

Issue BRIEF

Barbara Harris, Dana Petersen, and Claire Smither Wulsin

Integrating Mathematical Thinking into Family Engagement Programs

Exposing young children to early math concepts is important in the development of their math skills, in their confidence in these skills, and in their ability to use math later in life.¹⁻² Early exposure to math also supports the development of children's reasoning and problem-solving skills, both of which contribute to success in and out of school.³ In addition, a child's early math skills are an indicator of later success in both math and reading.⁴⁻⁷ Unfortunately, children who begin kindergarten with weak math skills are likely to remain behind in the later grades.^{5,8-9} And the students who are the least prepared in math when they begin school tend to be from minority and low-income families.¹⁰⁻¹¹

KEY TERMS

Caregivers. The parents, extended family members, friends, or neighbors who serve as caregivers for children and participate in the development of their early math skills and thinking.

Integrating math into family engagement programs is one promising strategy for strengthening early math skills, particularly among disadvantaged children. In particular, research shows that when caregivers engage children in math-related activities, they learn more readily and are more likely to succeed in school.¹²⁻¹⁴ Family engagement programs that include early math therefore have the potential to boost children's academic achievement in the later grades and reduce disparities in education outcomes over the long term.

To support the development of early math skills while leveraging a caregiver's power to engage children in the learning process, the Heising-Simons Foundation awarded grants to five family engagement programs to develop, test, and integrate early math learning into their usual activities. The Foundation facilitated relationships between each grantee and a nationally recognized expert in early math education and provided funding for the experts to consult with grantees and help them to develop projects to support early math learning.

The grantees represent a diverse set of family engagement programs that range from training for Head Start teachers to sharing books with families during pediatric well-child visits. As we might expect, the grantees' early math projects are similarly diverse. But despite their differences, each was able to enhance early math learning in their family engagement programs. This brief lays out seven practical tips that emerged from the grantees' experience and that can guide practitioners and other stakeholders who are interested in integrating early math into their own family engagement programs.

SEVEN TIPS FOR INTEGRATING EARLY MATH INTO FAMILY ENGAGEMENT PROGRAMS

The grantees' experiences shed light on issues that programs may want to keep in mind when attempting to integrate math learning into a family engagement program.

KEY TERMS

Practitioners. The teachers, pediatricians, family engagement staff, workshop leaders, and other individuals who interact with families (or children) about early math development.



TIP 1 Build on successful family engagement approaches and ensure staff buy-in

All family engagement programs, regardless of how they support families, can integrate mathematics into their work. Programs do not need to make a lot of changes to integrate math. The trick is to integrate math in a way that builds on the program's content, strategies, and strengths. For example, in the Reach Out and Read program, pediatricians give free books to low-income families during well-child visits. The program was able to infuse math into their activities by adding books with math content to their book list and giving pediatricians guidance on how to call a family's attention to the math concepts in the books. Alternatively, Abriendo Puertas added a math session to its series of 10 workshops for caregivers, and the

Santa Clara County Office of Education refocused four of its caregiver workshops to early math.

Regardless of the approach to family engagement, the successful integration of math into a family engagement program depends on strong leadership and buy-in from practitioners. Staff at all levels must be invested in and motivated to take on new initiatives,¹⁵⁻¹⁶ and the grantees' experience bears this out. It was easier for program leaders to generate a high level of commitment when program staff saw the early math project as meeting a program goal or need. For example, the Santa Clara County Office of Education noted that its practitioners were motivated to take on the Family Math Workshop Series because it corresponded with their school districts' desire to improve not only the children's early competence in math but also the teachers' ability to provide high quality instruction.

Grantee Spotlight: Abriendo Puertas

Service recipient: caregivers



, Setting: group



, Target age group: 0-5



Abriendo Puertas trains staff at local community organizations to provide workshops for Latino caregivers. The workshops involve weekly two-hour sessions over 10-weeks in which caregivers learn about a variety of topics ranging from school readiness to civic engagement. The goals of its early math project, Cuenta Conmigo, are to increase Latino caregivers' awareness of the importance of developing children's early math skills and build caregivers' capacity to support the development of these skills. To achieve these goals, Abriendo Puertas integrated early math learning into several sessions and created a standalone session on early math.

KEY TERMS

Math talk. Talking about numbers, shapes, space, and dimensions to encourage mathematical thinking; also involves asking children open-ended questions to stimulate discussion about math concepts.



TIP 2 Focus on developmentally appropriate math concepts

It is important for young children to build a strong foundation in math by exploring early math concepts such as:

- Numbers and counting
- Sorting and patterns
- Shapes
- Measurement

These early concepts form the basis for the more formal math concepts that are taught in school. And importantly, it may be easier than we realize for children to explore mathematical thinking in these early concepts. The grantees' practitioners were often surprised to learn that they were already familiar with several early math concepts such as size, sequence, and patterns.

For example, the YMCA's math consultant designed an activity in which practitioners and caregivers used paper dolls to represent family members, sort them, and order them by size. The practitioners learned that an activity such as this one helps children to recognize relative size, the concept of a series, and patterns.

Mathematical reasoning can also be cultivated by using "math talk" and open-ended questions in real-world situations. All of the math consultants strongly encouraged this idea, all grantees embraced it, and easily incorporated it into everyday activities. For example, one grantee taught caregivers to have their children count or sort articles of clothing while helping with the laundry. Other practitioners encouraged caregivers to ask children how many spoons were needed if they were setting the table for four people and to follow up by asking the children how they knew the answer.

CONSIDER USING RESEARCH-BASED MATH RESOURCES

- **High 5 Mathematize Guide:**
<https://eclkc.ohs.acf.hhs.gov/hslc/tta-system/teaching/practice/curricula/high-five.html>
- **Finding the Math:**
<https://eclkc.ohs.acf.hhs.gov/hslc/tta-system/teaching/eecd/Domains%20of%20Child%20Development/Mathematics/AFamilyNoteon2.htm>
- **CA Head Start: Training Materials**
http://www.caheadstart.org/Early_Math_Documents.html
- **DREME Network:**
<https://dreme.stanford.edu/projects/parent-and-early-care-giver-engagement-math>

Another effective way to integrate early math into family engagement programs is to combine early math concepts with other early childhood domains of learning, such as literacy, science, art, or gross motor skills. For example, the YMCA integrated math concepts into each of its informal preschool program's activities, which include literacy, arts and crafts, science, and physical activities. In addition, all of the grantees focused on making math explicit while reading books to children, by pointing out shapes and colors or by

asking number questions about the story or pictures.

Activities with early math concepts can be tailored to age and ability such that all children can participate in the same fundamental activity. For example, the California Head Start materials are designed to meet the needs unique to each child. The YMCA materials categorize questions for caregivers to ask children as "easy," "medium," and "hard."

Consider working with a math consultant

A key aspect of infusing early math into family engagement programs involves selecting or designing developmentally appropriate math content. One approach to identifying appropriate content could be utilizing a consultant. All of the grantees used math consultants to identify and design developmentally appropriate math activities, and to train staff to implement those activities. Grantees noted that they were not experts in early math and it would have taken them more time than the consultants to develop activities. They also noted that the activities might not have been as strong (or research-based) if they had been developed without the math consultants.

How to find an early math consultant. There are many places you could go to find a consultant with expertise in early math. Examples of places to look:

- Professors of math education, education, or math at a university or community college
- An early math supervisor, math curriculum supervisor, or math coach at a local school district

"[We] selected books that would resonate [with families] not just with respect to language and ethnicity but also with respect to settings and topics. [For example,] we looked for stories that take place in farming communities and in snowy settings."

—Program administrator



TIP 3 Tailor early math projects to a caregiver's language and culture

To improve a caregiver's ability to understand and connect with early math, grantees provided early math activities in the caregiver's home language. Most grantees serve populations that include many non-native English speakers, so providing support and resources in the caregiver's home language was critical to effective communication. All of the grantees translated their materials into at least one other language (typically Spanish), and they supported several other languages as well (Vietnamese, Hmong, Ojibwe, and more!). In addition, if the training provider was not fluent in the caregiver's home language, then the grantees almost always made translators available to the caregivers during trainings or workshops.

Grantees designed resources to be accessible regardless of caregivers' literacy levels in English or in the home language. For example,

the YMCA's activity sheets for caregivers were geared to an elementary school reading level and included pictures and symbols so that they could be used by caregivers with low literacy levels. Reach Out and Read staff selected books that would allow pediatricians to encourage caregivers with low literacy levels to make up their own stories by focusing on the colors and shapes in the books if the caregivers were not able to read.

Finally, grantees ensured that materials and activities were culturally relevant to the population being served, which made it more likely that caregivers used both at home. For example, Reach Out and Read staff selected one set of books for its Minnesota math project and another for its California project. In addition, the grantees found that caregivers relate more easily to culturally relevant materials and activities, so they incorporated both into their projects. For example, one practitioner who worked with many Vietnamese families incorporated chopsticks into the teaching routine.

CONSIDER USING MATH CONSULTANTS TO HELP WITH TRAINING

Early math experts may be particularly helpful when designing or providing professional development, particularly if they helped develop the math activities. In most cases, the grantees had their math consultant involved in the professional development. Grantees provided training through two approaches: (1) an “expert” (often the math consultant) trained practitioners directly or (2) a train-the-trainer model, in which the expert trained grantee staff, who in turn trained practitioners.

To increase the likelihood that early math activities are used at home, infuse them in everyday events.



TIP 4 Offer practitioners opportunities for professional development

Professional development is critical to the knowledge, skills, and confidence that practitioners need to support caregivers and children as they explore early math. Nearly all of the grantees reported that practitioners could not have implemented the early math projects without training. Training helped practitioners to understand what early math is and how it differs from math that is taught in school, why early math is important, and how to support caregivers with early math.

High quality professional development includes initial training and ongoing support¹⁷ and all of the grantees offered both. Initial training sessions involved a combination of explicit instruction, modeling, role-playing, and hands-on activities. This process motivated the

practitioners, provided concrete examples of what early math learning looks like, and gave them time to learn about and get comfortable with research-based instructional approaches to early math. In addition, all grantees provided reference materials for practitioners to keep and offered follow-up training or coaching. Videos were particularly helpful for ongoing support, since they could be reviewed after training to remind practitioners what early math looks like, and they could be shown to caregivers.

Professional development can also help practitioners to overcome any anxiety they might have about their own math skills and therefore about their ability to be a math instructor. In fact, all five grantees reported that after the practitioners were trained, and when they worked with families at least once, they felt much more confident in their ability to support caregivers and children in both the teaching and learning of early math.

Grantee Spotlight: California Head Start Association

Service recipient: practitioners



, Setting: group



, Target age group: 0-5



The California Head Start Association provides leadership and advocacy for Head Start programs across the state through a variety of services. The goal of the association’s Early Math Family Engagement Project is to strengthen the ability of Head Start staff to build children’s math skills so that they are better prepared to succeed when they enter kindergarten. The project is based on a large scale professional development effort that is intended to train all Head Start staff in California, including Head Start Training and Technical Assistance (T&TA) staff, program managers, coaches, trainers, teachers, and family advocates on early math. Through the training model, Head Start teachers and family advocates are expected to become more comfortable with, and effective in, supporting math learning and encouraging caregivers to do the same for their children.



TIP 5 Provide families with early math activities they can use in their everyday lives

Early math can be easy for caregivers to infuse into daily activities with inexpensive materials already on hand. The grantees taught caregivers how to make small changes in their regular activities, such as playing games with their children, reading books, going to the grocery store, and getting dressed. For example, caregivers can count out loud with a child as they play a board game together. Or they can teach children the names of shapes by saying the word out loud when pointing to the shape in a book. Caregivers can also ask a child what he or she should put on first, second, and third while they get dressed in the morning.

In addition to explicitly stating and labeling the math concepts to children, caregivers can help them to develop mathematical reasoning in two ways: (1) asking children open-ended questions that involve real-life problems and (2) giving children enough time to think about and respond to a question regardless of whether they answer it correctly.¹⁸ One of the common misconceptions about teaching early math is that children have to get the right answer to be “doing math right.” As the grantees learned, it is fine if children make mistakes. Rather than immediately correcting the “wrong” answer, caregivers were encouraged by grantees to support the children’s reasoning by helping them solve the problem another way and asking them to describe their thinking.

"I sit on the floor with the parents and play with all the materials that the parents are going to get, [to give them] them an idea of how they can use it at home with the children."

—Practitioner

Another way to integrate early math concepts into family engagement programs is to make math activities simple and fun for caregivers and children. The trick is to give caregivers (1) specific guidance on effective ways to engage children in early math, (2) a clear explanation

of how to use early math activities, and (3) opportunities to practice the math activities and to ask questions. For example, one of the grantee's practitioners models all math activities with caregivers so that they know how to "play" with children when they get home.

Grantee Spotlight: Reach Out and Read

Service recipient: caregivers and children



Setting: one-on-one



Target age group: 0-5



Reach Out and Read supports medical providers who "prescribe" reading and give free books to low-income families during well-child visits. The goal of its early math project is to extend its model to early math development by providing high quality books that include age appropriate math concepts and a resource document that helps providers to call a family's attention to these concepts. Providers encourage caregivers to make the math content explicit to children while reading stories and to engage children in math talk in their daily routines.

"[Some parents have] a knee-jerk reaction that math is difficult or that they were never good at math."

—Practitioner

TIP 6 Help families to overcome their anxiety about math

Many caregivers have math-related anxiety as well as misconceptions about what early math learning is. Like some practitioners, some caregivers feel that they are not good at math and therefore cannot effectively teach math to their children. Other caregivers believe that math is only about numbers and equations, and that math learning involves filling in worksheets or solving problems in silence, as they did when they were in school.

Caregivers can overcome their anxiety and reverse their misconceptions about math when given the opportunity to practice activities like math talk and when they hear that math anxiety

is normal. To that end, some practitioners empathized with caregivers, stressing the idea that math does not have to be scary and reminding them that their everyday lives already include many math-related activities. Other practitioners focused on connecting with caregivers in other ways. For example, one practitioner makes herself "relatable" to caregivers by ensuring that they know she's learning with them.

All grantees reported that caregivers are eager for guidance on how to help their children with math even if they are unsure about the subject themselves. One practitioner noted that even if caregivers were not familiar with early math before participating in the project, they were interested in learning about new ways to help their children.

Grantee Spotlight: Santa Clara County Office of Education

Service recipient: caregivers



Setting: group



Target age group: 3-5



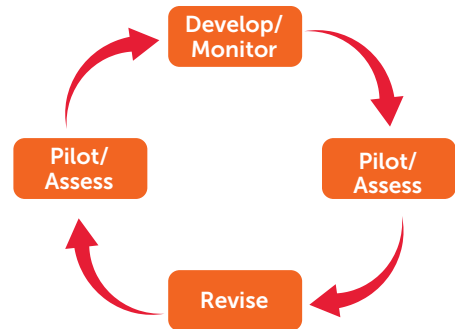
The Santa Clara County Office of Education is a regional service agency that supports 31 school districts in the county and serves more than 2,000 children up to age 5 through Head Start. The goal of the grantee's early math project, the Family Math Workshop Series, is to make Head Start staff and caregivers of Head Start children more confident about supporting early math learning and better able to do so by training them in math-focused workshops. There are four workshops for caregivers, each of which focuses on a different aspect of math. Caregivers take home a backpack with the toys and games used in the workshop, as well as an activity packet with tips and guidance on how to use these materials in their everyday activities. Head Start staff were trained in early math to help them lead the workshops effectively.

TIP 7 Use data for learning and improvement




Revising early math projects to reflect the experiences of practitioners and caregivers is a critical step in developing quality early math projects that support caregivers' and children's learning. In implementing their early math projects, all grantees completed an initial planning, goal-setting, and development phase. The grantees then piloted or implemented the new early math activities and revised them at least once based on their observations of the projects and on feedback from practitioners or caregivers. Most of the grantees revised their math activities to make them easier for practitioners and caregivers to use. In general, the first round of revisions was more substantial than subsequent revisions. For example, based on pediatricians' feedback, Reach Out and Read's first round of revisions included translating project materials into Spanish. In

addition, based on a review of the materials by the math consultant, the first round of revisions enhanced geometry support for children that are 2 to 3 years old. Subsequent revisions involved smaller changes, such as refining or clarifying tips for pediatricians, based on feedback provided by pediatricians and caregivers.

Implementation Cycle



Grantee Spotlight: The YMCA of Silicon Valley

Service recipient: caregivers and children , Setting: group , Target age group: 0-5 

The YMCA's Early Learning Readiness (ELR) program is an informal preschool in low-income communities for children from birth to age 5 and their caregivers. The program involves 2.5-hour sessions twice weekly over the course of nine months. At each session, caregivers and children interact at 13 interest centers to explore literacy, arts and crafts, science, and physical activities. The goal of the YMCA's math project is to improve the ELR program's math activities. For each ELR session, new math activities were developed and integrated into the 13 interest centers. The YMCA facilitators received training to increase their capacity to support caregiver and child learning in early math.

CONCLUSION

The grantees that were funded by the Heising-Simons Foundation developed and implemented a rich array of early math projects in a variety of settings. Their efforts show that regardless of the type of family engagement program, and despite the challenges faced by practitioners and the families they serve, there is room to integrate mathematical thinking and activities. We hope that you walk away feeling inspired and with ideas about how you can integrate early math into your own programs.

ACKNOWLEDGMENTS

This brief was prepared as part of a process evaluation funded by the Heising-Simons Foundation. The purpose of the evaluation was to describe how five family engagement programs developed early math projects, the approaches they used to integrate these projects into their programs, and the successes and challenges they encountered during the process. The evaluation and this brief benefited from the efforts and contributions of many people. We are grateful to the administrators and practitioners in the programs for sharing their experiences with us. The quality and content of this brief also benefited from the advice and guidance of Kimberly Brenneman of the Heising-Simons Foundation and a family engagement consultant, Margaret Caspe.

Process evaluation methods

Mathematica Policy Research conducted a process evaluation to explore how grantees worked with early math consultants, developed and implemented early math activities, engaged caregivers, monitored and refined their projects, and disseminated and scaled them up. The data for evaluation come from the following sources:

- Interviews with 57 key informants across the five grantees
- Observations of at least one math activity carried out by four grantees
- Reviews of grantee documents, early math project materials, and data collected by grantees on their early math projects
- Participation in a one-day grantee meeting
- A scan of the literature on family engagement and early math to find promising approaches that we could compare with the lessons learned by the grantees

We used qualitative analysis to explore the similarities and differences in the grantees' projects and experiences, and to identify key facilitators of and challenges to the integration of early math learning into family engagement programs.

ENDNOTES

- ¹ Clements, D.H., and J. Sarama. *Learning and Teaching Early Math: The Learning Trajectories Approach*. New York, NY: Routledge, 2014.
- ² Bowman, B.T., M.S. Donovan, and M.S. Burns, eds. *Eager to Learn: Educating Our Preschoolers*. Washington, DC: National Academy Press, 2001.
- ³ Clements, D.H., and Conference Working Group. "Part 1: Major Themes and Recommendations." In *Engaging Young Children in Mathematics: Standards for Early Childhood Mathematics Education*, edited by D.H. Clements, J. Sarama, and A. DiBiase. Mahwah, NJ: Lawrence Erlbaum, 2004, pp. 7–76.
- ⁴ Watts, T.W., G.J. Duncan, R.S. Siegler, and P.E. Davis-Kean. "What's Past Is Prologue: Relations Between Early Mathematics Knowledge and High School Achievement." *Educational Researcher*, vol. 43, no. 7, 2014, pp. 352–360.
- ⁵ Schoenfeld, A.H., and D. Stipek. "Math Matters: Children's Mathematical Journeys Start Early." Report of the Pathways for Supporting Early Mathematics Learning Conference. Berkeley, CA, 2011.
- ⁶ Claessens, A., G. Duncan, and M. Engel. "Kindergarten Skills and Fifth-Grade Achievement: Evidence from the ECLS-K." *Economics of Education Review*, vol. 28, no. 4, 2009, pp. 415–427.
- ⁷ Duncan, G.J., C.J. Dowsett, A. Claessens, K. Magnuson, A.C. Huston, P. Klebanov, and H. Sexton. "School Readiness and Later Achievement." *Developmental Psychology*, vol. 43, no. 6, 2007, p. 1428 .
- ⁸ Siegler, R.S., G.J. Duncan, P.E. Davis-Kean, K. Duckworth, A. Claessens, M. Engel, M.I. Susperreguy, and M. Chen. "Early Predictors of High School Mathematics Achievement." *Psychological Science*, vol. 23, 2012, pp. 691–697.
- ⁹ Duncan, G.J., and K. Magnuson. "The Nature and Impact of Early Achievement Skills, Attention Skills, and Behavior Problems." In *Whither Opportunity?: Rising Inequality, Schools, and Children's Life Chances*, edited by G.J. Duncan and R.J. Murnane. New York: Russell Sage Foundation, 2011.
- ¹⁰ Blevins-Knabe, B., and L. Musun-Miller. "Number Use at Home by Children and Their Parents and Its Relationship to Early Mathematical Performance." *Early Development and Parenting*, vol. 5, 1996, pp. 35–45.
- ¹¹ Starkey, P., A. Klein, I. Chang, Q. Dong, L. Pang, and Y. Zhou. "Environmental Supports for Young Children's Mathematical Development in China and the United States." Paper presented at the Society for Research in Child Development, 1999.
- ¹² Berkowitz, T., M.W. Schaeffer, E.A. Maloney, L. Peterson, C. Gregor, S.C. Levine, and S.L. Beilock. "Math at Home Adds Up to Achievement at School." *Science*, vol. 350, issue 6257, 2016, pp. 196–198.

-
- ¹³ Van Voorhis, F.L., M.F. Maier, J.L. Epstein, and C.M. Lloyd. “The Impact of Family Involvement on the Education of Children Ages 3 to 8: A Focus on Literacy and Math Achievement Outcomes and Social-Emotional Skills.” New York: MRDC, 2013.
- ¹⁴ Levine, S.C., L.W. Suriyakham, M.L. Rowe, J. Huttenlocher, and E.A. Gunderson. “What Counts in the Development of Young Children’s Number Knowledge?” *Developmental Psychology*, vol. 46, 2010, pp. 1309–1319.
- ¹⁵ Bodilly, S.J., S.W. Purnell, K. Ramsey, and S.J. Keith. “Lessons from New American Schools Development Corporation’s Demonstration Phase.” Santa Monica, CA: RAND, 1996.
- ¹⁶ Datnow, A. “Power and Politics in the Adoption of School Reform Models.” *Educational Evaluation and Policy Analysis*, vol. 22, no. 4, 2000, pp. 357–374.
- ¹⁷ Yoon, K.S., T. Duncan, S.W.-Y. Lee, B. Scarloss, and K. Shapley. “Reviewing the Evidence on How Teacher Professional Development Affects Student Achievement.” Issues & Answers Report, REL 2007–No. 033. Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Southwest, 2007. Retrieved from <http://www.ies.ed.gov/ncee/edlabs>.
- ¹⁸ Frye, D., A.J. Baroody, M. Burchinal, S.M. Carver, N.C. Jordan, and J. McDowell. “Teaching Math to Young Children: A Practice Guide” (NCEE 2014–4005). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, 2013. Retrieved from <http://www.whatworks.ed.gov>.

