesterday in class it really made sense to me. Is it crazy?”

The Teacher's Lounge: 10:15am

After an invigorating hour of teaching another lesson in the series on two-digit by two-digit multiplication, Beth was feeling confident in her students' understanding and ability to solve more difficult multiplication problems. Even Lena, who had come to her in tears hours before, was engaged, participating, and even offered to explain her process in arriving at an answer in front of the class.

Beth walked into the teachers' lounge to spend her free period correcting the previous night's homework. Her confidence and mood began to decline as she examined page after page of incomplete, incorrect math homework. In many cases, her students appeared to perform traditional

algorithms not taught in the framework of TERC Investigations, a K–5 mathematics curriculum with an emphasis on mathematical relationships using engaging activities and group learning experiences that her school had adopted. She wondered where her students were learning these methods. Beth quickly hypothesized that the school's push to get parents involved in their children's homework was one cause for this confusion between traditional math and the new math taught in the classrooms. She thought to herself: While the idea of families helping with homework sounds great, is it really beneficial when it just confuses the children? What am I going to do to get the parents, students, and myself on the same mathematical page?

While Beth was contemplating this question, two colleagues, Ray Donaldson and Darlene Brown entered the lounge, threw down their mountainous stacks of papers, and plopped down into the tattered vinyl chairs. Noticing Beth's pensive look, Ray, a fellow fourth grade teacher sarcastically asked, “Beth, so what about this job could possibly have you looking so concerned?” The group giggled realizing the humor in such a statement.

“Well Ray, to name one of the hundred things, I am struggling with the new Investigations curriculum. The classroom implementation of the program is really going well. My students are progressing nicely and are obviously enjoying math. In my own experience, I have never seen such a positive student response to a math curriculum. But homework has been such a problem for my students. Just this morning Lena was really upset about her father's help with an assignment. After telling her that the math we are teaching here is ‘crazy,’ he taught her the traditional algorithm for two-digit by two-digit multiplication. She was so confused about how to solve the problem, and who she should believe.”

“Oh Beth, this is just the beginning,” Darlene Brown confessed. “This will happen every time a new program or curriculum is thrown in front of your face and you're expected to understand and implement it. Parents are rarely notified of the changes when they happen. Nor are they told about the benefits and challenges of the new curriculum or how to deal with it at home. Basically, the teachers have to spend the next few years demystifying and defending the program to parents hoping they will either embrace it or give up questioning it. By that time we are changing the curriculum again anyway. Don't worry honey, you'll get use to it.”

Ray and Darlene chuckled empathetically for Beth. Ray added, “Actually, the other day I got a note from one of the directors of the after school program down the street. I guess they're getting some questions and grief from parents because the tutors don't understand the homework, which is done during the program. This made me think that our school should extend the professional development around the curriculum not just to teachers, but also to parents and after school program tutors.”

“While they're at it, how about a course for the teaching staff on working with parents. I'm 10 years into this profession and I still don't have a handle on that one,” admitted Darlene.

“So obviously I'm not the first teacher to feel the gap between what we know about the curriculum and what parents know. Why isn't this being addressed?” Beth asked.

Darlene explained, “The problem is finding someone who'll listen and then hoping they'll act on your suggestion. When you have as many years as we do you tend to act first without asking, hoping no one will mind.”

“Well then what actions are you two taking to defend the Investigations program to parents?” Beth asked.

Ray scrunched his face in a guilty manner, “Well, to be honest I haven't done a great job addressing the issue. I guess I've just been encouraging families to attend the math nights and sending the unit letters home consistently, being sure to print them in Spanish and English.”

Darlene lightly punched Ray in the shoulder. “Oh come on Ray, you know full well those family nights aren't enough. Yeah, the attendance is great and the idea of families spending quality time together focused on academics is exciting, but is that all the parents need?”

Realizing her free period was up, Beth packed up her worn canvas bag, said her goodbyes, and trudged back to her classroom. As she passed the front office she nearly collided with the principal. “Oh, good morning, *Maestra*. I have been looking for you. I just got a phone call from Lena's father, Mr. Coridan, and he would like you to call him regarding Lena's homework last night. He said they were having trouble and that Lena got upset when he tried to help. I told him you would call him when you had a moment today.”

Mr. Coridan, Lena's Father

“This year I have been really happy with Lena's teacher. She really cares about the kids and wants the best for them. At the parent-teacher conference she was easy to talk to and didn't intimidate me like teachers in past years. Even her room is inviting and seems like a great place for kids to be. My only concern is the way that Ms. Martin is teaching math to the kids. Lena comes home with only a few math problems each night. It seems like half the time she is writing sentences on her math papers rather than doing the arithmetic.”

“Last night she came to me asking if I could remind her which of the digits of the left number went with which digits of the right number? I told her that whatever she was talking about seemed a bit mixed up and she first had to set the numbers up on top of each other. I thought it was rather strange that she didn't do this to begin with, so I asked her to bring me her textbook to help her figure it out. When she told me they didn't have a book I was pretty surprised. From there I just had to use the way I was taught to do multiplication in elementary school. Why is Ms. Martin teaching math skills differently from the way I was taught? Maybe it is explained in the letters she sends home each month or so, but my wife and I really don't understand them. I called Ms. Martin today to express my concerns and maybe schedule a meeting to talk about this new math program.”

Lena, Fourth Grade Student

“I really used to hate math. It is such a hard subject for me to understand. This year, Ms. Martin is teaching us a different kind of math. We get to use number cards, counting rods, interlocking cubes, charts, and lots of other things to help us figure out the problems. Sometimes when I have trouble doing a problem I use the different materials and then I can figure the problem out on my own. Ms. Martin also lets us work with other kids at our tables on different problems and projects. At first we sort of just talked a lot and Ms. Martin got annoyed, but now we have learned to actually talk about math. We talk about how we get our answers, the tricks we use, and how to help each other.”

“My only problem is that when I go home and do my homework, I sometimes forget the way Ms. Martin taught us. When I ask my daddy he acts like he has no idea what I am talking about. He takes forever trying to teach me his way of doing the problem and then I end up more confused. I feel really frustrated when this happens, but it usually gets better the next day when Ms. Martin goes over it all in class. I think I'll just stop asking my daddy for help because he doesn't know as much about math as my teacher does.”

Beth Martin, Fourth Grade Teacher

“The new math curriculum has so much potential for increasing students' math abilities and their understanding of math concepts. The TERC Investigations curriculum we have adopted focuses on collaborative work, real-life math connections, and skill reinforcement games. Of course I question some aspects of the program, but overall I have been really pleased. Unlike last year, I now feel my students are able to write and talk about math in a more in-depth, realistic way and demonstrate a more concrete understanding of how and why they are solving problems. The teacher's manual offers so much content information so I'm learning as much if not more than my students. Also, our district has offered a lot of great professional development on how to implement the curriculum in the classroom, and to strengthen our own mathematical understanding.”

“My biggest concern is how parents are being prepared to deal with the new math. A lot of parents don't understand the shift in teaching methods and conclude that it's ‘crazy.’ I don't think they realize how this attitude undermines our teaching and sends negative messages to the students. I know that Principal Ramirez has made family involvement a priority for our school and started math nights, where parents can play some of the math games we use in the classroom. However, I think parents may need to see teachers teach a lesson, or explain the Investigations approach to teaching basic concepts such as multiplication or division. Somehow we need to defend why we've chosen this program and how parents can support it in the home.”

Beth's Lunch Break: 12:30pm

“Hello, Mr. Caridon, this is Beth Martin, Lena's teacher, returning your call about last night's math homework.”

“Oh, hello Ms. Martin, thanks for calling me back. I guess Lena already told you that we had a bit of trouble with the assignment. Well actually, my issue is a bit larger than that one assignment. I am really struggling to understand this new math curriculum. Last night I showed my daughter a simple two-digit by two-digit multiplication problem setup and she stared at it with a puzzled look on her face. It was as if she'd never seen it before. In talking to other parents, they seem to have similar experiences and concerns. The kids don't even have math textbooks to refer to. I really think you are a great teacher and care a lot about your students. Lena tells us this all the time. But I am seriously questioning the math instruction that is going on in your classroom.”

“Well, Mr. Caridon, the principal mentioned that you were concerned about the homework, but she didn't mention your greater concern.”

“I didn't actually get into much detail with her. She seemed a bit rushed and quickly suggested I attend the upcoming math night as a way to get involved and learn more. Maybe that would be a good event for my wife and I to attend.”

Beth paused for a moment to think about how to respond to this suggestion: Would Mr. and Mrs. Caridon really get what they needed out of this event? What should I say?

The people and events in this case are based on real life accounts, but have been disguised to protect confidentiality.



Expert Commentary to “Daddy Says This New Math Is Crazy”: Three Tips for Teachers

Marlene Kliman

Most parents, whatever their academic background, recognize the importance of math for children’s school and career success; they are eager to support children’s learning at home.¹ Yet, today’s parents are likely to have learned arithmetic as a set of memorized facts and algorithms, in contrast to current Common Core–aligned curricula that emphasize children developing the mathematical knowledge needed to devise and explain their own arithmetic strategies.²

The “Daddy Says This New Math Is Crazy” case suggests the need to reconcile two sometimes competing goals:

1. For teachers to implement a math curriculum that they (or their district leaders) believe is of great benefit to children but that diverges substantially from traditional arithmetic, and
2. For parents to support their children’s math learning and feel confident that their children are gaining a solid math education.

Below are several suggestions for achieving both goals simultaneously, illustrated with examples drawn from [Nana y Yo y las Matemáticas](#), a program in which parents and other caregivers experience a new approach to math alongside their preschoolers over the course of a year.³ Although the program involves younger children, the parallels are many: Most parents initially harbor views that preschool math consists of little more than memorizing the counting sequence and perhaps naming shapes. And at times they question the project approach, which involves exploring shapes, quantities, patterns, measurement, and logic through play, crafts, and active games.

Leverage parents’ mathematical strengths. Look for opportunities to identify curricular content and approaches with which parents are likely to be at least somewhat familiar. Homework assignments based on this material will offer parents an opportunity to draw on their own strengths in helping children with homework. For instance, many parents arrive at Nana y Yo y las Matemáticas already comfortable reciting the counting sequence with their young children: They count children’s fingers and toes when the children are



getting dressed, steps when they are walking, and pieces of food when parents are serving a snack. Few, however, are initially aware of the importance of giving children an opportunity to match, compare, and count objects on their own. From the outset, program facilitators acknowledge and applaud the counting parents already do with children; they also suggest ways to build on this, for instance, by encouraging children to count a set of objects, mix them up, and predict if they will get the same number if they re-count. In this way, parents feel supported and empowered as they use what they already know and do as a springboard.

Make communication with parents the focus of homework. Use the school day for engaging students in learning or practicing with new strategies; for homework, ask them to demonstrate a now-familiar approach to their parents. For instance, if they are grappling with two-digit-by-two-digit multiplication in the classroom, have them demonstrate an approach to solving a two-digit-by-one-digit problem to their parents. This gives parents a glimpse of the strategies children learn at school and a basis for their reassurance that children can, in fact, carry out arithmetic computations successfully and with understanding and meaning.

In Nana y Yo y las Matemáticas, parents report that the whole family benefits when children bring home a math-related craft to share with family members or a math game to play with others at home. Through these mathematical interactions with family members, children come to solidify their understandings, and family members begin to appreciate just how much children are learning and the value of the Nana y Yo y las Matemáticas approach.

Consider capturing children's classroom problem solving on video. Inviting parents into the classroom might help to allay their concerns, but visits to the classroom during the school day are not feasible for all parents. With near-ubiquitous smartphones, even in low-income communities, teachers can bring snippets of the classroom to parents via occasional videos sent via text.⁴



In Nana y Yo y las Matemáticas, video is serving as a powerful vehicle for communicating about developmentally appropriate math content and pedagogy. Program facilitators send home one-minute videos to parents via text and use them as a basis for in-the-moment communication with parents. For example, the parent of a 2-year-old questioned the mathematical value of an activity that involved matching a piece of pasta to each finger, wondering if the child's time wouldn't be better spent practicing writing numbers. The program facilitator showed a video of a

young child engaged in the same activity and grappling with a more-or-less comparison of her five fingers and three pieces of pasta. The video formed the basis for a reassuring conversation about the role of hands-on experiences with one-to-one-correspondence in developing number sense. The parent emerged with recognition of the value of the activity for her young child.

Final Thoughts

Children benefit from parental engagement in their learning, and many parents want to be involved. In math, an area in which adults often bring a history of rote learning rather than deep understanding, parental engagement can be particularly fraught. If educators are to enlist parents as allies in implementing a new math program, they need to start with parents' deep desires to see their children succeed and to play a role in helping their children achieve that success.

¹ Johnson, J., Rochkind, J., and Ott, A. (2014, April 14). *Are we beginning to see the light?* Public Agenda <http://www.publicagenda.org/pages/math-and-science-ed-2010-full-survey-results>; National Center for Families Learning (Spring, 2014). *Family Engagement Brief*. Retrieved from http://www.familieslearning.org/pdf/NCFL_Family_Engagement_Brief_.pdf

² National Governors Association Center for Best Practices, Council of Chief State School Officers. (2010). *Common core state standards for mathematics*. Retrieved from <http://www.corestandards.org/Math/>

³ Nana y Yo y las Matemáticas, a collaboration between YMCA of Silicon Valley and TERC, builds upon the YMCA's Early Learning Readiness programs for children from birth to age 5 and their parents, grandparents, and other caregivers. Nana y Yo y las Matemáticas is generously funded by the Heising-Simons Foundation.

⁴ Smith, A. (2015, April 1). *U.S. smartphone use in 2015*. Pew Research Center. Retrieved from <http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/>



Helping Teachers of Mathematics Integrate the Knowledge and Culture of Families Into Their Practice

Margaret Caspe and Laura Alves

[TODOS: Mathematics for ALL](#) (TODOS) is an international professional organization that advocates for equity and high-quality mathematics education for all students, particularly those who are Latino or Latina. By offering math educators high-quality professional development opportunities—through webinars, in-person conferences, publications, and online resource banks—TODOS helps educators establish equitable, rigorous, and coherent mathematics programs in their classrooms.

Diane Kinch, president of TODOS, and Marta Civil, vice president of TODOS and a professor of mathematics education at the University of Arizona, talk about ways to develop and support mathematics educators to engage families in their teaching practices. Below are four interrelated ideas that persist throughout their work:

1. **Mathematics is cultural.**

Mathematics is often viewed as a discipline, consisting of correct numbers, formulas, and algorithms that exist in a vacuum, without consideration of language, culture, and time. For this reason, mathematics is sometimes equated with intelligence in our society—that there are abstract ideas and symbols that people either grasp or don't. Consequently, mathematics is often used as a gatekeeper in schools and



applied to sort those who succeed and those who don't. What TODOS helps mathematics teachers understand is that mathematics is an activity that exists largely outside of school, and it involves interactions among people in a community, based in part on their values, beliefs, and culture. Families, in particular parents who have been schooled outside the U.S., are likely to bring different ways to do mathematics. For example, families might use a comma, instead of a period, to indicate decimals. Differences might also extend beyond simple functions. For example, families might view that the long division algorithm traditionally taught in the U.S. is “inefficient” because students should be able to do the subtraction in their head. When designing initiatives for family engagement in mathematics,

it is important that both schools and families are aware of these cultural differences and learn about and from them.

2. **Families have many mathematical strengths and are assets for their children.**

Too often research on mathematics and low-income families compares mathematics practices between families from upper- and lower-income homes. Results of these studies often conclude that families from low-income homes don't do as many math activities with their children as upper-income families do, or that the ideas they present are not as complex. TODOS helps teachers set aside these ideas, and instead, develop the disposition of being able to look into all communities and understand what they are doing, and the strengths that they do have.



3. **Mathematics exists in myriad ways in the everyday lives of families in their home and community.**

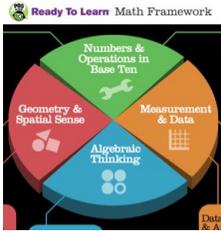
Teachers of mathematics need to understand the ways that families use mathematics concretely in their everyday lives. This can range from calculating gas mileage to identifying geometry in folded art designs. Based on the funds of knowledge approach—an approach that argues for putting the knowledge residing in the family and community at the foreground of children's learning and school educational experiences—teachers need to take time and build mutual trusting relationships with families to uncover and recognize how math is situated in their lives. Although this can be done through holding family mathematics workshops, inviting families into classrooms, and going on home visits, what is most critical is that teachers become embedded in the community in which they teach, and take the time to truly recognize mathematics and schooling through parents' eyes. What questions do parents have that they want heard? What does math dialogue between children and families feel and sound like? This knowledge can then serve as the foundation for curriculum in the classroom, and also, for reaching out to families to expand their mathematical knowledge and repertoire for supporting their children's learning.



4. **Learning is most powerful when families, students, and teachers are co-learners.**

Teachers are best served if they develop the mindset that everyone is a mathematics learner. Whether parent, student, teacher, or researcher, every person has his or her own values and beliefs about what "counts" as mathematics and how it should be taught and learned. There are a number of creative approaches for teachers to explore different beliefs in a

constructive way. One way this can be done is through tertulias, or get-togethers, where groups of families and teachers, without a power hierarchy, can talk about math and discuss not only the content of problems, but their values, and reasoning behind them. These types of opportunities are also ways for families to build networks among one another to support children's math learning in the community. Another approach is for teachers to host parent panels to hear their students' parents discuss their view about mathematics and their expectations for their children's education. Teachers can also invite parents into their classrooms and ask the parents—and their children—to share their personal experiences with using math in everyday life. A final, particularly immersive approach is for teachers to be placed in a situation where they experience “difference” in mathematics, for example by learning about algorithms from other parts in the world, or by participating in a mathematics class in a language other than English.



Transmedia Activities: Engaging Families to Improve Children's Early Mathematics Achievement

Betsy McCarthy

RESEARCH BACKGROUND

Early mathematics ability is a strong predictor of later mathematics achievement and overall academic success.¹ The study described in this paper attempts to evaluate an intervention designed to engage families and promote mathematics learning in preschool children.² The intervention model includes a school-based curriculum whereby families attend weekly parent support meetings and then use in-the-home PBS KIDS digital games, videos, and hands-on activities, all related to early mathematics and all provided in both Spanish and English.

METHOD

Theoretical Framework

This work is guided by the **PBS Ready to Learn Math Framework** (see Figure 1). The framework includes four main mathematical concepts, including algebraic thinking, and measurement and data. Each concept is accompanied by concrete mathematical tasks that support these concepts.

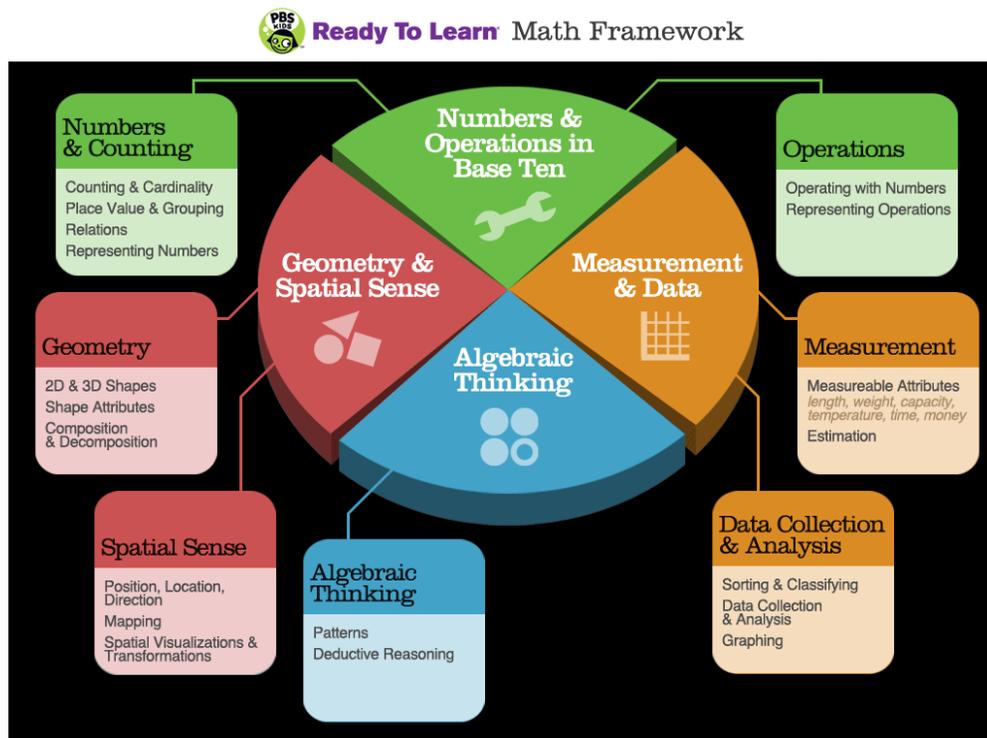


Figure 1. Mathematics Concepts in PBS KIDS Games and Support Materials

The Intervention

The study used a quasi-experimental design³ and focused on two overarching mathematics concepts: (1) numbers and operations in base 10, and (2) geometry and spatial sense. For nine weeks, parents of children in the intervention group participated in a weekly program at the preschool led by the classroom teacher. Each weekly session focused on mathematical concepts and how to use PBS KIDS transmedia activities in the home (see text box). Parents were encouraged to work with their children at home on the PBS KIDS activities for 30 minutes a day, four days per week, and were given a Chromebook laptop for the duration of the study to do so. Parents also received ideas for hands-on activities to do with their children, printed from the PBS KIDS website. Preschool teachers participated in six hours of facilitator training to learn how to conduct the weekly parent meetings.

FINDINGS

Children’s mathematics knowledge and skills improved. The intervention was positively associated with gains in children’s knowledge and skills in mathematics. On two types of measures,⁵ the intervention group improved more than the comparison group did.⁶ These findings were similar for Spanish- and English-speaking families, and across all income levels.

Parents’ awareness and support of their children’s mathematics learning increased. According to parents in the focus groups, the intervention motivated them to set aside time each day for math activities with their children; they learned new skills and became better prepared to support their children’s learning; and they learned to work collaboratively with their children to provide context-sensitive support. In addition, parents said that they learned to support their children in a learning environment that encourages playfulness and positive affect. A typical comment from a parent was:

For me, with my daughter, it was fun . . . I learned how to ask her more questions, and we found a way to learn together.

A CLOSE-UP ON TRANSMEDIA

The intervention in this study uses “transmedia storytelling,” or “transmedia.” This term refers to [representing a narrative or story experience](#) across multiple platforms and formats,⁴ and may provide new opportunities for families to engage with their young children in quality learning interactions. Below are examples of some of the transmedia activities (two digital and one hands-on) focused on numbers that were included in one week of the intervention. All activities in this intervention are available free of charge at the [PBS KIDS website](#).

- **Digital game:** [Hide and Seek with Curious George](#), which focuses on numbers and counting.
- **Hands-on activity:** A [card game](#) in which children and family members match cards that show written numbers and digits.
- **Video clip:** [Curious George](#) engaged in mathematics problem solving.

Teachers were successful in facilitating the parent meetings. Teachers at the intervention sites were successful facilitators of parent meetings, delivering intervention activities with fidelity and providing parents with deeper connections to their preschools. Nearly all teachers reported that they enjoyed the experience of teaching parents. One teacher commented:

I think the most exciting thing is to see more [parent] awareness of math all around. If there 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.

IMPLICATIONS

Digital media, coupled with parent training on how to use it to support children’s learning, is an effective way to improve mathematical competencies and narrow school readiness gaps. The current intervention, if scaled up to reach more low-income preschool families, could have a profound effect on kindergarten readiness in children in low-income communities, and could perhaps affect children’s future academic careers. The intervention allows for children at all income levels to progress in their mathematics abilities, and, most importantly, allows children in low-income families to progress toward meeting important standards for kindergarten readiness.

With training, early childhood educators are well suited to support families in choosing and utilizing digital media that can support children’s learning. As families gain more access to educational digital products, they may look to early childhood educators for guidance around how to responsibly and effectively use these new tools to support their children’s learning. Policymakers, schools of education, and professional developers of early childhood education preservice and in-service should anticipate families’ and providers’ needs as they build capacity of teachers and other professionals to provide this support to families with young children.

This research digest is a summary of McCarthy, B., Li, L., Tiu, M., Atienza, S., & Sexton, U. (2015). Learning with PBS KIDS: A study of family engagement and early mathematics achievement. San Francisco, CA: WestEd. Retrieved from <https://www.wested.org/resources/learning-with-pbs-kids/>

¹ Burchinal, M., McCartney, K., Steinberg, L., Crosnoe, R., Friedman, S. L., McLoyd, V., & Pianta, R. (2011). Examining the black-white achievement gap among low-income children using the NICHD study of early child care and youth development. *Child Development*, 82(5), 1404–1420; Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., Pagani, L. S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K. & Japel, C. (2007). School readiness and later achievement. *Developmental Psychology*, 43(6), 1428–1446; Jordan, N. C., Kaplan, D., Ramineni, C., & Locuniak, M. N. (2009). Early math matters: Kindergarten number competence and later mathematics outcomes. *Developmental Psychology*, 45(3), 850–867.

² 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.

³ Quasi-experimental design studies are frequently used when it is not logistically feasible to conduct a randomized controlled trial where subjects are randomly assigned to treatment or control groups. Instead, quasi-experimental designs typically allow the researcher to influence the assignment to the treatment condition using some criterion other than random assignment.

⁴ Herr-Stephenson, B., Alper, M., Reilly, E., & Jenkins, H. (2013). *T is for transmedia: Learning through transmedia play*. Los Angeles and New York: USC Annenberg Innovation Lab and the Joan Ganz Cooney Center at Sesame Workshop; Jenkins, H. (2006). *Convergence culture: Where old and new media collide*. New York: New York University Press.

⁵ The research team collected data using the Test of Early Mathematics Ability, Third Edition (TEMA-3), a researcher-developed assessment of mathematics skills related to the concept of shape, parent surveys, parent focus groups, and parent meeting observations.

⁶ Technical Note: Adjusted mean differences in 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.

CONTRIBUTOR BIOS

Taniesha A. Woods, PhD, is the vice president of research and quality improvement at Lutheran Social Services of New York. Taniesha's research provides insight about ways to support teachers in their knowledge and delivery of high-quality mathematics instruction, with an emphasis on improving the learning outcomes of low-income and poor children. Her publications include the National Research Council report *Mathematics Learning in Early Childhood: Paths Toward Excellence and Equity* and the book *Preparing Early Childhood Educators to Teach Math: Professional Development That Works*.

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Betsy McCarthy, PhD As a senior research associate at WestEd, Betsy provides technical assistance and research expertise for a number of large projects, including *Ready to Learn: Expanded Learning Through Transmedia Content Study*, in collaboration with the Corporation for Public Broadcasting (CPB) and the Public Broadcasting Service (PBS).

Discussion Questions: “Daddy Says This New Math Is Crazy”

Objective I. To consider the impact of curriculum changes on parent-teacher relations and on parents' participation in homework help.

- What is the teacher's role in explaining and defending curriculum changes to parents? What is the school's role?
- How do you evaluate Lena's father's concerns about the new math?
- If you were Beth Martin, how would you defend the strengths of the new math curriculum to Lena's father?

Objective II. To explore outreach activities for informing and engaging parents in curriculum changes.

- Why aren't math nights at Winner Elementary School working as well as expected?
- What other strategies could the school use to earn parent support for the new math curriculum?
- What skills do parents need to participate in their children's math learning at home and how can the school promote these skills?
- How do Ray Donaldson and Darlene Brown, the senior teachers who empathize with Beth Martin's concerns, deal with parents' confusion? How can communication among teachers and school leadership improve to find joint solutions to supporting parents?

ABOUT GLOBAL FAMILY RESEARCH PROJECT

The Global Family Research Project is an independent, entrepreneurial nonprofit organization that supports all families and communities in helping children find success in and out of school. We create a worldwide exchange of ideas to further the understanding and implementation of anywhere, anytime learning for all.

Since 1983, our team has provided leadership to promote strategies that build pathways for children's whole development across all learning environments. For more information, contact:

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