

Early Math Initiative

Engaging Families in Early Math



Families play an important role in children's early math development. Parents are children's first and primary teachers, and they lay the foundation for children's learning and development in all areas of life, including math. Families have many natural opportunities to engage children in math as part of their day-to-day lives. From measuring the amount of cereal at breakfast to counting the number of animals in a bedtime storybook, families can introduce math concepts and vocabulary in children's routines in many ways. The significance of such activities is confirmed in countless studies showing that the quality of children's home math environment has a direct impact on their future development. Such activities help predict not only how well children will do in preschool and elementary school^[1,2] but also whether children will pursue a future career in fields related to science, technology, engineering, or math (STEM).^[3] Increasing the likelihood that children are interested in STEM is important given the growth of STEM fields that potentially offer greater economic opportunities than many other fields.^[4]

Early childhood educators can help families create these math-rich home-learning environments. Although some families provide a supportive home math environment, not all families are aware of the importance of early math for children's development, and many families engage their children in very few math activities or little math talk. Some of these differences may be attributed to families' feelings and beliefs about children's early math development or even families' own experiences with math as a child.^[5] Other differences in the

home math environment may be attributed to the socioeconomic circumstances of the family. These circumstances in turn can affect the level of access families have to various math activities and materials, or the amount of time they have to spend with their children.^[6,7] Educators can help raise families' awareness of the many math opportunities that exist in the home through daily routines, interactions, and play. Educators can also guide families and help them feel confident in their ability to introduce mathematical thinking in the home.

In This Brief

- An overview of the beliefs and feelings families may have about early math development
- A summary of various home math activities that research suggests are helpful in supporting children's early math knowledge
- Practical implications for educators on how to support families in creating a rich home math environment



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This brief will begin by shedding light on some of the common beliefs and feelings families may have about children's early math learning. It continues with an overview of the various types of home interactions and activities that research suggests support children's early math development. Finally, it provides guidance on how teachers can support families to take part in home math activities and interactions by discussing successful family math programs.

Family Beliefs and Feelings About Math

Families have many opportunities to engage in math activities with children, yet many shy away from these interactions. Research suggests that parents' hesitation to engage in math with their child may be driven by various feelings they have

about math or their beliefs regarding the importance of math for young children.

Some parents are reluctant to engage in math with their children, which may stem from their own experiences learning math as a child or their lack of formal math experiences.^[6] In fact, multiple studies have found that parents (and also teachers) with more negative feelings about math transfer these feelings to their children.^[5] They may avoid math-related situations in the home or lack confidence when helping children with math homework.^[5,8] Encouraging parents to be mindful of the language they use with their children when engaging in math is one way to prevent their children from picking up on these unfavorable math feelings.^[9] Teachers may want to encourage parents to embrace a growth mindset when talking about math with their child (see the box below on Growth and Fixed Mindset).

Growth and Fixed Mindset

Studies suggest that children's and adults' beliefs about their own abilities—their mindset—affects how motivated they are to perform a task^[10] and, for children, their achievement in school.^[11,12] A child's mindset with respect to math ability, or beliefs about how easy or difficult math is, can therefore have a big impact on how interested the child is in math at school and how successful the child is with math tasks. Researchers have identified two types of mindsets:

- **Fixed mindset:** Belief that you have a certain amount of ability and that you cannot do much to change it
- **Growth mindset:** Belief that you can develop your abilities through hard work, effective strategies, and practice

Children with a growth mindset are more likely to persist in the face of challenges and look for opportunities to learn. Furthermore, studies have found that children with a growth mindset tend to outperform those with a fixed mindset in school.^[10,12] Parents and teachers have a strong impact on children's mindsets primarily through the praise they give.^[10,12] Rather than praising a child's intellect (e.g., "You are really smart"), which promotes a fixed mindset, families should focus on praising the child's effort (e.g., "you must have worked really hard on this task"), which promotes a growth mindset. In the context of math, caregivers should avoid talking about the difficulty of math (e.g., "I know math is hard") and instead focus on the importance of challenges (e.g., "It may take some effort, but that's because your brain is growing.").

In addition to parents' feelings about math, they may also hold certain beliefs about children's early math development that affect how they engage children in math activities at home. Although most parents agree that math is important, they often rate their child's language development as being more important. Parents report feeling more enthusiasm and more confidence teaching language to their child compared to math.^[13] These beliefs can affect how often families engage in math activities with their child. In fact, parents, especially those in less advantaged socioeconomic circumstances, tend to believe that the school, not the parent, is primarily responsible for supporting children's early math development.^[7,14]

Families have many natural opportunities to engage children in math as part of their day-to-day lives.



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Teachers can shape families' beliefs about the importance of math in early childhood and their role in supporting children by showing families how to incorporate math activities during daily routines and play. This practice will allow families to see how easy it can be to create a home environment rich in math opportunities. Research has found that parents who are more aware of the importance of math in early childhood tend to engage in more math activities with their children.^[15]

Furthermore, families may hold inaccurate ideas about children's math development.^[6,16] For example, they may not know at what age most children should be able to master certain math skills. Families may also lack an understanding of whether their own child has mastered certain math skills.^[6,16,17] One study found that parents overestimated what skills their preschool-aged child had, specifically in the domains of counting and number identification.^[16] By providing families with regular updates on their child's math development in school, families will have a more accurate understanding of their child's progress, allowing them to provide more developmentally appropriate responses at home.



Gender Stereotypes About Math

Gender stereotypes about math typically refer to the belief that girls are not as good at math as boys are. Although research has found that girls and boys perform similarly on objective measures of math achievement,^[18] few girls choose to pursue math-related careers.^[19] Young girls may have negative attitudes toward math, and they may also pick up on the beliefs that adults around them have about girls' math abilities.^[3,20,21] For example, research suggests parents believe boys have more natural talent in math and need to work less hard in math than girls do, which can cause girls to believe they are not as good at math as boys are.^[3] Consequently, this impression may discourage girls from taking additional math classes and pursuing math-related careers.

The first step in breaking down these gender stereotypes is creating an awareness among educators and families of how children are treated differently based on gender. Specifically, educators need to ensure that they have similar expectations in math for boys and girls and that they take the time to discuss these expectations with families of both boys and girls.^[3] Additionally, given that young children are especially sensitive to the behavior and language of same-gendered adults around them,^[22] surrounding girls with positive female role models—for example, women in the community who are involved in STEM careers—can prevent girls from making the assumption that STEM careers are for boys only.

Parent–Child Math Interactions and Activities

Research suggests various home math activities that help support children's early math knowledge and skills. However, families may need guidance on how to engage children in these math activities.^[13,23] Educators can play a valuable role in helping families recognize the various opportunities that exist in the home to support children's early math through daily routines, interactions, and play.

A Focus on Language: Math Talk

Researchers studying families' math interaction at home often use the term “math talk” when referring to using math vocabulary and math concepts in conversations.

Families can use math talk at any time of the day during almost any activity. Math talk can easily be introduced during daily routines, such as snack time (e.g., “You and your sister can each have five grapes.”) or bath time (e.g., “Which rubber duck is the biggest?”), and during children's play such as when playing with



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blocks (e.g., “How many blocks are you using in your tower?”). Families should be encouraged to engage in math talk even with young infants and should focus on this engagement especially in the preschool and early elementary years when children are rapidly learning new math skills and vocabulary. Families who engage in math talk in their home language provide the foundations for dual language learners’ math learning in both their home language and English.

Several studies have shown that the amount of math talk parents use in the home is related to children’s mathematical knowledge.^[24–26] For example, parents who reported engaging in more math talk at home with their preschoolers had children with more advanced number knowledge.^[25] However, the amount of math talk parents engage in can vary substantially from one family to the next.^[24,25,27] One study found that when parents and children were given math-related toys to play with together, the amount of math talk that families engaged in varied from 4–34 percent, depending on the family.^[26]

Family math talk also varies in quality. During the preschool years, parents most often engage in math talk related to identifying and counting small sets of objects (e.g., “One, two, three cats” or “Uno, dos, tres gatos”), while rarely talking about advanced number concepts such as adding, subtracting, or comparing objects (e.g., “Who has more crayons, you or me?”)

or “¿Quién tiene más crayones, tú o yo?”).^[24,28,29] Yet, children can really benefit from slightly more advanced math talk such as counting to solve a problem, ordering objects from small to big, or finding the sum of two quantities. Such rich interactions can help children grasp more advanced math concepts.^[25,26,30] For example, for children to learn the cardinality principle (an important principle in learning to count), they need to hear their families talk about quantities greater than three or four (e.g., “How many steps until we get to the house? One, two, ..., eight, nine. Nine steps to the house!” or “¿Cuántos pasos hasta llegar a la casa? Uno, dos, ..., ocho, nueve. ¡Nueve pasos a la casa!”). Talking about small numbers alone (e.g., one to three items) does not help children learn this counting principle.^[30]

Families who engage in math talk in their home language provide the foundations for dual language learners’ math learning in both their home language and English.

Gestures

Gestures allow people to make a connection between a word and the corresponding object or action. For example, pointing can make the connection between a set of objects (e.g., five rubber ducks) and the number word (e.g., “Look, five ducks”). Gestures can also visually demonstrate math concepts such as small or large, short or tall.

Although gestures are often natural and spontaneous, research suggests that children who are in the process of learning a concept may be able to express what they know with gestures before they can do so with words.^[31] For example, when preschoolers were asked how many items they saw on a card, those who failed to correctly identify “three” items using words were frequently able to produce the correct hand gesture (i.e., holding up three fingers).^[31]

Furthermore, gesturing helps children learn how to count. Studies found that preschoolers count objects more accurately when they use pointing gestures because it helps them coordinate saying one number word for each object.^[32] Modeling gestures for children during activities like counting may therefore help children make connections between number words and the quantity they represent. Beyond counting, gestures can be used to help illustrate a variety of math concepts and vocabulary, such as which cup of juice is wider or taller or highlighting that an inch on a ruler is the space between the two lines.

Gestures may be particularly beneficial for dual language learners. Gestures can help them understand the meaning of new words (e.g., when someone points to an object while saying its name) and can help dual language learners communicate when they are struggling to express their ideas verbally.



Math Through Everyday Routines

Daily activities provide meaningful opportunities for learning and applying math skills such as counting, adding, subtracting, measuring, and comparing or naming shapes. Meaningful math talk can occur when cleaning up toys, grocery shopping, brushing teeth, setting the table, or gardening. For example, when grocery shopping with their child, families may talk about the number of apples needed for a recipe, which box of cereal is bigger, or what numerals are displayed on price tags. Similarly, when cleaning up toys, families can help infants and children count the number of toys they are putting in the toy bin or arrange the books on the shelf from smallest to largest.

Families may be already incorporating math in their everyday activities. Take the time to learn from families about their daily routines and cultural practices and ask families whether they ever count or talk about math with their child during any of the activities (e.g., comparing or ordering objects by size). Identify the ways in which parents may already be engaging in math talk during some of their daily routines and share how parents can extend the math talk as children become more skilled (e.g., talking about the different shapes they see in the bathroom during bath time). Additionally, provide parents with examples of how they can incorporate math talk in other cultural activities that are important to the family. Encourage families to use a child's home language when engaging in these cultural practices to support children's math and language development. What is important is that families talk about math in the language they are most comfortable speaking.

Reading to infants and children also offers rich opportunities for families to discuss math concepts and engage in math talk.

Cooking. Cooking is another routine in which math is inherently embedded. When following recipes, children can help measure ingredients, count the number of cups of flour needed to bake bread, or work on their addition when figuring out how many cups of flour and sugar there are altogether. In fact, a study found that when parents were given guidance on how to engage in conversations that referred to math concepts and vocabulary during cooking activities with their preschool-aged children, their children were more likely to answer their parents' math questions correctly.^[28] Since cooking is a common home activity and a cultural practice, it may be a particularly useful way to encourage families to engage in math. In fact, a study of Latinx families found that children benefited from an intervention (conducted in Spanish) that provided parents with



strategies for engaging in math-related talk during cooking and mealtimes.^[33] This benefit was particularly true for children who had lower math skills to begin with.

Book reading. Although storybooks build children's literacy and vocabulary skills,^[34,35] reading to infants and children also offers rich opportunities for families to discuss math concepts and engage in math talk. For example, one way families can incorporate math in reading with infants and children is to count sets of items (e.g., animals, cookies) illustrated on a page. Research suggests that children learn best when parents count the objects and make connections between the counting procedure and the total number of objects counted (e.g., "One, two, three, four, five. Look, there are *five* cats!" or "Uno, dos, tres, cuatro, cinco. Mira, hay *cinco* gatos!").^[36] This type of math talk during book reading supports children's counting skills and understanding of cardinality.

Given that research has shown that children who are exposed to more math talk during book reading make greater gains in math achievement, raising family awareness of the many ways that they can incorporate math talk in book reading may be



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particularly important.^[37] Observational studies of parent book reading have shown that parents do engage in math talk when reading books with their children, although how much they do so varies significantly.^[38]

Many families already enjoy reading books with their children, but even just a little training by educators on how families can include more math talk when reading with their infant or child can make a big difference in the quality of the storybook interactions. One study found that after just one training session with a researcher and with the help of some reading guides, parents increased their math talk dramatically over the next few

weeks. In the training, parents were encouraged to incorporate math talk by asking questions (e.g., “Which one is smaller?” or “¿Cuál es más pequeño?”), responding to a child’s question (e.g., “How many fish are there?” “There are eight fish.” or “¿Cuántos peces hay?” “Hay ocho peces.”), explaining or commenting (e.g., “The triangle has three sides.”), and providing feedback on children’s contributions (e.g., “Yes, there are more plates than cups” or “Sí, hay más platos que tazas.”).^[39] To encourage families to incorporate more math talk during book reading, teachers may want to provide families with some simple reading guides or provide a list of math vocabulary in children’s home language for families to use when reading with their child.

Practical Implications for Fostering Math in Routines and Daily Interactions

Educators can play a critical role in encouraging families to engage in math interactions and activities with their children.

Research-Based Strategies

- Provide families with concrete examples of how they can engage in number and math activities in daily routines. Be sure to provide materials in families’ home languages and encourage families to do “math talk” in their home languages as well as English. For example:
 - *Grocery shopping*: Count the number of apples you are putting in your grocery cart or how many items are left on your grocery list.
 - *Laundry*: Play a matching game and compare the colors and patterns of the different socks.
 - *Cooking and baking*: Measure out ingredients for a cake and use a clock to count how many more minutes the cake needs to stay in the oven.
 - *Setting the table*: Count how many plates are needed for dinner and use addition to add the number of plates and cups on the table.
- Provide families with a list of math vocabulary the children are learning (e.g., number words). Include the words in English and the children’s home languages. Making the link to the home language supports the connection between activities in the home and school.
- Encourage families to introduce math talk when engaging in reading, storytelling, and singing. Emphasize the importance of using math talk in home languages. It may be helpful to provide them with reading guides that present ideas on how to include math talk during storytelling.^[39] You can find some examples of reading guides on the CA Early Math Project website at: <https://www.earlymathca.org/children-s-literature>
- Send children home with a list of books that encourage math talk and that families can check out of their local library. Include books in English and in the families’ home languages on the lists.

Engaging in Math Through Activities and Games

Outside of daily routines and book reading, families can support math learning through games and activities that children enjoy and that are common practices in their family and culture. For example, playing hopscotch, solving puzzles, or playing with marbles or blocks not only provide opportunities for math talk but also allow children to practice mathematical procedures such as counting or addition. Some games, such as dominos, have a

clear mathematical component (matching the number of dots on the dominos) and lend themselves to talking about math very easily. Others, for example, a game of memory, may not have a clear mathematical component but carry the potential for math talk (comparing the number of pairs each person has to see who has more). Remember that the math talk may be in English or a home language—talking about math in any language supports math skills! The activities and games listed below are some examples of math activities that have been studied systematically.^[26,40–42]



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Blocks and puzzles. Block and puzzle play help children of all ages develop spatial reasoning skills—an important math skill that children learn. These activities allow children to think about objects in three dimensions and explore how they move in space.^[43] When children play with blocks or puzzles, they mentally and physically manipulate the objects in the environment and understand how different objects fit together. This activity allows children to use spatial and math language by talking about the object's dimensions (e.g., long, short), direction (e.g., top, right, left), and transformation (e.g., flip, rotate, upside-down). Studies have found that block play can improve children's spatial reasoning skills.^[44] Similarly, research suggests that four-year-olds who engaged in frequent puzzle play performed better on spatial assessments than those who played with puzzles infrequently.^[45]

Children are more likely to use words that describe objects in space (e.g., under, on, next to) when they hear their families do so as well. Furthermore, children who hear and produce more spatial and math language perform better on spatial tasks.^[46] Providing families with guidance on how to engage in spatial activities and talk can benefit children's mathematical development. For example, a study found that children and parents engaged in

more spatial talk when they were given a clear set of steps on how to build a particular structure (similar to the instructions you might receive when assembling furniture).^[47] This guidance not only provided families with small achievable goals, but it also presented them with opportunities to discuss (using spatial language) how to achieve each of these goals.^[47] Providing this guidance (including vocabulary) in home languages as well as English supports all families to engage in this type of talk, regardless of the languages they speak.

Board games. Many children begin to enjoy playing board games in preschool or early elementary. Board games are not only enjoyable for children but also effective in promoting the development of number and math skills. In fact, families who report spending more time playing board games at home tend to have children with better number skills.^[40,48,49] Board games that have a number line or number grid structure (such as Chutes and Ladders) may be particularly effective in promoting mathematical thinking because they allow children to practice addition through counting (e.g., when moving up the board) and to gain a sense of the relationship between numbers and their location on the number line (i.e., that higher numbers are farther away on the number line).

Practical Implications for Fostering Math Through Activities and Games

Encouraging families to find ways to play math-related games can help children develop math skills and concepts in meaningful ways. Furthermore, showing families how they can incorporate math talk (in English or a home language) even when playing games that are less obviously about math (e.g., memory) can help families see the math in everyday life. Learning about activities and games that families like to play, including those common in their culture, provides an opportunity to support families in using math talk during these activities and games too.

Research-Based Strategies

- Encourage families to play board games that involve numbers, such as dominos, dice, number lines games, puzzles, and other games common in their culture, with their children. Families can find many printable versions of these games online, and they often can be played in any language. Educators may even want to create an art project that allows children to design and decorate their own version of the games. For example, when designing their own number grid board game children can practice writing out numerals in the design process.
- Explain to families how block play allows children to practice their imagination, innovation, and problem-solving skills. Encourage families to join their children in these activities. Provide families with a list of spatial and math vocabulary words, in English and in the children's home languages, to use when engaging in these activities.
- Send home ideas for math activities that children can do together with their families in English or home languages. Such activities will allow families to become familiar with the math content that children are learning in school. Some examples of activities include asking children to find several objects and arranging them from small to large, creating patterns using objects found in the home (e.g., beads, crayons, blocks), or comparing how many steps it takes to walk from one side of the room to the other. Children can then share their experiences of these activities in the classroom.



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Board games are not only enjoyable for children but also effective in promoting the development of number and math skills.

In one study children used a spinner to move one or two spaces on the board with the goal to reach the end of the number grid before their playmate did. After two weeks of practice with the games, these children made significant improvements in their number understanding and arithmetic skills.^[49–51] Encourage families of dual language learners to play these number grid and board games in the language they feel most comfortable speaking. This practice supports children who are dual language learners to learn math concepts and skills and make connections between new English words and words they already know in their home language.

Programs to Engage Families in Early Math

Researchers have examined various math programs designed to encourage family support of math in the home. These programs can take on many different formats, from a family math night to a workshop series for families on children's early math development. One common aim among these programs has been to explain to families the importance of early math for children's later math development. For example, these programs set aside about 15–30 minutes at the beginning of the event to explain the pivotal role families can play in children's early math learning and how easy it is to engage in math during daily activities.

Additionally, these programs have aimed to build families' knowledge of children's early math development by presenting families with concrete ideas of early math activities they can engage in at home with their child.^[52–55] To start, most programs spent some time demonstrating to families how to play various math activities. They explained to families how to set up the materials, described the rules of the games, and provided tips on how to create an environment conducive to children's learning (e.g., the importance of uncluttering the working area). By dedicating a significant portion of the program to families and children practicing playing various math activities together, the teachers were able to guide the families' play and answer any questions that arose.^[52] Some of these programs were specifically

designed with dual language learners in mind. They provided families with training in their home language and translated materials in the families' home language to make sure the program was accessible to all families.^[52]

Successful programs have also given families personalized feedback when they were playing math games with their child. In one study, teachers explained to each family how they could assess their child's current skills (in English or the family's home language) and how they could use this assessment to adapt the activity to meet their child's needs (e.g., by making the activity slightly easier or more difficult).^[52] Another program provided a one-on-one session for each family in which parents were coached on how to support children's counting skills.^[53] Other programs provided guidance in the form of videotapes that were made available to parents.^[55]

Lastly, most early math programs tried to promote early math activities in the home by providing families with math kits or math activity sheets to bring home, in English or the family's home language.^[52,54] Some programs made math kits available through their school library, where families could check them out at their own pace.^[52] Another program allowed families to take home the games that they had played with their child during the workshop along with a handout with tips on how to play these games.^[53] Other programs sent home math activity booklets throughout the school year that included games and activities families could play with common household items.^[55]



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Tips for Early Math Family Engagement in Your Program

Research suggests educators can play an important role in encouraging families to engage in math at home. By organizing programs like family math nights or by handing out math kits, educators can help families feel more empowered to engage in home math activities with their children. Below we have shared some tips on how your program can engage families in children's math learning.

Research-Based Strategies

Types of Early Math Family Engagement Initiatives

- Family math night: Hold a one-time event for families at which your program can explain the importance of early math in the home and share examples of math activities families and children can do at home. Bilingual staff and trained interpreters can support families who speak languages other than English.
- Math workshop series: Each workshop may be centered around a topic in math children are learning about in your program (e.g., number sense, patterning, arithmetic). Use these workshops to give an overview to families of the mathematical concepts their children are learning in school and how families can talk about these topics with their child through daily routines and play. Some workshops may be conducted in languages other than English, or interpreters may be used.
- Math kits and activity booklets: Send children home with math activities and materials they can use at home. Center each booklet around a math topic children are learning at school.^[55] Booklets should be translated into families' home languages.

Lowering Barriers to Participation

- Families may find it difficult to participate in an early math event at your program for various reasons. For example, they may experience conflicting work schedules, lack of child care, or some other cost of attending the event. As such, consider the following simple yet effective ways to lower barriers and help families participate in your program^[49,52]:
 - Give families a choice of times for the workshop(s), including options during the week and weekend, so that families do not have to take time off work to attend.
 - Organize transportation to and from the events, especially if public transportation is not readily available.
 - Provide child care at the events so that siblings have a place to go.
 - Consider offering a meal or some snacks during the event because families' busy schedules may prevent them from giving their children a meal before or after the event.
 - Offer workshops in families' home languages.
 - Translate all materials in the families' home language, including math kits, activity booklets, and instruction sheets.

Keeping Families Engaged in Your Early Math Family Engagement Initiatives

- Inform families of the importance of the home environment in children's mathematical learning and what role they can take on in their child's learning trajectory.
- Families may be unsure about the sequences of learning various math skills. Therefore, when organizing an event, spend a little time explaining to families what math milestones children are expected to reach throughout and by the end of the school year. You may use the California Preschool Foundations or Common Core State Standards in Mathematics as a guide.
- Families of dual language learners may be unsure of whether their children should be counting and using other math talk in English, a home language, or both. Emphasize that math talk in their most comfortable language supports children's development of critical math skills.



Conclusion

Families can play a significant role in supporting children's early math development through everyday routines and interactions. This brief identified some home math activities that research suggests are helpful in supporting children's early math development as well as providing educators with tips on how to help families engage in math activities and interactions at home. Using math during daily routines, such as cooking, cleaning, grocery shopping, or doing laundry, is one effective way families can engage their children in math at home. These unstructured times are ideal for introducing math vocabulary and concepts in conversation whether in English or another home language. Families play an important role in fostering children's development of math talk in a home language and should be supported to use their most comfortable language with their children. Similarly, activities such as block play or board games provide unique opportunities for children to practice math skills like counting, addition, and subtraction.

Educators play a very important role in fostering a fun math-filled home. Through programs like a family math night, educators can provide families and children with examples of fun math activities to engage in math at home while simultaneously emphasizing to families the importance of math in early childhood.



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