

DESIGNING FAMILY MATH

Recommendations + Tools for Developing a Family Math Curriculum



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Introduction

From January through March 2020, the Early Learning Lab worked with PBS SoCal to help inform the Compton Family Math Initiative through an exploration of what parents and caregivers need to support their young children in math.

This brief is the culmination of our research and recommendations for how a family math curriculum could support and inspire parents to have fun teaching and learning with their children anywhere, anytime.

Objectives

The two main goals of the Compton Family Math Initiative are to increase math proficiency and kindergarten readiness for low-income children by providing access to high-quality math-centric resources and to increase child and family math positivity by offering fun learning opportunities and engagement experiences.

To achieve these goals, the Compton Family Math Initiative needs a curriculum that resonates with local families. The Early Learning Lab set out to better understand what experiences and learning opportunities will be fun, engaging, and easy for Compton families to do at home.

Our objectives were to gain insight into parents' attitudes and beliefs about math; their understanding of preschool-level math concepts; how they see their role in ensuring their children are kindergarten ready in regards to math; and how they are already supporting their children's early math development.

Methodology

We used human-centered design, behavioural economics, systems thinking and regenerative design with the PBS SoCal team to craft experiential prototypes of the Family Math Parent Academy content plan to learn from community members. Using these different tools, we took a holistic and all encompassing approach to include organizational goals, human relationships and the complexity of child development, parent-child relationships, and societal inequities.



We collected feedback on the prototypes and gathered insights through the following activities with parents of children ages 2-7 in Compton:

- Two three-hour long design sessions with a total of 25 parents
- One-on-one interviews with eight parents
- Follow up survey with seven parents

The participants were all mothers; predominantly Hispanic/Latinx; largely Spanish only speakers and bilingual speakers of English and Spanish to varying degrees; and a mix of education levels across less than high school, high school graduates, and some college/associates degrees.

Following the conclusion of the research activities, we held a debrief discussion with the PBS SoCal team to discuss their notes and perspectives as facilitators, interviewers, and observers.

How to use this report

This report is meant to be a "wrap-up conversation" with the PBS SoCal team in which the Early Learning Lab shares the insights we have generated from our collaborative journey thus far. Included in the analysis are findings on parents, recommendations for curriculum design, additional tips from the Lab's child development perspective, and a syntheses of the prototypes from the design session.

This main section of this brief covers **design principles** and **curriculum recommendations** for the curriculum design.

Design principles are fundamental recommendations created by a practitioner of design. The Early Learning Lab developed these after rigorous synthesizing and generation of insights and patterns from the data accumulated over the course of research. These design principles are meant to be clear, simple, and easy to use ideas to implement in the final design.

Curriculum recommendations are more specific ideas, advice, guidelines, or tools created to support the application of the design principles into the curriculum. In other words, if the design principles are what to do, the recommendations are examples of how to do it.

This second section of the report also provides **guidelines for interviewing parents and a template for running future design sessions** so the PBS SoCal team can continue to strengthen their offerings to families.

Parent Attitudes, Beliefs, Challenges

From the research, we found that participating families hold overwhelmingly positive attitudes and beliefs toward being involved in their young children's math learning. It will be vital for the success of the family math curriculum to help parents overcome the barriers and challenges that might prevent them from helping their children in the ways that they want. The following is a summary of what we learned about parents' attitudes, beliefs, and challenges in math.

Parents see math as fundamental to their children's learning

- **Math and their children:** Parents viewed math as an integral part of their children becoming "well-rounded" learners. Regardless of their own positive or negative experiences with math growing up, parents consistently saw the value in their young children learning math.
- **Math outside school:** Parents seemed very open to helping to teach their children math outside of school. They also recognized that math is part of their lives every single day, from cooking to party planning to keeping time.
- **Experience and empathy:** Several parents shared similar accounts of enjoying math up until they hit a point where it was hard for them, they had a negative experience in school, or they had to quit school. Recalling this seemed to bring out empathy and patience for how children might struggle with math and become discouraged.
- **Enthusiasm for making math exciting:** Parents shared in interviews that they saw their young children as both being good at math and liking math. Some also expressed that their older children, and/or they themselves in the past, lost interest. Thus, they were enthusiastic about making math exciting to maintain and grow their young children's interest in math.
- **Math anxiety mostly with older children:** Most parents did not have anxiety about helping their young children with math. For those that did not feel that they had strong math skills, they typically had another family member support children with math at home. Several parents shared that while they felt confident in their ability to help young children, they did have anxiety around Common Core and helping their older children with math.

"Anything you do, you're always doing math."

— Parent Participant

Parents believe they have a similar but distinct role from school

- **Importance of school and home:** Parents saw both themselves and the school as having important roles in their children learning math—“We both want the best for kids.”
- **How it’s different:** Most of the parent interviewees saw their role as different from the school’s role in that parents should supplement and reinforce what the school teaches first. Some also viewed it as the parents’ role to prepare children to be respectful, to behave in class so they can learn, and to ask teachers questions when they need help.
- **Math support at home:** Most parents were actively involved in their young children’s math learning. When asked what they do related to math at home, many of the parents said that they helped them with their homework, played games, did counting activities with their children, and allowed them to play/watch educational media.

“The work is the responsibility of both, here and at home, because they teach them here, but if they don’t practice or don’t understand, I think they won’t like it.”

— Parent Participant

Parents face barriers and challenges in supporting math at home

- **Time and energy:** Parents are extremely busy and, subsequently, low on time and energy to provide additional support to children in math. Their average day to day is packed with work, getting children ready for school and bed, cooking, doctor appointments, etc. (See Appendix A for the full list.) This translates to parents not having the fuel to do discrete learning activities at home or wanting to try activities with significant prep and clean up.
- **Multiple children:** It can be a challenge for families with multiple children to engage each child, and keep the peace, all at the same time. Parents expressed that it was difficult to have their children all doing an activity together, particularly with children of different ages and with different interests. Sibling rivalry emerged as a common issue.
- **Getting creative with teaching and learning:** After having children in school during the day and then helping them with homework, parents find it difficult to do additional structured learning activities on top of that.
- **Math knowledge and confidence:** Though most parents said they felt they could help their young children in math, we also heard that parents do not always remember what math concepts children are currently learning in school and do not know when to reinforce what they do remember. And when considering the whole family, as mentioned previously, there is a lack of confidence around Common Core and older children in K-12.
- **Culture and language:** Parents with geographically and linguistically diverse backgrounds expressed that some of their main challenges were that they grew up learning different math concepts, experienced other teaching methods, and they now face language barriers in understanding what their children are learning and trying to teach those concepts at home.



Recommendations

From the group design sessions, parent interviews, and follow-up conversations with the PBS SoCal facilitators, we identified nine core design principles. These principles are related to each other and build on one another. Under each of the design principles, there are recommendations for how to incorporate them into the family math curriculum.

The nine core design principles include:

1. Teach parents to be curiosity guides
2. Design 'class to home' cues
3. Leverage every relationship-building opportunity
4. Build curiosity around how their child learns
5. Make learning easeful for probable adaptation
6. Infuse cultural resonance with equity
7. Strive for rigorous simplicity
8. Make it playful, silly!
9. Consider and involve the whole family

This section also includes checklists for ensuring optimal design and recommendations for videos that can be shared with content and curriculum creators.

Core Design Principles + Curriculum Recommendations

1. Teach parents to be curiosity guides

This is the most important design principle to embody. Never forget the intention of the family math curriculum is ultimately to empower parents with the skills and confidence to build on their child's curiosity in math and learning. Modeling, reminders, scripts, examples, etc. will support parents' efforts to fold early math talks and concepts into everyday activities with their children.

- **Use language that frames the parents' role and the class learning objectives** so they see themselves as 'curiosity guides' for their children and know that what they are doing in family math classes are 'modeling exercises' that showcase not only math concepts and activities, but how they can engage back-and-forth with children to guide their learning. Reflect this in how they are addressed, the script, slides, takeaway tools, etc.
- **Develop a script for the facilitator(s)** based on effective experience design. As you define the script, ask yourselves: "What do we want the parents to understand, feel, think, and do?" This will help ensure language is grounded in helping parents learn how to teach rather than just learn the math concepts.
- **Model and provide examples of how to talk math** with children. Model how parents can narrate what they're doing, engage, ask questions, etc. During the piñata exercise, one mom noticed a facilitator pointing out objects and she "realized she can also have more conversations" instead of helping with materials. The facilitation guide should be thoughtful about including opportunities to model, prompt parents to do this, and ask them to think about how they could do this in other activities. Parents could also take home tip sheets/scripts for math concepts and conversations in their everyday lives (see additional tips from the Lab for an example).

2. Design 'Class to Home' Cues

Make it easy and tangible for parents to translate lessons from class to home. With parents being so busy, they could use support in seeing the math opportunities in what they are already doing with their children. Design cues, tools, and activities with this in mind and be sure to account for a lack of time and energy, the two most prevalent barriers for parents.

- **Provide parents with ways to bring math into what they already do** and make this the most important element of the class. Leverage parents' routines (e.g., media/screen time, cooking, school drop off/pick up) and activities they enjoy (e.g., family meals, the park, sports, games). Mix and match from daily and weekly activities parents mentioned as ingredients for crafting math activities. Consider how math can be incorporated into fun, special occasions too. (See Appendix A, B, and C for lists of activities parents mentioned.)

- **Impart a mindset that math is everywhere** and consider a slogan you can use throughout the curriculum as a reminder. During the interviews one parent said, “Anything you do, you’re always doing math.” Using this slogan would be an opportunity to attribute it to a parent and acknowledge they are at the center of the curriculum design.
- **Build in time for group reflection** upfront on what activities they already do normally and at the end on how the math concepts can be incorporated into their lives. Parents expressed that they liked hearing reflections from other parents. It sparked creativity, conversation, and excitement about how activities could translate into their lives.
- **Create a one-page colorful cheat sheet** to give to each parent along with a fridge magnet. This cheat sheet should have the core 5-6 concepts and activities listed to refer to quickly. Such things that can easily make their way into the home environment will further link the learning and fun in the session to the actual life of families.

3. Leverage every relationship-building opportunity

A core aspect of this curriculum’s power will be in its ability to support the building of long-term relationships between participants and their children, participant peers, and facilitators. From the research, we learn that parents enjoyed and benefited from the social and community aspect of the design session.

- **Choose skilled facilitators** who can embody playfulness and humor, can improvise, and can build relationships to lead family math sessions. The choice of facilitators is the biggest factor in the effectiveness of the curriculum.
- **Share only what is relevant** for parents to know without overloading them with background (e.g., details of the mission, grant, overall plan) while striking a balance of leveraging the PBS brand. For example, a simple slide introduction to PBS as everyone gathers is more than enough.
- **Foster parent-facilitator relationships** and have facilitators call/text parents during the recruitment process, greet parents at the door, and say goodbye after a session. Have any reminders or texts that go out be signed in their name, making it seem like the facilitator is reminding them and not a program manager.
- **Make space for parent-to-parent relationships** and aim for more than 50% of each session to be peer-to-peer conversation, sharing ideas based on class content. Also encourage them to exchange numbers, create a text thread, or WhatsApp group to communicate with each other outside of the sessions if they are interested. This opens a channel for them to build community, share successes and struggles with their children, and ask for advice.

4. Build curiosity around how their child learns

For both children and adults, curiosity is a powerful mindset to make learning a default mode. If the curriculum inspires curiosity in parents, especially about how their child learns, then modeling curiosity will become easier. From the research, we learn that when parents talk math with their children, they tend to focus on counting. We also saw during the prototypes that parents did not associate activities that were more creative and less explicitly math-focused with math and concepts such as shapes, 2D/3D, etc. Young children are just learning math and it's helpful to break down what, and how, they are learning for parents.

- **Emphasize that learning begins with curiosity** for children. It is the first step in the [cycle of learning](#) that leads to exploration, discovery, pleasure, repetition, mastery, new skills, confidence, and more.¹
- **Explain how children are learning math before and during** the modeling exercises. This will serve as a refresher for math concepts parents might not have thought about since they were younger and will provide parents with a strong grounding in how exactly an activity promotes math and what they can do to guide children's curiosity along the way.
- **Create 3-5 core mantras you want parents to embody** curiosity throughout the curriculum (examples: ask questions, playfully encounter the unfamiliar, be amazed by everyday things and activities). This would be useful in addressing the two biggest barriers to curiosity, which are [seeking efficiency and having a negative mindset](#) around exploration. These mindsets could be taught in the first session.²

5. Make learning easeful for adaptation

New knowledge is assimilated and processed by the brain when learning is easeful with the least path of resistance. Therefore how easeful the learning is for parents will inform how much of that learning they will adapt into their lives. From the research, we learn that materials and technology were not generally a major barrier as long as the parents had ideas for what they can do with what they already have at home or how they can incorporate math into what they already do.

- **Translate math jargon into clear language, symbols, imagery** to make math concepts more easeful to grasp for parents. Avoid only using terms like place value and instead create an association that parents can remember. Try to incorporate math concepts into names in a playful way. One can share that the concept is called place value, for example, but we like to call it "_____." A word of caution: What we might find punny, such as "Don't Lose Your Marbles" may not carry meaning for those who do not have that phrase in their vocabulary or language. Name activities from the perspective of families.
- **Instill confidence in parents** that they all have what it takes to support their young children in math. Equip them with information they need, recognize their efforts, build on their strengths, encourage achievable goals. They do not have to be Common Core

experts, particularly with children 2-5. Parents also do not need to have all the answers, and part of sparking curiosity and critical thinking is asking open questions.

- **Think of materials families typically already have on hand** and can use at home as you design activities. They will be more likely to do a math activity that does not require an overwhelming amount of purchasing, prep, or clean up. If you are giving any materials to them, try to think from the parent perspective first and be clear about its purpose.

6. Infuse cultural resonance with equity

The community in Compton is extremely diverse, and while Latinx culture might be resonant to a majority, there were also parents during the design sessions who did not identify with the same cultural content. Equity needs to be at the center of designing cultural resonance so as to invite everyone in.

- **Reflect the diversity of the community** in curriculum elements. As you develop culturally relevant content for the Latinx community, be sure to also develop content and context that is inclusive of the diverse mix of people present. For example, referring to *lotería* as bingo as well, or including culturally diverse pictures in the game sheet.
- **Relate content to shared interests** and what parents have in common. Again, look to the top routines and enjoyable activities that parents mentioned for inspiration (Appendix A, B, and C). They also live in the same vibrant city, and one parent suggested that *lotería* could include images from around the community.

7. Strive for rigorous simplicity

It is essential that the curriculum as a whole, each session design, and then each modeling exercise and related activity design be in its simplest form with only the most essential elements of materials, steps, concepts, language used. During the design session the cupcake modeling exercise had a few too many steps to make the activity translate to the home.

- **Assign someone on the team to be the simplicity monitor** of the lesson plan and have them objectively look at what is not essential. What can be snipped off while retaining the core essence of the learning?
- **Reduce the number of props, steps** to each modeling exercise and activity. Not more than three ideas per session that a person needs to retain.
- **Have someone from the team go home and do the modeling exercise** to test it before finalizing it as part of the curriculum.

8. Make it playful, silly!

Play is a child's way of exploring and understanding what is in their environment. The idea that playing is learning is a fundamental idea for families to understand. Even a little playfulness on the parent's part will engage the child's attention and make learning more likely to happen. Play

can also be valuable in capturing and keeping the attention of parents.

- **Frame ‘Playful Curiosity’ as a core theme of math** in the first session. Emphasize that children learn through play, and how playing presents many opportunities for learning, and repeat this throughout the curriculum. At the design session, children were excited to join their parents in making a piñata but most parents did not see the throughline of math or know how to engage children in math talk, and one parent said it was almost ‘too fun.’
- **Explore gamified learning** for both activities for children and the lessons for parents. From the research, we learn that parents liked to play the lotería and marbles games, where it was like a ‘race.’ They also shared that their kids get excited about prizes. In addition to explicit games as activities, infusing game elements into learning at the math academy itself, could be fun and motivating for families.
- **Embody play on your own team** of facilitators and curriculum developers. Bringing more playfulness in how you work amongst yourselves will translate into whatever you create. The entire PBS team could try an improv class. Doing a session on [LEGO® Serious Play®](#) might also help incorporate play into your work tremendously.³

9. Consider the whole family

The curriculum for young children and their parents should also take into account their sphere at home, including siblings and other family caregivers that could be involved. Parents enjoyed the design session group activities and games, and said that they liked playing games in their family. At the same time, sibling and family conflict emerged as a common challenge.

- **Offer ideas for how to involve siblings** of different ages, whether that’s assigning different roles, taking turns, giving more challenge to older siblings, having some be helpers, etc. to keep it interesting for everyone involved.
- **Explore cooperative games** to involve everyone, negate family conflict, and support family bonding. This would preserve the social aspect that many parents liked about the games without creating potential conflict that can arise from competition.
- **Include a handout of tips and tricks for parents with multiple children** to prevent sibling fighting, defuse conflicts, and promote positive relationships.

Design Checklists

Use the following checklists for optimal design. This can be shared with any new content creators that may be joining or involved later in the process of curriculum development.

Checklist for modeling exercises/experiences/interactions:

- ✓ How does this help the parent be a curiosity guide?
- ✓ How does it embed 'class to home' cues?
- ✓ How does this help the parent understand how the child will learn the concept?
- ✓ How easeful is the math learning content for the parent?
- ✓ How does this embed cultural resonance for the parent?
- ✓ How simplified is the content?
- ✓ How does this model playfulness for the parent?

Checklist for overall curriculum:

- ✓ How does it consider the whole family?
- ✓ How does it build relationships between the participants and PBS facilitators?
- ✓ How does it build relationships among the participants?
- ✓ How can we support the peer to peer interaction after the delivery of the curriculum?

Design Recommendations for Video Content

1. **Be clear about videos audience(s) and inspire action.** Parents did not tend to think of videos as a teaching tool to engage children in math, and viewed them to be more directly for the child. While videos were fun and engaging, one parent commented it did not 'inspire action.' Consider and communicate how parents can use videos to interact with children, whether that's through families watching and discussing together, doing a related activity afterwards, or parents watching videos on math talk or activities.
2. **Consider videos for teaching parents.** In the Tangram video, while most parents liked it, some commented they wanted more examples of shapes, what materials they could use, and an explanation of what it is, and how it's useful. This illustrates that a video that helped parents how to teach would be better than one that just explains the concepts. A stretch goal could be to make videos that model how to teach for parents.
3. **Style of the video is important.** Parents liked videos featuring children, DIY videos, higher quality video, and catchy elements. They thought their children would like cartoon characters and more modern animation style than Schoolhouse Rock.
4. **Include diverse representation in videos.** To make the digital content resonant and centered in equity, ensure content has a diverse representation in children across race, language, and gender. After watching the videos, several parents commented they would like to see more children of color and girls.



Additional Tips from the Lab's Experience

Below are additional ideas and considerations for developing the math academy based on the Early Learning Lab team's early childhood background and previous work with communities.

- Early math big ideas + math talk tips for parents
- Considerations for curriculum developers

Early math big ideas + math talk tips for parents

Specific math concepts may be difficult to remember and relate to a child's interests in a given moment. It may be helpful to categorize math into big, memorable, go-to concepts for parents, and provide them with math talk tips that can be used at any time and in any activity. The following is an example of how to do that for parents:

Math is everywhere—and it's about way more than counting. You may be teaching your child math without even knowing it (or without your child knowing it!). That is the best way for learning to occur with young children because it takes advantage of a child's natural curiosity.

Here are 5 early math big ideas and related words you can use to talk about them:

1. Numbers and operations: 1, 2, 3...; more, less, same as.
2. Shapes and spatial relationships: Square, round, circle; under, next to, over, on top of.
3. Measurement (size, weight, volume, time): Big, bigger, heavy, light, long, short, how far?
4. Patterns, relationships, and changes: Find repetitions or create them; noting this happens, then that happens; things that change or grow from day to day.
5. Collecting and organizing: Sort, classify, find similarities, differences, make sets.

Math talk tips:

Listen and watch for times to add math talk—add these ideas and words into what your child is doing during the day. Here are some easy ways to do this:

1. Post reminders or lists of ‘math talk’ words for yourself on the refrigerator. Add them to your conversations during mealtime, snacktime, etc. (Eating is a great time to discuss more, less, half, whole, how many, etc.)
2. Math and literacy are natural partners—many books at the local library or on your bookshelf are perfect for teaching and practicing math concepts.
3. Create pictures of what you see to help show quantity, size, etc. (Example: Look, this circle has three cheerios in it and this circle has five.)
4. Make simple pictures to show timelines for children to help them know what comes first, next, last (this works great for morning routines, lunch routines, pre/post nap, bedtime, etc.). And it helps with these challenging times of the day!
5. Make things playful around what they are saying or doing. When young children do not want to engage in a moment, it may be that they sense adults are controlling the learning (and that they may not measure up). They love when you are part of the learning.
6. Build on the natural joy of learning by celebrating when your child notices any of these ideas. Be ready to add just a little more challenge. (Ask an open question: How did you figure that out? Add a little more detail: Yes, I see the two antennas...and I see four legs!)
7. Most of all, keep it simple and keep it fun! Oh—and encourage children to use their fingers, toes or whatever else can help!

Considerations for curriculum developers

When thinking about creating an early math curriculum, make sure it:

- Builds on the early math big ideas above
- Takes advantage of children’s [natural curiosity](#) ⁴
- Embeds the [trajectories of math](#) development in young children ⁵
- Provides repetition and practice done through playful and active experiences

Synthesis of Design Session Prototypes

Don't Lose Your Marbles

Summary: This modeling exercise was simple but powerful in making a concept come alive through 3D tangible materials that can be touched, played with, and draw the attention of a child's natural curiosity. The visual association of the size of the marbles and place value breaks down hard-to-grasp concepts effectively. The main concern in doing this with children is the use of age-appropriate materials.



Here is how the modeling exercise performed on the design checklist for modeling exercises, needing improvement in two areas:

- ✗ Does this help the parent be a curiosity guide?
- ✗ Does it embed 'class to home' cues?
- ✓ Does this help the parent understand how the child will learn the concept?
- ✓ Is the math learning content in this experience easeful for the parent?
- ✓ Does this embed cultural resonance for the parent?
- ✓ Is the content simplified enough?
- ✓ Does this model playfulness for the parent?

Participant ratings: All 5's and one 4

What to keep: It's simple but effective, visual, hands on, attention keeping, social, easy to do with materials at home, and doable on the go.

What to change: Use safe materials for young children (food, blocks, etc.), simplify the whiteboard aspect and reduce multitasking, and provide more explanation for the math concept. Some suggestions from parents include tying in other math concepts for older children, using paper or a tablet instead of the white board (if keeping), and coordinating colors for place values.

What we heard:

- *"Hands on activity is better, using a piece of paper and writing can be frustrating. The marbles make it easier. The marbles help break it down. I think it's fun."* — Parent
- *"It's visual, It's good. Pretty fair and square. Kids will have more fun doing this."* — Parent

Shapes Piñatas

Summary: The power in this activity lies in parents and children creating together, bonding, and making math fun. Many of the children in the room were drawn to the creative aspect and came over on their own to join their mother. While parents enjoyed it too, they found it difficult to see how they could support math learning in this activity. This would have more of an impact after parents have a better understanding of how children learn and when framed for special occasions. You could have a craft party near the end of the academy where the parents bring their children along to the session.



Per the modeling exercise design checklist below, improvements are needed in five areas:

- ✗ Does this help the parent be a curiosity guide?
- ✗ Does it embed 'class to home' cues?
- ✗ Does this help the parent understand how the child will learn the concept?
- ✗ Is the math learning content in this experience easeful for the parent?
- ✓ Does this embed cultural resonance for the parent?
- ✗ Is the content simplified enough?
- ✓ Does this model playfulness for the parent?

Participant ratings: A mix of 4's and 5's

What to keep: The cheat sheet helps reinforce the math component, the activity holds potential to introduce many math concepts, and the parents enjoyed the engaging and creative nature.

What to change: Parents saw the art component but not the math, did not point out the shapes, and thought it was messy and less practical than marbles. Modeling how to do this activity and talk math would make a significant difference.

What we heard:

- *"It's almost too fun."* — Parent
- *"You can use your imagination and be creative."* — Parent
- *"Doing these activities helps us review these concepts ourselves because we don't always remember things from our childhood."* — Parent

Lotería

Summary: The main strengths of this prototype are twofold: 1) the engaging communal and competitive game aspect and 2) the powerful embedding of learning into a popular childhood activity that is culturally relevant.



This met all of the design principles on the modeling exercise checklist:

- ✓ Does this help the parent be a curiosity guide?
- ✓ Does it embed 'class to home' cues?
- ✓ Does this help the parent understand how the child will learn the concept?
- ✓ Is the math learning content in this experience easeful for the parent?
- ✓ Does this embed cultural resonance for the parent?
- ✓ Is the content simplified enough?
- ✓ Does this model playfulness for the parent?

Participant Ratings: Rated all 5's, except one parent gave it a 3

(The 3 was from a parent who did not like the competition while having to quickly process and translate.)

What to keep: Parents enjoyed the fun and competitive game aspect, and the math concept itself reminded parents children are still learning, they liked inflecting their voice and coupling that with the visuals, and the activity taught modeling.

What to change: Parents could benefit from a better understanding of the learning objective before starting and reminders during the activity to emphasize the last number. In addition, the game sheets could be switched up from one another to add winners. Parents also suggested incorporating images from the community or children's characters as well as making it more challenging, particularly for older children.

What we heard:

- *"The parents had an aha moment that watching mom having fun with math helps children develop positive attitudes toward math."* — PBS Facilitator
- *"The parents had an extensive discussion about wishing they knew how to incorporate learning games into their daily lives when their oldest children were younger. They joked but also expressed disappointment with the older kids' loss of interest in games like these, lack of interest in math, and their focus on using technology."* — PBS Facilitator
- *"I tell my oldest, if I go to work or leave the house for any other reason, you wouldn't miss me the way you'd miss your tablet."* — Parent

Cupcake Addiction

Summary: The main learning from this prototype is the necessity to simplify experiences to the most essential aspects. Anything that has overwhelming steps, and where related math concepts are not clear, will not be adopted into everyday behaviour effectively.

Below is the design checklist applied to this modeling exercise, which needs improvement in four areas:



- ✗ Does this help the parent be a curiosity guide?
- ✓ Does it embed 'class to home' cues?
- ✗ Does this help the parent understand how the child will learn the concept?
- ✗ Is the math learning content in this experience easeful for the parent?
- ✓ Does this embed cultural resonance for the parent?
- ✗ Is the content simplified enough?
- ✓ Does this model playfulness for the parent?

Participant Ratings: Mostly rated 5's, a few 4's, and one 3

What to keep: It is fun, creative, tactile, and sparks thinking about other concepts to add like shapes and geometry. One parent commented that it is also a good option for children who are more introverted.

What to change: Parents did not incorporate the addition component. At the same time, some also thought it could be more challenging, perhaps by including subtraction, different shapes, etc.

What we heard:

- *"Addition component wasn't clear to parents, and the focus was more on counting and decorating" — PBS Facilitator*
- *"Parents shared that they learned a fun way to motivate their children to make math fun and creative." — PBS Facilitator*
- *"The parents were surprised by the educational attributes of Play-Doh and jewels. They enjoyed it but were a little confused by the sequence of steps..." — PBS Facilitator*



Design Session Templates for the Future

This section helps you develop design sessions for future insight gathering. It provides details about how to frame your inquiry and how to tend to logistics.

Developing a design session involves the following steps:

1. Define your inquiry
2. Plan your design session
3. Create and execute recruitment plan
4. Implement & follow up

Step 1: Define Your Inquiry

Why do we want to conduct a design session?

- A) Create a frame of inquiry.** The team lead should put together a brief paragraph to frame why they would like to do a design session and what they want to learn.
- B) Brainstorm and generate a list of “How might we…” (HMW) questions** that build on the frame of inquiry. A good prompt for each team member to reflect on is: What questions do I have about (insert topic ‘videos, lessons, curriculum parents’ life, etc.)? Have some way of visualizing this to what you want to learn. A whiteboard, flipchart, online share document is recommended.

Tips:

- Involve everyone (larger team) from the beginning—researching, designing activities, looking for videos, etc. Include other station staff to bring different perspectives.
- What is a “How Might We” question? For this method of discovery, a “How Might We” (HMW) question serves two purposes. First, it is the frame of inquiry of the research. And second, a HMW question should spur and inspire the team. The words have meaning. Might is open, something to play with. Compare this to the word ‘should’ which puts undue pressure and narrowing on the research from the start.
- Test each HMW against the proposed frame of inquiry. Does the HMW question strongly align? As a team, select the HMW that will now guide your research. Ensure your HMW question is open enough. For reference, below are the HMW question for the last two design sessions were as follows:
 1. How might we explore and learn about the parents’ culture and traditions as math opportunities?
 2. How might we explore their daily lives and routines as math opportunities?
 3. How might we bring playful curiosity in all aspects of the curriculum?
 4. How might we prototype the content plan?

Step 2: Plan Your Design Session

Who, What, When

- A) Assign roles** for who will be responsible for what aspect of the design session. Below are some references for what roles could be to build off, based on your future needs.
- B) Identify a timeline for the design session**, including dates, times, etc. Consider the participation and experiences of working and nonworking parents and caregivers.

Project Managers recruit, schedule interviews, confirm interviews, gather/store consent forms, gather/store raw and synthesized data, communicate with Facilitator, Small Group Facilitator, and Research Assistants.

Facilitators design the prototype activities and the flow of the design session for gathering qualitative data, conduct interviews, lead synthesis, guide efforts to identify the most relevant design opportunities, and facilitate the sessions. Identify lead Facilitators and Assistant Facilitators.

Assistant facilitators take photographs and gather audio recordings of the interviews. Take care of other logistics of the design session, including food, classroom arrangement, projector/technology requirements, etc.

Tips:

- Test Saturday as it was suggested in the research data. Also, evening time was preferred as parents could come after picking up kids from school. The morning time allowed for a longer session as parents had more mental bandwidth. Choose accordingly based on what you want to learn and how much mental capacity you require of parents. We also recommend design sessions be two hours if in the evening, three hours if in the morning.
- Do the session in one language as that will cut down on translation time and make it deeper, more easeful and enjoyable for everyone.

Step 3: Recruitment

Who from the community can help you learn the above objectives

- A) Identifying Participants:** The focus of your research project determines who you recruit and how many people you recruit. Additionally, your recruitment effort should aim to capture a wide net of perspectives on the issue that is the focus of your discovery research. Consider recruiting people of different employment fields, ages, ethnicities, genders, and life circumstances so as to capture a breadth of experience and perspectives.
- B) Scheduling Participation:** Involve your allies, partner organizations and supporters to find participants who are the best match for your research project. Going through established networks is always more reliable than open calls, which are likely to result in a less reliable intake. Over the long haul, you want to have a list of orgs that you have built a relationship with over time that can consistently request for recruitment.
- C) Scheduling Brief Phone Conversations** (recommended, but optional):
Once participants have registered/selected, it would be ideal to have one of the Facilitators call the parents to start the relationship-building process. They could use this time to answer any questions the parents and caregivers have and also give them some idea about what to expect. If possible, use their preferred method of receiving communication (be it a phone call, email, or text) to contact them when the interview date is set, and also give them a courtesy reminder a day in advance of the interview.

Tips:

- Set clear expectations by informing your participants at the point of recruitment that they have the right to withdraw from participation at any time for any reason.
- Guard against recruitment that results in participants who all bring to the table similar perspectives. Course-correct and ask those doing recruitment to widen their search.
- Define target age groups of children when recruiting as some parents have older and younger children.

Step 4: Implement & Follow Up

Sample design session agenda and other tips for running design sessions

Observing during the design session: This is a very important aspect that is done by others who are not engaged in facilitating the conversation, taking notes, etc. To build their capacity in observation, conversation, and empathy, people participating in the design and implementation of the design session could study the Stanford D.School's [Ethnography Field Guide](#). The core idea this field guide provides is how to more deeply understand people in order to design for them.⁶

Tips:

- Start with a game or activity and tie it to learning, playfulness, curiosity and culture as much as possible. During the design session, for example, we had a ball throwing game to introduce everyone and ask what they liked to play as a child.
- Have more bilingual notetaker observers at each table if continuing with bilingual design sessions.
- Provide more opportunities to get to know small groups before asking for feedback.
- Create a timely follow-up process including follow up calls.

Sample questions for follow up after the design session:

1. Since participating in the workshop last week, how have your conversations or activities at home been different? Tell us how they are different if yes. If not, what would support you in being able to do so?
2. Did participating in the workshop change your view of how you can teach your child math at home? How has it changed?
3. Did you talk to anyone—a friend, family member—about your experience at the workshop? What did you say?
4. Have you tried any of the things at home in any small way?
5. If such activities were conducted every week for six weeks, would you find that useful? Would you attend?
6. What do you think would keep you from attending such a course?

Sample agenda for 2-hour design session:

Use this as a reference to build out your own design sessions.

Time	Activity	Notes/Recommendation
Informal Start (15 minutes before scheduled time)	Welcome, Music, Food	Organic, use the opportunity to talk to parents/caregivers, build relationships and make sure they are comfortable and feel welcomed into your space.
30 minutes	Setting the Container	Include the following (longer list below): <ol style="list-style-type: none">1. Welcome2. Gamified Introduction (Sample below)3. Playful Curiosity
15 Minutes	Modeling Exercise Prototype 1	Run as per the team designed
15 Minutes	Feedback	Use skilled facilitators who can stimulate conversation with the parents/caregivers to learn from them. Let this be self led.
10 Minutes	Take Home Cues	Co-design take home cues with parents/caregivers or have samples and see which ones they like and want to take back home to use.
15 Minutes	Modeling Exercise Prototype 2	Run as per the team designed
15 Minutes	Feedback	Use skilled facilitators who can stimulate conversation with the parents/caregivers to learn from them. Let this be self led.
10 Minutes	Take Home Cues	Co-design take home cues with parents/caregivers or have samples and see which ones they like and want to take back home to use.
10 Minutes	Plus/Deltas/Ahas	What worked for you, what could be better, and what did you learn, Aha.
15 Minutes	Informal Relationship Building	Organic and greet every parent as they leave and thank them.

Points to cover for container setting:

1. There are no rules here: You can go to the bathroom whenever you need to, we have food and drinks, anytime. No authority figures. Please take care of yourself whatever that looks like. Share logistics of where the bathroom is. It is important to us that you feel welcome and comfortable here.
2. PBS SoCal mission and slides: Keep very short like we did in the last design session.
3. Rather than just create programs, we want to co-create with you: Your input here is helping us serve the Compton community better. We're going to do some modeling exercises of activities you can do with children and then go into feedback mode. You have on your table a group facilitator who is going to be helping your discussion and noting your thoughts. You will use post-it notes, materials, etc. (Feel free to add a slide with the agenda in very short form, no need to add all the time breakdowns, etc.)
4. We have a theme for this session: 'Playful Curiosity' (Have a slide with playful curiosity in English and Spanish on while you cover all these points.)
5. Bring your whole self: Whatever you actually think is what we want to know. Be as present as you can be with us. This will help us make this day successful.
6. Consent forms are needed: This allows us to include what you say here in our research work. You only need to sign it at the end of the session. There are photographers, audio recorders, notetakers around the room and everyone is playing a role to help you learn from us and help us learn from you.
7. Any questions or concerns: At any point, if you need anything, or have a concern or question, please come to (designate an Assistant Facilitator) and we can help you.

Guidelines for Interviewing Parents & Caregivers

Dont:

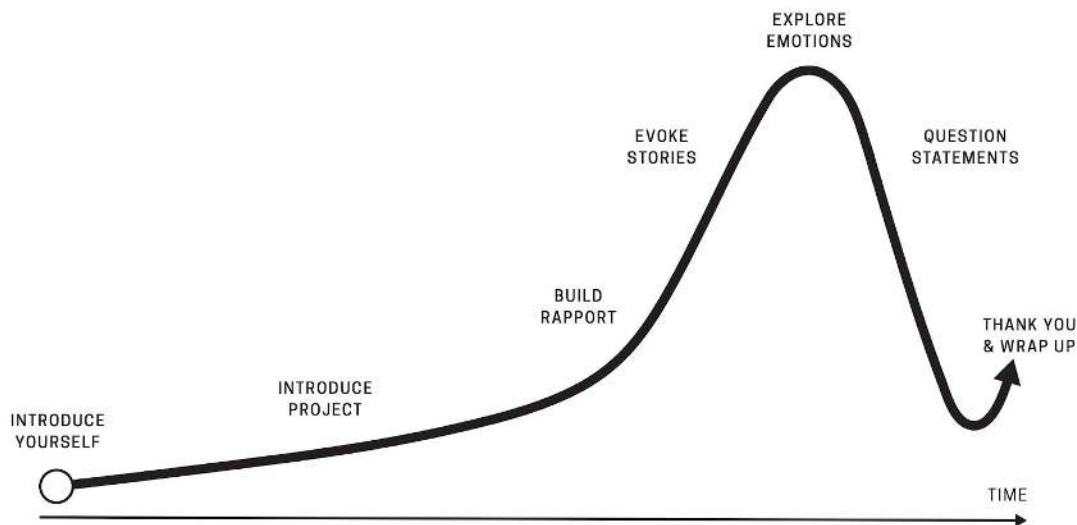
- ✗ **Don't ask leading, binary, or biased questions:** For example, 'Do you let your children use technology?'
- ✗ **Don't tell the person I am going to interview you upfront:** Instead tell them we are going to be having a regular conversation like drinking tea together like new friends.
- ✗ **Don't be afraid of silence, pauses:** Avoid giving in to the pressure to fill the gaps. Some people just take time to process and open up. Interviewers often feel the need to ask another question when there is a pause. Sometimes if you allow there to be silence, a person will reflect on what they've just said and say something deeper.

Do:

- ✓ **Ask open-ended questions:** Allow participants to answer in their own unique way by asking them easy to follow, open-ended (as opposed to yes-or-no) questions (e.g., What experiences motivated you to take part in this interview? How do your children engage with technology at home, in school, etc.)
- ✓ **Be fluid:** Interviews should be planned and questions pre-decided. During the interview itself, however, consider your interview script as a compass that guides you. Feel free to go "off script" or change the order of questions if you feel that will benefit the conversation and research.
- ✓ **Know when to pivot:** Stay mindful of the situation and purpose. Use what your participant says as direction on where to go in the interview. Ask yourself: Is this part of the conversation informing the challenge or HMW question? Can it inform the question if I continue this line of conversation further or should I redirect my approach? If a participant embarks on an interesting tangent, use your best judgment to surface insights that might inform your research.
- ✓ **Close the interview at the right time:** How long is enough? The answer is that you'll get a better sense for this with practice. You need enough time to build rapport and allow the participant to open up and share their story. Good interviews can be draining for the participant and for the interview team. It's important to respect people's time and wind down the interview in a timely manner. Don't go over the planned time frame. If an interviewee seems tapped out before the scheduled end, gently close out early. Always thank the person for their time. Provide follow up information as necessary, such as contact details.

Two intensive resources are included in the References list to support any future interviews that your team might undertake. I recommend the person who does the interviewing next studies the resource “Using Interviews in Design Thinking for Innovation Classes” carefully.

1. [Using Interviews in Design Thinking for Innovation Classes](#): The following diagram is a visual representation of the path of a typical human-centered design discovery interview. Use it as a guide for your own interviews if you find it helpful.⁷



2. [Empathy Planner by D.School](#): This reference would help the curriculum developer as well as any future alternative to interviewing—testing of digital content, etc. that you might want to undertake as a team. Empathy is the foundation for a strong, human-centered point of view, and a great design project demands a rich empathy experience. While empathy interviews are the most common way to engage the person you're designing for, the Empathy Planner helps educators think beyond the interview. This tool guides you to craft an empathy experience.⁸

Below are sample questions to ask participants in interviews or design sessions to dig deeper and stimulate conversation when parents give short or one-word answers:

1. What experiences motivated you to take part in this project?
2. How do you feel about that? (Listen for feelings, versus thoughts.)
3. What do you think about that?
4. Tell me about that.
5. That's an interesting thought; can you help me understand what you mean by that?
6. Why do you think that?
7. Why do you think it's like that?

Additional design resources that may be useful to your team are included in the References list.

Possible New Questions for Research

1. How might we build learning communities and communities of practice knowing time and child care can be constraints?
2. How might we make the curriculum content adaptable for use by other stations/partners and for other content subjects?

Compiled in Appendix D are aspirational ideas from PBS staff and parent participants that could spur more innovative thinking and possibilities.

Conclusion

Throughout the research, we find that families are supportive of and involved in their young children's math learning. They also demonstrated that they are deeply interested in bringing new life to math for their children by bringing it into their lives.

Given the information, inspiration, and tools they need—in ways that work for them and their schedules—parents and caregivers will be well-positioned to infuse math into everyday moments with their children.

To create such an experience, it will be essential for curriculum and content creators to have a good grasp of the overarching design principles while applying the curriculum recommendations. In the future, continuing to hold design sessions and adapt programming will keep families and their evolving needs at the core of the curriculum.



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References

1. Perry, Bruce D. (2011). Emotional Development: Curiosity - The Fuel of Development. *Early Childhood Today*.
<https://www.scholastic.com/teachers/articles/teaching-content/emotional-development-curiosity-fuel-development/>
2. Gino, Francesca (2018). The Business Case for Curiosity. *Harvard Business Review*.
<https://hbr.org/2018/09/curiosity>
3. LEGO® Serious Play®. <https://www.lego.com/en-us/seriousplay>
4. Perry, Bruce D. (2011). Emotional Development: Curiosity - The Fuel of Development. *Early Childhood Today*.
<https://www.scholastic.com/teachers/articles/teaching-content/emotional-development-curiosity-fuel-development/>
5. Clements, D. H., & Sarama, J. (2017/2019). Learning and Teaching with Learning Trajectories [LT]2. Retrieved from Marsico Institute, Morgridge College of Education, University of Denver. <https://www.learningtrajectories.org/>
6. Ethnography Fieldguide. (2019). Stanford d.school.
<https://static1.squarespace.com/static/57c6b79629687fde090a0fdd/t/5d980bbeef5b5717b186539f/1570245598860/Ethnography+Fieldguide-DSS-Aug-2019-screen.pdf>
7. Henry Ford Learning Institute (2009). Using Interviews in Design Thinking for Innovation Classes. Adapted from work done at Stanford d.school.
<https://www.dropbox.com/s/x5kcvqlgmV6ng0h/Interviews%20in%20Design%20Thinking%20for%20Innovation%20v%201.0.pdf?dl=0>
8. K12 Lab Network. Empathy Planner. Stanford d.school
<https://static1.squarespace.com/static/57c6b79629687fde090a0fdd/t/5a00e6a09140b785ddab7678/1510008481226/K12+Lab+Empathy+Planner.pdf>

Additional resources:

- Resources for virtual empathy and design sessions:
 - a. [Liberating Structures](#) to build capacity in your team (free online sessions)
 - b. [Insight Pact](#) to hire Design Facilitators to help you run meetings
- Other design thinking resources for your team:
 - a. [Collective Action toolkit](#) by Frog Design
 - b. [Design Sprint Kit](#) by Google
 - c. [HCD Self Led Free Course](#) by +Acumen

Appendix

Appendix A: Daily Activities Mentioned by Parent Participants

Note: Numbers next to activities indicate frequency of mentions.

1. Media (15) - including screen time on phone/tablet/computer (6), tv (5), Youtube (1), TikTok (1), video games (1), movies (1)
 - Screen time is for both moms and children. For moms, it's used as a way to unwind after children go to bed. For children, it's used as a reward after they finish homework.
2. Preparing dinner/cooking (10) - including breakfast too
3. Drop off and pick up (7) - including driving, walking, bus, but mostly driving
4. Physical Activities (7) - including going to the park, playing outside, basketball, practice playing ball, bike riding, exercising
5. Getting ready for bed (6) - including brushing teeth/showering
6. Getting ready for school (5) - including brushing teeth/baths
7. Doing laundry (5) - including folding and sorting
8. Working (4+)
 - Many people were working 4-7 days a week
 - Grandparents help with drop off/watching kids for some
9. Playing (4) - including puzzles, family game nights, Monopoly, board games, building with Legos/blocks
10. Homework (4)
11. Reading books (4)
 - One challenge to a parent's daily reading was the language barrier, so she tells her children stories
12. Shopping at the grocery store (3)
13. Chores (3) - including cleaning, picking up toys
14. Personal time (3) - including screen time, eating with friends, Zumba, gym, taking English classes
15. Weekend time and weekend gatherings (2)
16. Other (1 each) - includes volunteering in child's class, talking to children, doing hair, arts and crafts, reading family prayers, volunteer in child's classroom/school

Appendix B: Weekly Activities Mentioned by Parents

Note: Numbers next to activities indicate frequency of mentions.

1. Physical activities (9) - including sports, roller skating, pool, bowling alley, soccer, dancing, practice/games, baseball practice, working out
2. Reading books/visiting the library (7)
3. Playing together (7) - including building forts, board games, lotería
4. Family events/visiting family (6)
5. Shopping (5) - includes malls, Target, etc.
6. Special events (5) - including vacations, zoo visits, theme parks, Monster Jam
7. Social events (4) - including sleepovers, parties, friends' houses
8. Local events (4) - including events on Facebook, swap meets, school events
9. Shopping at the grocery store (4)
10. Playing in the park (4)
11. Cooking/baking (4)
12. Laundry at laundromat or at home (4)
13. Church (4)
14. Movies (3)
15. Gardening (3)
16. Chores and cleaning (2)
17. Doctor appointments (2)
18. Arts and crafts (1)
19. Afterschool programs (1) - including violin, robotics, guitar, music
20. Special weekly activities/treats (≥ 1) - including Starbucks, McDonalds, ice cream, boba, eat at a restaurant
21. Working (≥ 1)

Appendix C: Enjoyable/fun Activities Mentioned by Parents

The following is a list of activities that parents like doing with their children.

- Eating together
- Cooking
- Storytelling
- Family game night
- Card games
- Board games
- Patty cake
- Hand games
- Movies
- Drive-in movies
- Walks
- Playing make believe
- Dolls
- Going to the park
- Playing on slides
- Collecting flowers, rocks
- Watching soccer
- Exercise
- Jump rope
- Riding bikes
- HORSE (basketball)
- Skating
- Skateboarding
- Hopscotch
- Aceholita, or leapfrog and counting
- Red light, green light
- Shopping
- Getting nails done
- Getting hair done
- Make up
- Dress up
- Tying shoes
- Anything that involves their child
- Play on phones
- Starbucks Fridays
- Zoo
- Amusement parks
- Vacations
- Road trips

Below is a list of activities parents mentioned liking as children themselves.

- Hide and seek / Los Escondidas
- Marbles
- Eighteen
- Go Fish
- Tag
- Soccer
- Basketball
- Baseball
- Four square
- Tik Tok
- Burglar
- House
- Teacher
- Taking pictures
- Dominos
- Tetherball
- Dodgeball
- Barbies
- T ball
- HORSE
- Volleyball
- Freeze tag
- Soccer
- Jacks
- Hopscotch
- Riding bicycles

Appendix D: Inspirational Ideas from PBS Staff and Parents

- A. A math or learning zone that families could set up in their home
- B. A community of people to do activities with
- C. A reminder, or zoom in tool that could activate excitement about learning/math in the most stressful moments of life, or when life is getting in the way of remembering what was exciting about the workshops
- D. A video tour of a house that shows everywhere math is
- E. Videos where kids are the stars, so that they can see themselves doing it.
- F. A hologram that parents can access whenever they had a math-related doubt/self-doubt—"Am I teaching this the right way? How can I teach my child to add?"—this hologram would model a real-world example
- G. A PBS SoCal community corner
- H. PBS SoCal preschool with a special center for parents to bridge research and practice.
- I. Replicable toolkits for other organizations and or families that have digital content and curriculum to implement
- J. Podcast and curriculum
- K. Something like a magic 8 ball, that parents could shake and say, "I want a math activity that's X long, requires x materials and focuses on X," and it would give it to them complete with all of the resources—games, videos, hands-on activities, and if they have questions or don't understand anything, they can ask and it answers
- L. A curriculum that builds so it begins with simple concepts first then progresses to more chaotic fun, and incorporates scripts for how parents can talk about math during the more fun, and less obvious math activities
- M. A PBS SoCal library or recreation space that exists somewhere communal like the park, where families can go to get resources and participate in activities.
- N. A fun learning space with changing installations and activities that families view as safe and welcoming that would always be staffed with people who could support the learning and answer questions and direct to other resources
- O. A math community space, whether online, through an app, in-person or all three, for families to come together and create math experiences for their children—they could watch a short and engaging video about a math concept that gives them strategies on how to do math at home and in the community
- P. A video series of a child telling parents all the things they do not understand that a parent would take for a given like how 10, 100s are hard for me to understand
- Q. Weekday and weekend community space with a calendar of learning events for parents, some activities for parents with kids, and child care, plus take home toolkits, downloadable resources, ways to interact with kids at home
- R. Parents on the go see billboards of ways to use family math on the bus with act-it-out tips
- S. A math wizard character that does math tricks
- T. DIY-like videos for parents to do math activities with kids