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Language Counts

Supporting Early Math Development for Dual Language Learners

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Introduction

In recent years, a new movement to raise awareness about early math learning has been growing in the U.S., driven by research showing that foundational math knowledge is more predictive of later success in school than nearly any other indicator, including literacy.[1] This awareness of the importance of early math has led to an increasing focus among funders, researchers, and educators on understanding how to effectively promote development of math skills in early childhood — both in educational settings and in the home, where parents are young children's first teachers. Supporting early math learning is particularly critical to advancing educational equity for children from low-income families and children of color, who are less likely than other students to achieve proficiency in math by fourth grade. To date, however, this emerging early math movement has included little attention to the particular needs of a specific set of early learners: dual language learners.

Any effort to improve opportunity gaps in U.S. education must include attention to the needs of dual language learners.

Any effort to improve opportunity gaps in U.S. education must include attention to the needs of dual language learners, defined as young children between the ages of 0 and 8 with at least one parent who speaks a language other than English at home.[2] Dual language learners (DLLs) are a substantial and growing subset of early learners in the U.S. Studies show that DLLs represent more than 350 language groups, a multitude of cultural groups, and all socioeconomic levels in U.S. society, though they are more likely to live in low-income households.

While research is clear that growing up speaking more than one language has many cognitive benefits, many DLLs are faced with socioeconomic opportunity gaps and an education system designed for monolingual students. These factors likely contribute to the disparities in early math achievement for DLLs that are evident as early as kindergarten and persist throughout the academic career and beyond. The long-term economic consequences of early disparities are particularly dire in states like California, where DLLs make up the majority of children ages 0-8;[3] given that a shortage of skilled workers is predicted in California within the next five years, it is in the state's interest to ensure all students are being served well in order to meet future workforce needs.[4] These academic and economic data underscore the need to better understand how to drive early math achievement for DLLs in order to improve lifelong educational, career, and social outcomes for these young learners.

This report sets out to begin addressing the gap in knowledge about effective strategies to promote early math learning for DLLs in educational settings and at home. Building this knowledge base requires marrying what we already know about evidence-based practices in early *math instruction* with evidence-based strategies for *teaching math to older English learners*, along with emerging strategies for *engaging families of DLLs and English learners* in supporting children's learning. This report examines existing research and practice in each of these areas, to identify lessons and promising practices for supporting DLLs' early math development, and to offer recommendations for research, policy, and practice to further improve support for DLLs' early math learning in the future.[5] Throughout the report, we couple our investigation of national trends with highlights from California — the state with the highest proportion of DLLs under age 8 — to help illustrate what demographic, achievement, and policy trends look like at a state level.

Building this knowledge base requires marrying what we already know about evidence-based practices in early math instruction with evidence-based strategies for teaching math to older English learners, along with emerging strategies for engaging families of DLLs and English learners in supporting children's learning.

The report begins with an overview of the importance of early math learning, followed by an overview of math achievement among DLLs nationally and in California. Next, we examine existing evidence about effective and promising practices for supporting DLLs' early math learning in school and for engaging DLL families in early math at home, including profiles of two organizations that embody the lessons we identify for supporting DLLs' early math achievement. The following section highlights research, policy, and practice gaps and opportunities related to promoting early math for DLLs. Finally, we offer recommendations for opportunities for improving support for DLLs' early math achievement in research, policy, and practice.

Overview of Early Math Development and Learning

When many of us think of math, we think of the formal procedures and disciplines taught in school, such as arithmetic (addition, subtraction, multiplication, and division), algebra, geometry, and calculus. In reality, math proficiency involves much more than learning these procedures; it also includes building conceptual understanding, engaging in logical reasoning, employing strategic problem-solving, and perceiving math as useful and worthwhile.[6] Though we may not realize it, math concepts and language are a natural part of everyday life, in activities such as sorting clothes (sorting and classifying), calculating change (numbers and operations), combining ingredients when cooking (measuring), or thinking of places where you may have left your keys (spatial relationships).

Young children begin developing these broad math concepts and skills as early as infancy. For example, babies can understand the concept of "more," and can classify other people as familiar or unfamiliar. Toddlers recognize shapes and patterns in books and use spatial relationships when stacking blocks in size order.[7] Children in preschool and early elementary school continue to use and practice math concepts and language as they play with blocks, pretend to cook in the play kitchen, sort crayons and markers, or keep score in a kickball game.

Though we typically don't recognize such activities as developing math skills, engaging in these types of math-related thinking, talk, and practice lays a critical foundation for young children's future success in school. Research shows that children's conceptual math understanding at school entry predicts their later math and reading achievement — and is an even stronger predictor of later academic success than early literacy skills.[8] More research is needed to fully understand the association between early math development and later academic achievement, but it is clear that early math skills encompass critical thinking, conceptual understanding, and reasoning skills that are valuable across the academic spectrum.

Given the critical importance of early math skills, promoting the development of these skills in young children should be a priority to ensure that all children have an equal opportunity to succeed in school. Families and teachers both have roles to play in supporting early math development. Families can promote development of math concepts early on, even before children enter early childhood care or school. Early childhood educators and elementary school teachers need an understanding of developmentally appropriate strategies for fostering early math skills. More information about how families and educators can promote early math development is discussed in later sections.

Given the critical importance of early math skills, promoting the development of these skills in young children should be a priority to ensure that all children have an equal opportunity to succeed in school.

Although much of what we know about early math learning applies to all young children, early math development for DLLs deserves some special consideration. As discussed above, math learning includes many tasks that require communication, such as comprehending abstract concepts, engaging in problem-solving, and demonstrating logical reasoning. In order to provide DLLs with a strong math foundation, educators must understand the role that *language* — not just numbers and operations — plays in math proficiency, and have the ability to support DLLs in learning and displaying their math knowledge even as these students are simultaneously learning the language of the classroom. Unfortunately, too often educators lack the awareness and training to make the most of the strengths that DLLs bring to early math learning, contributing to disparities in math achievement for students whose home language is not English. The next section provides an introduction to the DLL population in the U.S. and California, and an overview of current academic outcomes for DLLs and young English learners compared to their peers.

Demographics and Academic Outcomes of Dual Language Learners

The DLL population in the United States has grown by 24% since the year 2000; DLLs currently make up nearly one-third of all young children (ages 0 to 8) in the country.

As described earlier, dual language learners (DLLs) are defined as children between the ages of 0 and 8 with at least one parent who speaks a language other than English at home.[9] DLLs make up a substantial and growing portion of young children entering school in the U.S. According to a 2017 report by the nonpartisan Migration Policy Institute, the DLL population in the United States has grown by 24% since the year 2000; DLLs currently make up nearly one-third of all young children (ages 0 to 8) in the country.[10] According to that MPI report, in California, DLLs compose 60% of children ages birth to age 8, making the state home to the nation's largest population of DLLs.[11]

MPI's analysis provides additional details about the demographics of DLLs in California and nationwide. As seen in Figure 1, two-thirds or more of DLL children both nationally and in California are Hispanic, while Asian and white DLLs make up the bulk of the remaining population. As Figure 2 shows, DLL children in the U.S. come from linguistically diverse backgrounds, with Arabic, Vietnamese, Tagalog, and Chinese languages (including Cantonese and Mandarin) among the top five home languages spoken by parents of DLLs nationally; however, the majority of DLLs nationally and in California live in homes where the primary language is Spanish.

Figure 1

Percent Race/Ethnicity of DLLs Nationally and in California, 2011-2015

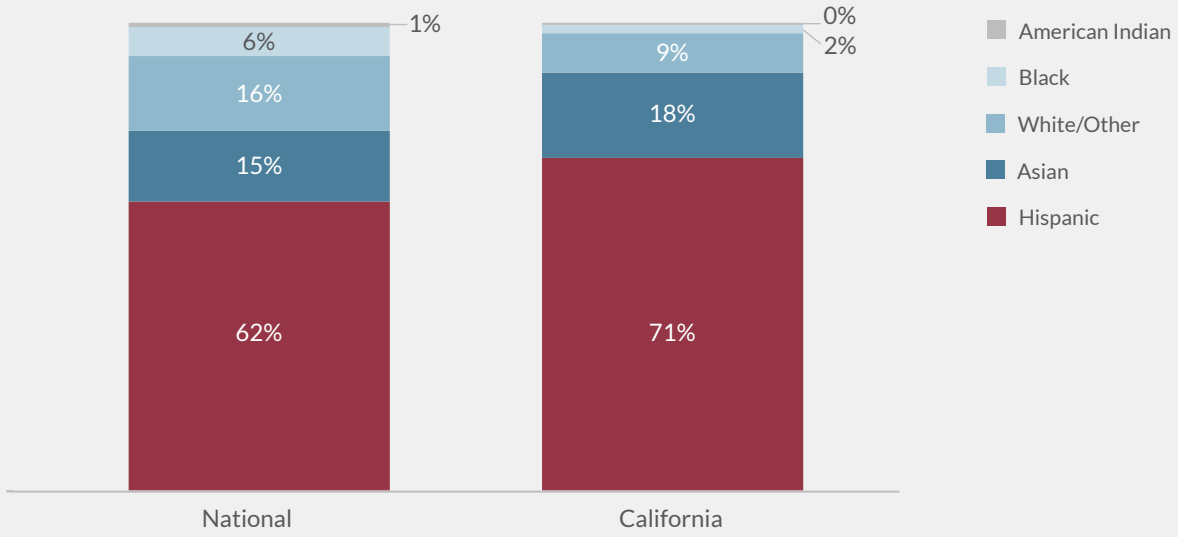
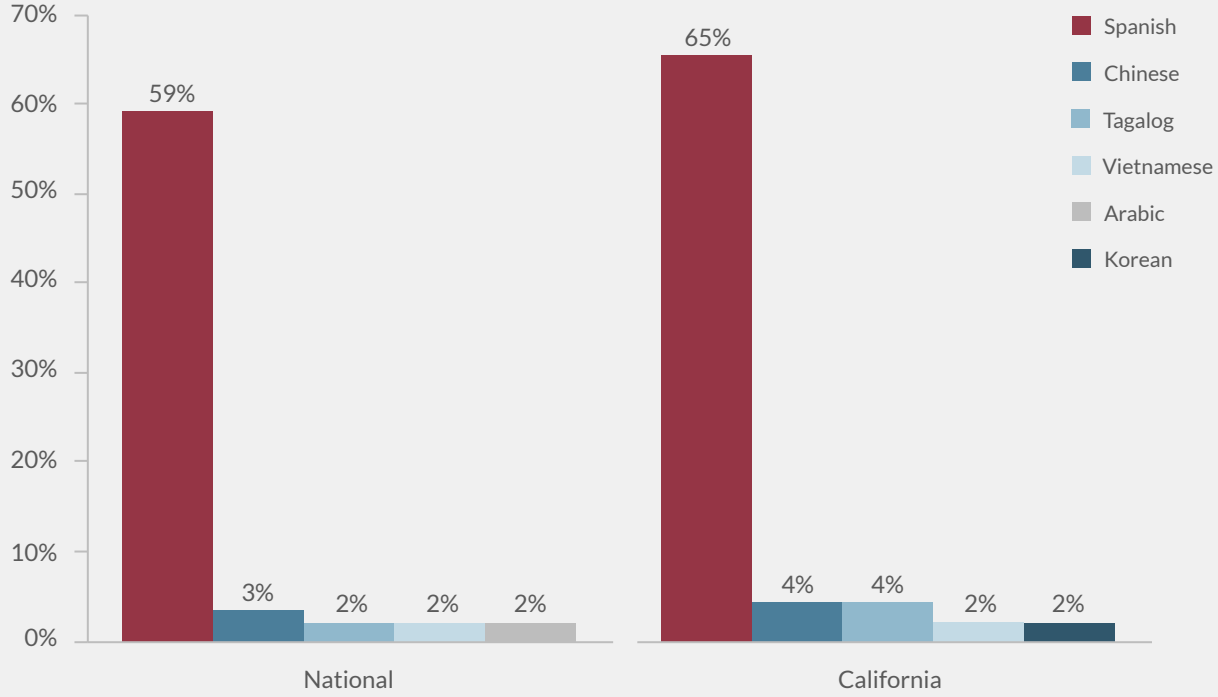


Figure 2

Top 5 Home Languages Spoken by Parents of DLLs Nationally and in California, as percentage of all DLL parents, 2011-2015



Note: This graph excludes parents of DLLs who speak English only. Chinese includes Cantonese, Mandarin, and other Chinese languages.

Socioeconomic and early care statistics point to a concerning opportunity gap for this growing subset of American students. When compared with children from monolingual families, DLL children are more likely to live in poverty and nearly twice as likely to live with parents whose educational attainment does not exceed high school (Figure 3).[12] These are two significant academic risk indicators for DLL students, and this risk is exacerbated by the fact that DLLs are less likely to be enrolled in pre-K than non-DLL students (Figure 4).[13] Research has shown that preschool programs have the potential to close the achievement gap for low-income children and help prepare them for success in the classroom, so this disparity in pre-K enrollment could have significant consequences for DLL students as they transition to school-based learning.[14]

Figure 3 Percent of DLLs vs. Non-DLLs, 2011-2015:

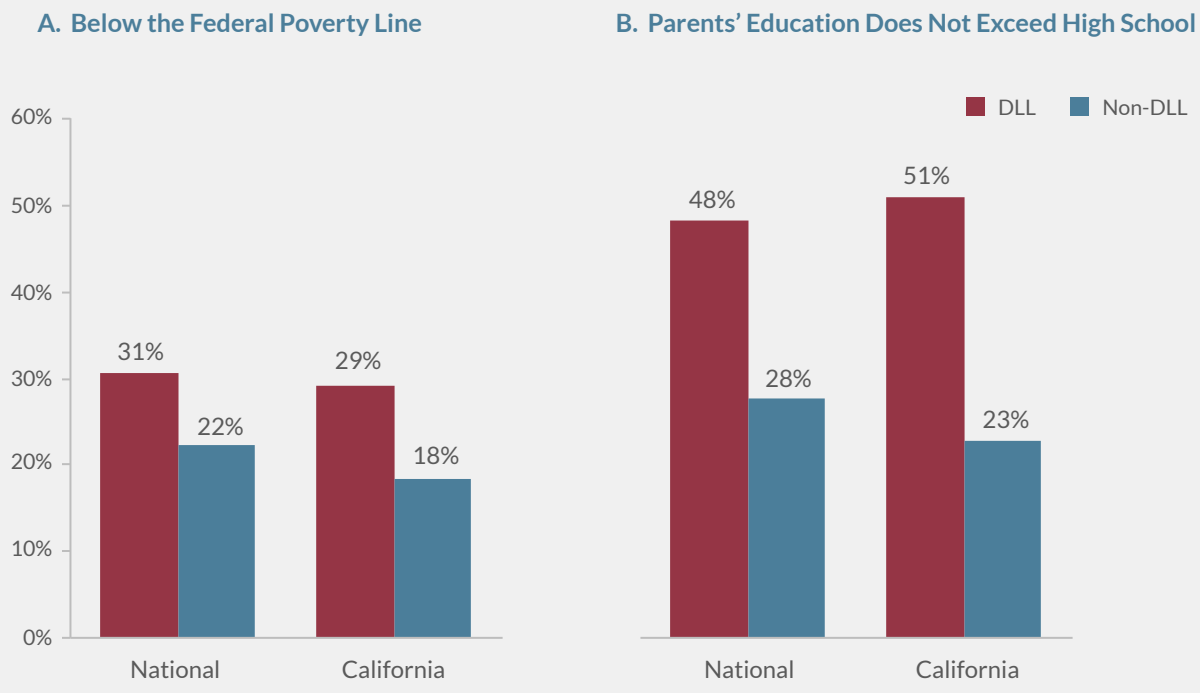
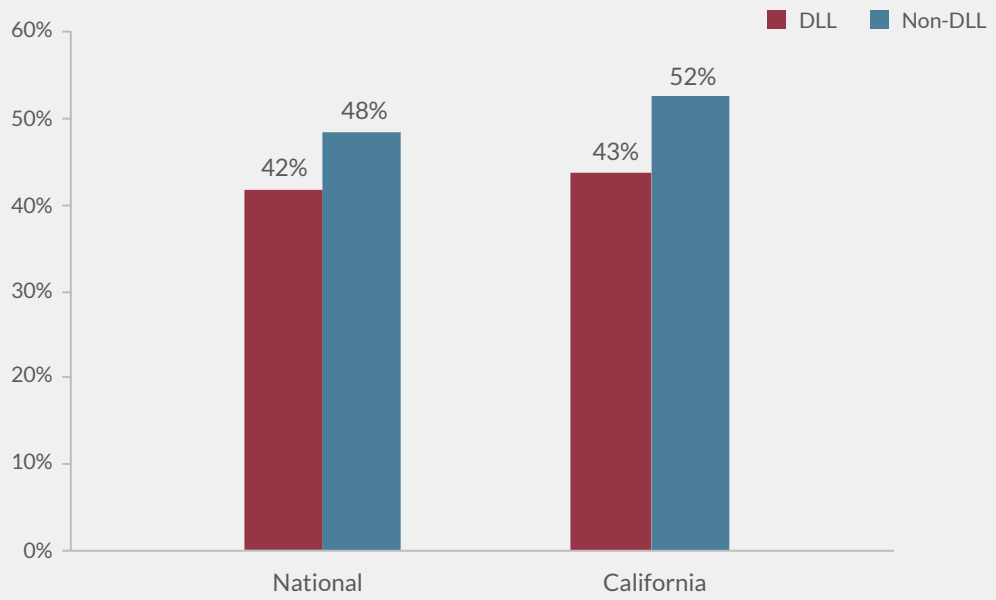


Figure 4 Percent of DLLs vs. Non-DLLs Enrolled in Pre-K (ages 3-4), 2011-2015



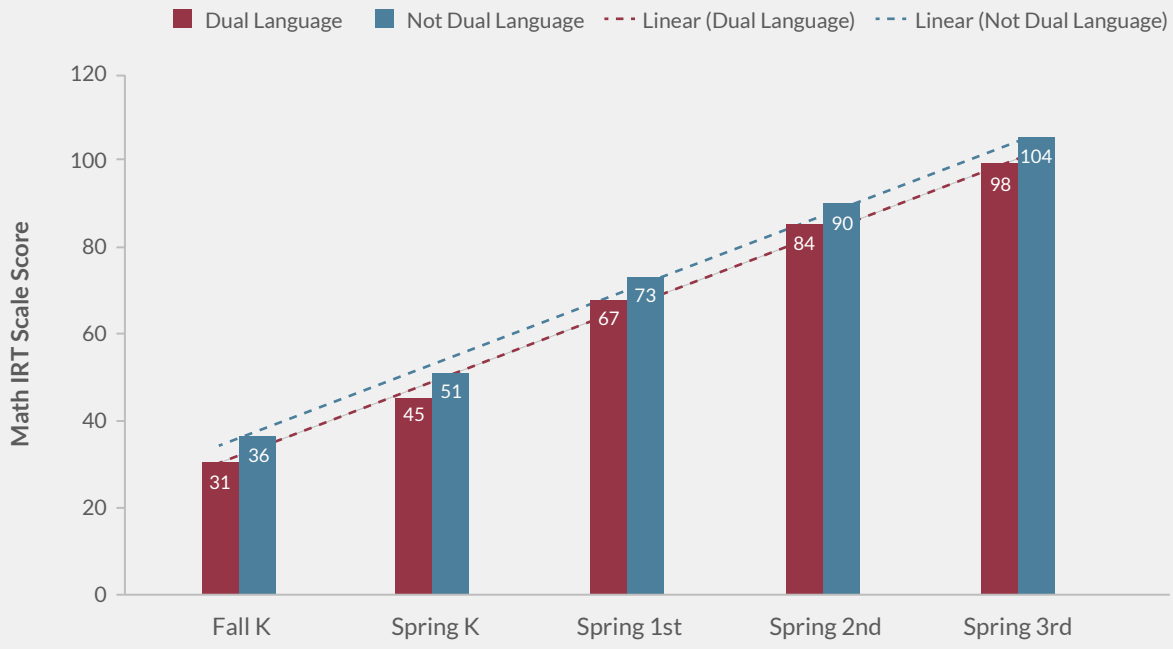
Long-held data and tracking practices in state and federal education policies make it difficult to develop a clear picture of the long-term academic outcomes for DLL students.

What we do know about DLLs' early and long-term academic performance is limited. Few states have tools or assessments in place to measure DLLs' school readiness, and some states — including California — make the use of these tools optional. Long-held data and tracking practices in state and federal education policies make it difficult to develop a clear picture of the long-term academic outcomes for DLL students. Once DLL students begin grade school, typically they are formally identified by state systems as either English learners (ELs) or as limited English proficient (LEP). As these students progress through their educational career and become English-proficient, they are generally exited from formal EL status and grouped with English-dominant peers in school data systems. Therefore, traditional data sets (e.g., state assessments) that disaggregate outcomes for ELs are of limited use for tracking trajectories of academic growth for DLLs because they exclude students who began school as DLLs and subsequently became English-proficient.

One useful source of comparison for early academic performance of DLLs is the Early Childhood Longitudinal Study (ECLS). The ECLS is the only nationally representative, longitudinal study that measures school readiness, early school performance, and early academic results.[15] Beginning with the 2011 iteration of this study, the ECLS-K, researchers for the first time began to track differences in early school outcomes for DLLs and non-DLLs.

Figure 5

Dual Language Learner vs Non-Dual Language Learner Academic Achievement on ECLS-K Math Assessment, Grades K-3



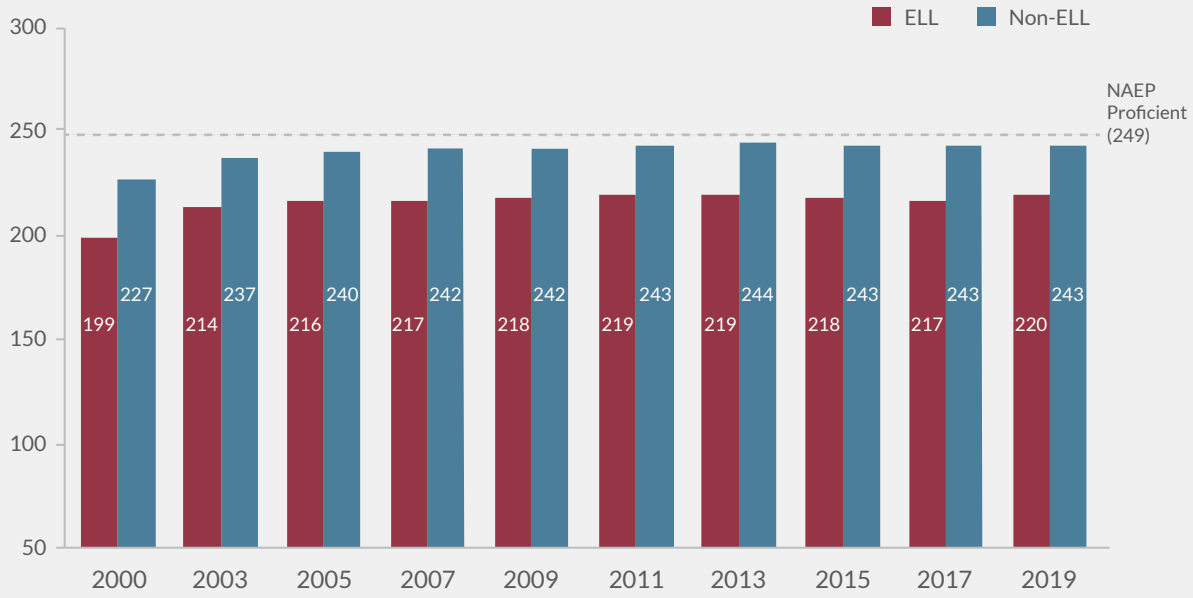
Note: Sample is limited to 9,605 students with math scores at each of these 5 time points. Estimates are weighted by W7C7P_20 for a population size of 3,044,500.

While ELLs across the nation's schools have made gradual gains in math achievement over time, achievement has plateaued in recent years, and the gap between ELLs and monolingual students in fourth-grade math achievement persists

The results (Figure 5) showed that gaps in early math performance between DLLs and non-DLLs emerge beginning in kindergarten and persist steadily throughout the rest of early elementary school.[16] These data drive home the importance of improving support for early math development in DLLs so that they enter school on par with their non-DLL peers.

Beyond the ECLS-K, no other useful measurement tools exist to compare the early math performance of DLLs vs. non-DLLs nationally, prior to third grade. Instead, fourth-grade reading scores taken from the National Assessment of Educational Progress (NAEP) provide the earliest indication of cross-state student performance. Analysis of 20 years of NAEP data reveals that while ELLs ("English Language Learners" — the term used in NAEP reporting) across the nation's schools have made gradual gains in math achievement over time, achievement has plateaued in recent years, and the gap between ELLs and monolingual students in fourth-grade math achievement persists.[17]

Figure 6 4th Grade NAEP Math Average Scores, by ELL status, 2000-2019



The gap between ELs and non-ELs is also evident in some state-level achievement data. On the 2019 California Assessment of Student Performance and Progress (CAASPP), 18% of ELs met third-grade math standards, compared with 29% of English-speaking students.[18] Similar results can be found in neighboring Nevada, where DLLs compose 44% of the young child population under 8: Only 23% of Nevada ELLs (the state's designated term) met third-grade math standards compared with 30% of non-ELL students.[19] Third-grade math gaps are also evident in states including Texas and Arizona, but in official documents neither state compares performance of ELs and non-ELs.[20] Instead both states compare the performance of ELs with the all-student group (which includes ELs), an unhelpful comparison that masks the true size of the gap between student groups.

This isn't the only way that DLL performance is masked. As noted earlier, dual language students come from a diverse group of cultural and linguistic communities, and some research shows that these cultural and linguistic differences can impact student performance. But state and national data typically lump all DLLs into one category, obscuring the fact that academic outcomes vary across these groups of students. This can present a challenge for researchers and early care professionals invested in DLL academic achievement, because the way data are collected hides the differences in performance between DLL student groups. Researchers, policymakers, and early child care providers need to consider these differences, in order to target policy and programs that will enhance the school readiness and achievement of DLLs that need the most support.

Notwithstanding the significant data challenges and limitations, it appears that dual language learners are more likely to lag behind their monolingual peers in early math proficiency, as measured by standardized tests, and these disparities persist throughout their academic trajectories. Given the strong association between foundational math skills and later academic success across subjects, promoting better early math learning for DLLs would be a powerful strategy for closing educational opportunity gaps for young children whose home language is not English. In the next two sections, we explore what can be learned from existing research and practice about effective strategies for supporting DLLs' early math development in the classroom and at home.

Sidebar 1

English Learners: One Subgroup with Many Definitions

The 2015 federal Every Student Succeeds Act (ESSA) requires that each state develop a uniform definition of "English learner," for the purposes of accountability and identifying students for support services where needed.[21] Federal law provides a foundation, formally defining an English learner as a student who a) speaks a native language other than English, and b) demonstrates a level of English proficiency low enough that it would be difficult for them to meet academic standards in school. However, states vary widely in the processes and tools they use to screen for English proficiency, as well as in the cutoff score and supplemental criteria required to determine EL status.[22] Furthermore, different states may select different EL subgroups (such as newcomers or former ELs) to disaggregate and include in reporting performance on state standardized assessments.[23] These differences in how states define ELs and track and report EL data make cross-state comparisons of EL academic performance challenging, if not impossible.

Lessons From Existing Research and Practice About Early Math Learning for DLLs in the Classroom

In early childhood and early elementary school settings, it is important for educators to use instructional strategies to bridge language differences and ensure that DLLs can access the curriculum and show their learning. To date, little research has explored causal relationships between specific instructional strategies and improved math outcomes for DLLs in early childhood settings, though a few studies have pointed to some promising practices. However, a growing body of research has identified important elements of early math education for all students, and research focused on later grades recommends instructional strategies for teaching math to older English learners. Putting these sets of research together points to several important principles for educators to keep in mind when teaching early math to DLLs.

Create a language-rich environment that includes in-context use of mathematics vocabulary and discourse.[24] Research shows that learning academic vocabulary is critical for English learners of any age; students need to know the language of mathematics in order to be able to express their reasoning, questions, and knowledge. Furthermore, young children learn through using language in context and making connections among concepts, so the math language should be taught in the context of hands-on, math-related activities and not as isolated vocabulary.[25] That said, the focus should be on encouraging DLLs to represent their learning in their own way, rather than on precision in language, with the educator helping the child to gradually transition from using their own forms of expression to practicing more academic language. Evidence-based methods of supporting DLLs to convey their thinking include storytelling (for example, using a story about going to the supermarket as the setting for a math discussion) and using multimodal representations (such as drawing and symbols, and physical gestures).[26]

As much as possible, educators should set up opportunities for students to use math talk in play scenarios that are culturally relevant and reflect the everyday experiences of DLLs outside of school.

Use play-based learning to support development of mathematical concepts and language.[27] In any early childhood classroom, play is an important part of children's learning and practice of new concepts. Teachers can reinforce DLLs' use of mathematics discourse and application of math concepts by encouraging play that naturally integrates skills like making patterns and shapes, counting, sorting, and exploring spatial relationships. For example, a teacher can encourage children to pretend they are counting money in a grocery store or write prices on a menu in a restaurant; in the process, they support DLLs in showing their math knowledge and demonstrate how math is integrated into everyday activities. As much as possible, educators should set up opportunities for students to use math talk in play scenarios that are culturally relevant and reflect the everyday experiences of DLLs outside of school.

Seek out opportunities to instruct and assess DLLs in both English and their home language whenever possible. Research shows that for multilingual children, linguistic skills are often distributed across their two (or more) languages.[28] In other words, they may be able to express understanding of one concept more accurately and completely in their home language, while another concept may be more clearly expressed using English. Therefore, it is important for teachers — whether they speak the child's home language or not — to find opportunities to use the home language as a resource during math instruction. Furthermore, assessing in one language may not capture all of the DLL's knowledge.[29] When early math assessments are available in more than one language, educators should consider using both to accurately gauge students' math progress. When no assessment is available in the child's home language, it is important to acknowledge and consider this context when interpreting results of an English-only assessment.

Treat the child's home culture and emerging bilingualism as assets and resources, rather than as deficits.[30] California's English Learner Roadmap provides the following explanation of what it means to take an asset-based approach to teaching English language learners:

> *Pre-schools and schools are responsive to different English learner (EL) strengths, needs, and identities and support the socio-emotional health and development of English learners. Programs value and build upon the cultural and linguistic assets students bring to their education in safe and affirming school climates. Educators value and build strong family, community, and school partnerships.*[31]

Taking an asset-based approach will help the teacher understand how a young student uses their language, gestures, and other means to demonstrate their mathematical understanding.

Among other benefits, taking an asset-based approach will help the teacher understand how a young student uses their language, gestures, and other means to demonstrate their mathematical understanding. This approach also includes taking time to learn about individual students' histories with language and education, which can vary greatly for different dual language learners and have implications for instruction. For example, teaching a math concept to a student who has already been introduced to the concept in their home language is different from introducing the concept to a student for the first time.

In order to identify and draw on the assets that DLLs bring to the classroom, educators will also need to invest time to talk with families, either through home visits or through a structured interview. These conversations can help identify the ways in which math and math language are used in the home, as well as math-related funds of knowledge (see sidebar, p. 18) that can be leveraged for instruction. For example, if a family or community is familiar with the construction field, a teacher can build math lessons around the concept of construction. Or a teacher can ask families to send in notes or photos of artifacts from home and use these to construct culturally relevant math problems and activities. Identifying and honoring students' and families' strengths not only helps students access the curriculum, but also engages families and signals that the preschool or school views them as equal partners in the child's education.

Unfortunately, many educators, especially in early childhood settings, have not received the support they need to successfully incorporate instructional strategies into their practice in order to better serve young dual language learners. Programs like the California Early Math Initiative (CAEMI), a multiagency initiative led by the Fresno County superintendent of schools, aim to address this problem through targeted educator training. CAEMI provides training and support to early childhood administrators, coaches, and teacher leaders across the early childhood sector to build their capacity to support high-quality early math education in their local communities. The initiative's 2019 Summer Institute convened leaders from 28 counties, followed by quarterly Community of Practice meetings and monthly two-hour coaching sessions for participants. Early formative research on the initiative provides promising evidence that this type of effort could be a helpful model for creating a network of well-trained early math educators; at a check-in halfway through the yearlong project, the percentage of participants who reported feeling confident in their ability to train others on early math topics increased from 64% at the beginning of the Summer Institute to 87% at midyear.[32]

Sidebar 2

Using the 'Funds of Knowledge' Concept for DLL Students' Math Achievement

Many of the researchers we spoke with in preparation for this report and much of the academic research on working with dual language students and families reference a foundational educational concept called "funds of knowledge." The term first came into popular use in the early 1990s and was used to describe all the "essential bodies of knowledge and information that households use to survive, to get ahead, or to thrive."[33] Later researchers such as Marta Civil built and added to this concept, particularly in mathematics education; Civil's research specifically identified Latino parents as intellectual resources critical to their students' math education.[34] Her work presents a model for parental involvement in mathematics in which parents engage as learners, facilitators, and leaders for other parents. A key focus of the Funds of Knowledge for Teaching project is the idea of teachers engaging families outside of school contexts, including home visits, to help teachers recognize families' particular funds of knowledge and explore how to apply them in a classroom setting.[35]

The fundamental premise of this approach is that when teachers develop a better understanding of a student's or parent's funds of knowledge, they can enhance and customize classroom practices based on students' strengths, and unearth culturally responsive home practices for parents to do with their children. For those leaders committed to creating an educational system that is more equitable, this approach can be helpful to achieve that vision. Traditionally, many school-based practices, curricula, policies, and behaviors are based on mainstream, white, middle-class norms and perspectives; practices, behaviors, and perspectives that do not match the mainstream view are positioned as deficits. The funds of knowledge concept rejects this view and instead emphasizes that students from all communities, including low-income students and students of color, bring to school a background of rich experiences and cultural knowledge that can be assets in their learning. The theory demands educators to rethink their curricular and academic approach to develop culturally relevant materials so that students can connect the content to their lives and understand it at a deeper level. This is especially important for immigrants and dual language learners who rarely see their cultures represented or valued in academic settings

Lessons From Existing Research and Practice About Engaging Families of DLLs in Early Math Learning

While well-prepared educators are an essential component for promoting early math skills for DLLs, families also play a central role in children's learning, especially for young children who may not yet be in an early care or formal school setting. Experts agree that it is important for educators, community organizations, and advocates to find ways to engage families of all young learners, including DLLs, to help support early math learning. These experts often use the term "family math" (paralleling the more widely known concept of "family literacy") to refer to activities that families can do together with their children in the context of their everyday lives to strengthen their math understanding, skills, and confidence.

Capturing and quantifying the specific benefits of family engagement for children's early math learning can be challenging. Some research has documented qualitative benefits of outreach to families around early math, such as parents feeling more confident to help their child(ren) with homework, and the student(s) expressing more interest in and enthusiasm about math.[36] In one example, the California Early Math Initiative (CAEMI) surveyed parents at their demonstration site, a community center called Lighthouse for Children, which is developing and piloting programs designed to engage families in early math. Programs include a Family Math Night and Family M.A.T.H. Packs (backpacks filled with family math activities that can be checked out). A survey of 19 parents who attended one Family Math Night showed that "94% of parents agreed that the Family Math Night provided them with ideas for math activities to do at home and taught them the skills they needed to do these activities; and 88% of parents agreed that they learned valuable

Community institutions can play a role in shaping families' awareness of and confidence with family math.

information … that provided tips on how to include math talk as they read books with children."[37] Pilots like this one provide promising evidence that community institutions can play a role in shaping families' awareness of and confidence with family math.

Additional evidence of the academic benefits of family engagement in early math comes from a 2014 study of a Public Broadcasting Service (PBS) initiative. Families that participated in the nine-week program engaged in online and hands-on math activities at home with their preschool children for 30 minutes a day, four days a week, and also attended weekly parent meetings. The study found that not only did parents improve in their awareness of their children's math development and in their ability to support math learning, but participating children of all income levels also improved in their overall math knowledge, as measured by the Test of Early Mathematics Ability (TEMA-3).[38] Studies like this provide preliminary evidence that family math can translate into tangible improvements in children's math learning. Much more research is warranted to investigate whether and how increased family engagement in early math learning is associated with measurable improvements in children's math performance in school.

Despite the potential benefits of engaging families in early math learning, many parents receive minimal messaging about the importance of family math from the early education institutions in their lives.

Despite the potential benefits of engaging families in early math learning, many parents receive minimal messaging about the importance of family math from the early education institutions in their lives (e.g., Head Start, day care, libraries). And families themselves do not necessarily seek out math resources; parent advocates at the United Parent Leaders Action Network (UPLAN), for example, haven't observed a specific demand from families to learn more about supporting their children's math development, likely because much of the public is unaware of the importance of developing early math skills. Therefore, it is imperative that early childhood educators, elementary schools, and community advocates and organizers make outreach around early math a priority for all children, including DLLs.

Engaging DLL Families in Early Math Learning

Little research has specifically investigated effective practices for promoting family math with families who speak a language at home other than English — and the evidence is especially sparse for families of non-Spanish-speaking DLLs. Our research did identify a few examples of math-focused family engagement research and practice that includes large numbers of Latino families. Lessons from these initiatives provide a starting point for identifying promising practices, outlined below, for building awareness and knowledge of early math with families of DLLs. Much more research is needed to test these emerging strategies with a variety of families and to explore how the specific engagement needs of DLL families might differ from those of their peers.

Engage parents as co-leaders and co-creators of family math initiatives. Marta Civil and colleagues at the University of Arizona are leaders in research on applying funds of knowledge to family engagement in math (not necessarily focused on early math). They developed two projects — Project BRIDGE and Math and Parent Partnerships in the Southwest (MAPPS) — that investigated the benefits of a funds of knowledge approach with low-income Latino families. In Project BRIDGE, which ended in 2002, faculty researchers and teacher researchers explored students' and families' mathematical experiences and knowledge as learning resources in school. Similarly, MAPPS focused on strengthening parents in their roles as parents, learners, and teachers through math awareness workshops, and math for parents mini-courses. Though those specific programs have now ended,[39] they offered some important lessons about what it means to implement an asset-based approach to family engagement in math.[40]

For example, rather than assigning parents to traditional involvement roles like helping in the cafeteria or making copies, BRIDGE invited parents into the math class to engage in discussions and to teach students about their areas of expertise. MAPPS was grounded in the understanding that knowledge is co-created and that many parents, especially those who did not grow up in the U.S., have different experiences with math learning and approaches than their children. Parents participating in MAPPS workshops were encouraged to discuss these differences between their own and their children's math experiences, and to share multiple approaches to problem-solving.

Work with parents to highlight math language in everyday activities. Researchers at the DREME (Development and Research in Early Math Education) Network provide additional documentation of the existing assets that parents of DLLs bring to family math activities. DREME members are in the process of conducting research (currently unpublished) to understand the unprompted math language that Latino families use naturally with their young children in different contexts. They found that the parents routinely engaged in talk about shapes, matching, patterns, sorting, and logical reasoning while doing tasks with children like setting the table or folding laundry.[41] Researchers at Erikson's Early Math Collaborative also emphasize the importance of using everyday activities (e.g., putting groceries away) to help children understand shapes and spatial reasoning.[42] Efforts to engage DLL families in early math should help parents see this type of language as part of fostering early math skills.

Understanding how math language occurs in the home is crucial to developing a culturally competent approach with DLL families.

Consider how family math activities may look different in different cultural contexts. Understanding how math language occurs in the home is crucial to developing a culturally competent approach with DLL families. Some experts argue that because adult-child dynamics and role expectations differ across cultures, promoters of family math should take into account these cultural differences. For example, parent-child time in some households may center around activities like cooking, shopping, or household chores, and it may feel more natural to incorporate math talk into those tasks than for parent and child to play a math game together. Melzi (2020) gives the example that weaving — an intergenerational craft common to many indigenous Latino cultures — is a non-play-based, purposeful task that offers rich opportunities for talk about math concepts like patterns, measurement, and spatial thinking.[43]

Families of dual language learners may be more responsive when math learning is framed within the broader context of educational equity.

Frame conversations about the importance of early math in the language of educational equity. Experience from parent advocacy organizations that have implemented family math initiatives in Black and Latino communities, such as UPLAN and Community Organizing and Family Issues (COFI), suggests that the framing of the issue could be important to getting DLL families invested in learning more about early math. Families of dual language learners may be more responsive when math learning is framed within the broader context of educational equity — i.e., that their children need early math skills to be ready for kindergarten and have a strong start in school (especially in a system where they may face barriers as dual language learners); that strong math skills are connected to success in a variety of subjects later in school and in life; and even that their children will need to have confidence in math to effectively manage personal finances in the future. Another potential concern for immigrant families is lack of familiarity with the U.S. education system, so it can be helpful to communicate that engaging in family math initiatives can help equip caregivers and students with the knowledge they need to be successful in this system.

Efforts to promote family math for DLLs may be more successful if they include a set of parent leaders as partners in the initiative.

Seek out and enlist trusted ambassadors to build relationships with DLL communities. Parents themselves can be powerful partners with educators in conveying the importance of early math to their peers. In Chicago, COFI hired and trained a group of parents in their network to lead a series of "family fun nights" that focused on ways families can support their children's math learning at home. The sessions were targeted to parents of children ages 0-5, and included information about young children's math development and time for families to engage in math activities with their children. The organizers of the event found that the parent facilitators were able to connect with the participants in an authentic way, sharing their own questions and struggles with math learning, and helping to build other parents' confidence with the activities.[44] COFI's experience suggests that efforts to promote family math for DLLs may be more successful if they include a set of parent leaders as partners in the initiative.

COFI also enlisted parents as leaders in a door-to-door campaign that brought the message about the importance of early math literacy to 12,000 families in 22 Chicago neighborhoods. The parent ambassadors handed out flyers and math kits (that included a toy, book, and other materials) and talked to neighborhood parents about supporting young children's math development. Although the campaign did not specifically target families of DLLs, the strategy could be replicated in other locations and tailored to communities in which many families speak a home language other than English, as a way to reach families whose children might not yet be enrolled in any formal child care or educational setting.

Importantly, understanding the socioeconomic reality of many DLL families, COFI pays parent leaders for their time and expertise. Some parent engagement programs designed to engage low-income families expect that parents will volunteer unlimited hours to advance a cause. Instead, COFI's approach places a monetary value on the time that parents spend organizing and advocating, which reinforces their asset-based approach. Organizations looking to mirror this kind of advocacy in dual language communities should consider stipends or even salaries for parents who dedicate themselves to this work.

Putting Lessons Into Practice: Case Studies

The clearest way to illustrate the impact of asset-based engagement of dual language families and students is to tell the stories of organizations that have done it successfully. The two case studies below describe organizations that have pioneered innovative approaches to building relationships in dual language communities, messaging the importance of early math, and supplying communities with tools to help young dual language learners master critical math skills. Earning the trust of dual language communities takes time, and as both case studies demonstrate, student outcomes won't change rapidly just because a program has been introduced. However, in both of these cases, parents and early care professionals reflect on the importance of these kinds of resources in dual language communities, and the lasting impact of their early math messages.

CASE STUDY

Mighty Math, Chicago, IL

> *A peer-to-peer parent leadership model raises awareness among families of dual language learners about how to promote early math at home.*

Background

Mighty Math was an early math initiative based in Chicago. It was developed as a partnership between two nonprofit education advocacy organizations: Community Organizing and Family Issues (COFI), which develops parents as leaders on critical community issues, and Voices for Illinois Children, which advocates for sound public policy and proper investments in children. Recognizing the importance of parental involvement in children's early education, the two organizations secured funding to establish a program and set of tools empowering parents to engage in fun math activities at home.

For two years, COFI and Voices for Illinois Children activated COFI's network of parent leaders to conduct a door-to-door campaign that introduced more than 900 low-income parents to early math development, distributed more than 870 math kits each year, and recruited 145 parents and children to seven family early math events. The partnership did not have a specific focus on DLL families, but the materials and the programming were developed to support emerging bilingual children. Though this partnership ended in 2019 due to lack of continued funding, the program they developed continues to offer lessons and strategies on how to engage dual language families in a parent-led early math campaign.

Program Description

Mighty Math featured two primary strategies to engage families:

- **Parent-Led Door-to-Door Campaign:** When COFI and Voices for Illinois Children joined to launch the Mighty Math campaign, COFI brought years of experience organizing parents in Chicago to the partnership. At the time, COFI parent ambassadors were leading a door-to-door campaign focused on early learning, targeted to low-income communities that were under-enrolled in formal preschool. The organizations decided that these parent ambassadors would continue their door-to-door campaign with additional Mighty Math materials and outreach language. Each parent ambassador was given Mighty Math kits that included an early childhood book, an insert describing math exercises for parents and children to do together, a measuring cup and spoon set, a sewing ruler tape, and eight large plastic fish to use in math activities. During each interaction, parent ambassadors would

emphasize the importance of early learning, discuss the family's goals for their children, and share how a strong foundation in early math could set children on a path toward college and lifelong success. Parent ambassadors also extended invitations to Mighty Math family events.

- **Family Math Events:** COFI and Voices for Illinois Children conceived family math events as an opportunity for parents to learn new skills to bring math into the home, share stories and strategies with each other, and play math games with their children. All family math events followed a similar format:
  - **Icebreaker:** A brief exercise to build trust among participants and identify common cultural practices.
  - **Introduction to Early Math:** A short presentation developed by Voices for IL children focused on key concepts and questions related to early math (for example, "What are early math skills?" "Why is math important now and not later?" and "What activities can I do to support early math learning?").
  - **Peer-to-Peer Practice:** Time set aside for parents to play early math games with their children in small groups with a COFI parent ambassador. During this time parents could ask each other questions, practice what they learned from the presentation, and brainstorm ideas for how to emphasize math at home.

Impact

COFI and Voices for Illinois Children primarily relied on survey data to measure the impact of the program. Results from pre/post surveys given to family math attendees showed a clear increase in knowledge of family math and a high level of reported commitment to continuing to incorporate math activities at home. In the course of doing research on this program, we were able to organize a roundtable with dual language parents who had all attended a Mighty Math family math event. One parent, Rosalia, explained the impact of the program:

> *The training was pretty awesome because lots of parents came with closed minds about math, but left the training thinking that math could be so much more fun. Math is everywhere. We play with our kids, we read, we learn with our kids. You don't need a specific language to do math. If your child builds good math habits early, then when they get older math won't be such a foreign concept.*

A second parent, Maria, explained how she used the Math Kits with her child:

> *My child was going into first grade and we used the materials quite a bit. We pretended we were cooking and used the measuring cup [to measure ingredients]. We used the measuring tape to measure various things [around the house]. At the time my son was also learning about counting and grouping by 10 and he was struggling. I used the blocks from Mighty Math to play with my son and have him create groups of 10 so he could visually see the groupings and count by 10, which was more useful than what he was learning in school.*

Key Lessons

Mighty Math's approach provides key lessons on engaging dual language families:

1 **Programs should tailor their outreach and messaging to dual language families, with a particular focus on educational equity.** Programs hoping to engage dual language families should be strategic in their approach. As COFI developed its door-to-door campaign, it determined that the best way to reach its desired population of parents would be to target neighborhoods with low enrollment rates in pre-K. As we discuss, dual language families are less likely than their non-dual language peers to be enrolled in pre-K and are more likely to rely on informal community and family networks to care for young children. Once COFI identified which communities to target, it worked with Voices for IL Children to frame a message that would engage dual language families. Parent ambassadors were trained in key messages to share with families, including emphasizing the importance of early math to a child's success in kindergarten and later years. These messages resonated. As one parent, Leti, explained:

> *In Latino communities, we have very low rates of graduating from university. [Parent Ambassadors trained in Mighty Math] would ask parents in the community, "Do you want your children to graduate from college?" and parents would enthusiastically respond, "Yes!" Then the Parent Ambassador would transition to talking about the power of math and starting math at an early age. It's something I wish I had.*

Importantly, parent ambassadors did not attempt to shame or embarrass parents for their own anxiety around math. Parent ambassadors emphasized that any parent can do math at home and pointed out the ways in which parents might already do math instruction. This approach and framing was designed to quickly build trust with dual language families, and encourage them to try new math activities at home.

2 **Parent leaders can be effective advocates to reach dual language families.** One unique aspect of the partnership between COFI and Voices for Illinois Children is that most programming was parent-led. COFI understands that parents, especially dual language parents and parents of color, are often not seen as leaders on key issues in education. COFI strategically trained parents in early learning and early math because it believed that parents would be the best ambassadors to reach other parents. Moreover, this approach allowed parents to build relationships and trust with each other, and problem-solve around common challenges. As Giselle, a COFI staff member who supervised the program, explained:

> *We trained 40-50 parent leaders who came to us not feeling confident about math. Through the training, we reinforced the idea that parents are already doing math at home. Counting stairs, keeping rhythm through song, identifying patterns and shapes — things we do already — made parents feel more confident. This encouraged parents to believe that they can teach their own children about math.*

CASE STUDY

3 **Using an asset-based, culturally relevant approach to early math education helps build trust and engage dual language families.** As we discuss throughout this report, effective outreach to dual language families needs to be asset-based and culturally relevant. COFI demonstrated this approach through icebreakers at family math events. Each math event began with an exercise in which parents shared a lullaby or song from their culture, in English or in their home language. The activity built trust and camaraderie among participants, but also helped parents recognize some of the ways in which they already use math in the home. Across cultures, songs and lullabies are used to teach children about rhythm and timing, both of which are important math concepts. Some early childhood songs refer to specific math concepts including distance, numeracy, or size. Activities like this can reinforce for parents that early math instruction is something that is already part of their culture and their regular routines.

4 **Offering free, bilingual take-home materials helps support dual language families in engaging in early math at home.** Parents who participated in Mighty Math noted that the games, books, and other materials they received from Mighty Math were useful tools to continue work on early math at home with their children. "The children we met [during the door-to-door campaign] were so excited to get the bag of toys, and didn't know they'd be learning math while playing with them," said Maria, a parent ambassador who helped deliver math kits to families. Access to free early math materials is also a way to advance educational equity. "Parents in our communities don't think that there are resources out there to help them with math education. If I knew about them, I would have asked for these resources earlier because I struggled with math as a kid, and I wanted to start earlier with my own children," added Rosalia. Targeting free bilingual math resources to dual language families is one way to address the vast resource gap that exists between communities.

These approaches highlight how asset-based parent engagement helps address educational inequities. Simply put, providers and philanthropic organizations need to listen to parents to determine what they need and engage parents as ambassadors and advocates in their communities. Following this model, COFI and Voices for Illinois Children continue to be a resource for parents during the COVID-19 pandemic. COFI, as Leti describes, "has recently gone through the process of asking what families need and now we're at the stage of organizing campaigns to meet parents' needs [during the pandemic]." For its part, Voices for Illinois Children began to record short Mighty Math lessons in English and Spanish to help parents and caregivers incorporate math into their home practices. Both organizations, and their partnership, should serve as a model for others interested in building relationships with the dual language community.

Zeno Math, Seattle, WA

> *A nonprofit partners with early child care providers to amplify the importance of early math for young students in underserved communities, including dual language learners.*

Background

Zeno Math is a nonprofit based in Seattle with a mission to "[build] young children's early math skills by equipping families with fun and engaging tools to create the math foundation for a future of limitless opportunity." It offers early math games and professional development to 400 providers at community-based organizations and early learning programs, serving nearly 3,000 families with preschool-aged children throughout the state. Zeno's network of providers primarily serves low-income families of color, and 32% of those families speak languages other than English. Zeno Math tailors its programming and games to meet the needs of diverse audiences, including dual language learners, by following a process of community engagement.

Zeno Math was founded in 2003 by a community of parents interested in how games could be used to teach math to young children. The program, which began by partnering with one elementary school that served primarily low-income students, initially offered family math game nights, schoolwide math games, and in-class support for teachers. As the program evolved over the next decade, Zeno Math shifted its focus from elementary-aged children to preschool children (ages 3-5) to help give children an even earlier start with math. Today, the program focuses on serving low-income families of color through a racial equity lens.

Program Description

Zeno Math's programming for early child care providers includes three primary strategies:

- **Math Game Kits:** Zeno Math is primarily known for its fun, interactive Math Game Kits. Zeno has developed a total of 16 kits, each focusing on different math concepts. The kits are packaged in small boxes that include a game subdivided into three levels targeted to different age groups. All early child care providers who choose to partner with Zeno receive math game kits. The number and type of games providers receive varies based on the specific needs of the early care program. Zeno staff deliver games to providers and model their use, so that providers and children understand how to play each game and its central math concept. Providers and children play with the game for a week in the classroom, and then children take the game home to teach it to their families.
- **Professional Learning Sessions:** Zeno developed a series of five professional learning sessions designed to support early care professionals. Any early care provider that has partnered with Zeno Math has access to these professional learning sessions. Each session focuses on a different math concept (for example, "Mathematizing Literature" — a session focused on how to incorporate math while reading). Zeno staff provide the training, which includes whole group direct instruction, and smaller breakout groups in which staff have the ability to practice what they've learned and co-create activities to play with the children they serve.
- **Family Math Parties:** Zeno Math staff have limited interactions with families because the organization is not designed to work directly with families. Instead the organization provides services, tools, and training to early child care providers who do work directly with families. However, in some communities, Zeno staff co-host family math parties with early child care partners. During these family math parties, Zeno staff and the provider invite families to learn about different ways to bring math into the home. Parents work through different stations, each focused on a different math concept, and learn about activities they can do at home with their child to teach that concept.

Impact

Zeno uses a number of tools to measure its impact, including retrospective surveys, net promoter scores (NPS), and retention. Retrospective surveys are administered to early childhood providers who partner with Zeno and the families they serve. These surveys show that after participating in Zeno's programs families are more comfortable building their child's math skills at home, use math words more often, and play math games at home more often than they did prior to engaging with Zeno. Net promoter scores are a widely used management tool that organizations use to measure customer experience and satisfaction on a scale of 0 to 100, based on their reports of how likely they would be to recommend the organization to a friend. Average net promoter scores vary by industry, but 50 and above is typically

considered very good. Zeno's average NPS is 48, which suggests families enjoyed Zeno's games and events, and would recommend them to other families in their community. Each year, Zeno takes account of how many providers renew their partnership, and in recent years more than 80% of partners returned. The growing number of early child care providers interested in the program has led to a waitlist every year for the past three years.

Some early child care partners have sought more formal program evaluations to measure the impact of Zeno on the students they serve. One partner, the Children's Museum of Tacoma, participated in an evaluation and found that math achievement improved significantly after the program was introduced to its students.

A Seattle-based provider, Jaqueline, explained the impact of the program on the students she serves:

> *Zeno has helped [my students] develop their skills and it helped them like math and stop thinking it's boring because it can be learned through play. They learned that math is everywhere — in numbers, in colors, shapes. An 18-month-old child might not understand the concepts, but children ages 3,4, and 5 years old can learn this way because it is fun. Even the older ones have realized this and think math is fun.*

Key Lessons

Zeno's approach to working with early child care partners on early math instruction provides several key lessons about early math learning for dual language learners:

1 **Programs/providers must build relationships with dual language communities in order to understand and meet the needs of the families they serve.** As we discussed earlier, any entity that wants to engage dual language families and children must value their home culture and language as an asset rather than as a deficit. We identify intentional conversations as one strategy to identify and draw on the assets that dual language learners bring to formal education. Zeno Math exemplifies this strategy by building intentional relationships with families prior to implementing its math program. Before Zeno will bring its program to a new community, Zeno staff have a series of listening sessions with providers, families, and community members to assess their needs and listen to stories about their experience with education. Zeno's programs and operations director, Maile Hadley, who has roots in dual language communities, noted that prior to expanding Zeno to a new Spanish-speaking community, "We redesigned all of our listening sessions based on my knowledge of the community. We wanted the providers to be able to give feedback and share stories of their own experiences with math instruction. We use a relational approach that begins with listening to providers in their home language." Zeno follows a similar process in other dual language communities, which allows the team to tailor their programming and materials to meet the needs of the communities they serve.

2 Programs/providers demonstrate respect and value for dual language learners' home language and culture by ensuring that materials are accessible in multiple languages. Another way programs and providers that work with dual language families can demonstrate an asset-based approach is to offer materials in multiple languages. To maximize its reach and impact, Zeno Math translates its math materials into 10 different languages including English, Spanish, Somali, Oromo, and Russian. Translating these materials signals that the Zeno Math team values the home languages of the students it serves, and believes that students should be exposed to foundational math skills in their home language.

3 Engaging informal early care providers in early math initiatives is critical to reach dual language learners. As we discuss in the data section, dual language learners are less likely to be enrolled in pre-K than non-dual language learners, which contributes to lags in kindergarten readiness for this population of students. Other data suggest that dual language students not enrolled in formal pre-K are more likely to be cared for by a family or community member. Often these informal networks of early child care are overlooked when policymakers and program leaders want to engage early child care providers. Zeno Math avoids this omission by intentionally engaging different kinds of early care providers and offering them professional learning opportunities. Gladys Reyes explains, "When we began talking about expansion into a Spanish-speaking community, we weren't sure whether we should start by engaging families or home-based providers. But through listening sessions, we learned that many families rely on home-based early child care providers. We tailored our professional learnings to meet the needs of this community in their home language."

4 Programs and providers should use culturally relevant, play-based learning to support the development of math skills for dual language learners. Zeno Math's approach reflects the understanding that play is an important strategy for teaching early math to all young children. The crux of the Zeno Math program is its Math Game Kits that encourage children to master foundational math principles through play. Jaqueline explains how she's used Zeno to incorporate math into her activities:

> *Now when I do my activities or play outside, I implement the material that we are working on for the month. For example, this July we worked on geometric shapes, so we searched for shapes around the house. The kids looked for objects that resembled shapes; for example, plates are circles, a door frame is a rectangle, a cupcake is a pentagon, and a cup is a cylinder, etc.*

In addition, the Zeno team takes steps to ensure that the play is culturally relevant. During professional learning sessions, providers are encouraged to co-create math learning activities using cultural references familiar to their students. For example, as Gladys Reyes explains, "If you're talking about the grocery store, you might encourage the child to count the tomatoes, instead of Brussels sprouts." And during family math nights, Zeno gives families ideas of materials they can create at home, using familiar objects found around their house, to stimulate math play in their own way. Through these simple techniques, Zeno Math reinforces the importance of culturally relevant play through all of its programming.

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Few programs across the country have successfully blended a focus on math and young children of color, but Zeno's approach demonstrates several best practices to reach communities of color and have a lasting impact. Over nearly 17 years, Zeno staff have worked to build trust among these communities and the organization has pushed itself to be responsive to the needs of its evolving dual language communities. Even during a global pandemic and series of national crises, Zeno has continued to offer regular digital professional learning sessions to center-based and home-based early child care providers like Jaqueline, who says, "We haven't lost our training because it's online now. In addition, we have an [online] support group where we can share examples and experience with other child care providers." Zeno's approach could serve as a model for other community-based organizations or funders interested in building relationships with dual language communities.

Gaps and Opportunities in Research, Practice, and Policy

Our research surfaced a number of gaps in research, practice, and policy when it comes to supporting early math learning for DLLs. In this section, we review these gaps and discuss potential opportunities to advance knowledge and practice in the future.

Research

More differentiated research is needed to specifically develop our understanding of how to best support DLLs' math development.

Experts agree that there is a pressing need for research specifically related to early math learning and teaching for DLLs. Currently, the research base is more robust and/or growing in related areas, such as early math development for all students, engagement of all families in early math, and general instruction for DLLs. Within each of these topic areas, more differentiated research is needed to specifically develop our understanding of how to best support DLLs' math development.

Research on Early Math Development

The field of research on early math development is still growing. Studies have identified general trajectories of math learning in pre-K through second grade, which helps educators understand how children develop certain math concepts.[45] However, more research needs to be done to understand the most effective strategies to promote children's learning in math in class and at home, particularly for preschoolers and younger children. Furthermore, more investigation is needed of math trajectories or effective instructional strategies specific to DLLs. For example, studies have found an association between executive function and math skills in early childhood,[46] and other research suggests that DLLs have strong executive function skills; further investigation is warranted to explore whether there is a connection between emerging bilingualism and stronger math skills.

Research on Family Math

In recent years, as awareness grows about the importance of promoting early math skills, researchers, funders, and policymakers around the country have supported emerging efforts to understand how best to engage families in math learning at home. For example, in 2018 a group of funders launched the Family Math Roadmap Implementation Project; part of this initiative involves supporting a learning community of programs piloting and studying family engagement strategies in early math. Similarly, the state-funded CAEMI initiative in California includes a demonstration site to develop and research family math engagement efforts. Although families participating in such initiatives include those whose home language is not English, this emerging field of research so far has not focused specifically on identifying best practices for engaging DLL families in early math.

Research on the Effectiveness of Various Mathematics Instructional Strategies with DLLs

Although there is an increasing body of research describing approaches that are beneficial for DLLs and emerging bilingual students in the math classroom (for example, leveraging the home language for learning), we need more evaluative data to guide implementation of specific strategies (for example, what percentage of time should the home language be used in the classroom?). Much of the current research is more qualitative and descriptive; more large-scale studies are needed to provide generalizable, causal evidence linking specific instructional strategies to outcomes for DLLs of various backgrounds.[47] Some research is currently underway that could add to our understanding of how best to support DLLs across the curriculum and in math specifically. For example, a rigorous longitudinal study of effective instructional strategies for DLLs, led by American Institutes for Research (AIR), was due to conclude in spring 2020. Unfortunately, the final data collection will no longer be possible because of COVID-19-related school shutdowns, throwing in doubt the ability of the researchers to draw conclusions about which strategies were most effective across subjects, including math. In a separate research study, the Erikson Institute, SRI, and Chicago Head Start collaborated to provide professional development to teaching staff and leaders at 28 Head Start and day care centers, to create centers of early math excellence.[48] This study, which is due to be published soon, did not focus specifically on DLLs, but the study sample includes a substantial number of DLLs and will likely yield some relevant insights. The limited causal evidence of effectiveness of specific strategies to promote math learning for DLLs highlights the pressing need for more attention to this topic in the research field.

Practice

Around the country, early care providers and elementary school teachers need professional training and development to learn how to best support the learning of the DLLs in their classrooms — in all subjects as well as in math specifically. To be effective with DLLs in any subject, educators must first learn how to take a culturally competent, asset-based approach — reaching out to families as valued partners, soliciting their input and

collaboration on a variety of issues, and understanding and appreciating families' existing strengths and resources. Teacher preparation programs are an important part of the equation when it comes to ensuring that the educator workforce is well prepared to serve DLLs. Furthermore, locally based professional development is important for this purpose, so that educators can really get to know and understand their local communities. The Head Start National Center, for example, is structured to provide both national trainings and regional professional development to meet the needs of local communities, recognizing that one size does not fit all.

States, districts, and schools need to dedicate resources to improving educators' knowledge of best practice for teaching DLLs in all subjects, including math. In California, this often means helping teachers unlearn practices that have become routine after two decades of English-only policy in education. The California Department of Education recently awarded a $5 million grant to five programs to provide in-service training to teachers around implementing the state's English Learner Roadmap, which is an important step toward helping teachers shift their practices. Professional development for educators around the state has begun, but has been disrupted by COVID-19 school shutdowns, and advocates worry about the future of the funding as budgets tighten due to the pandemic.

For young DLLs specifically, it's important to consider professional development for early child care professionals, including those who provide child care at home and family members who look after young children while their parents work.

For young DLLs specifically, it's important to consider professional development for early child care professionals, including those who provide child care at home and family members who look after young children while their parents work. Nonprofits like Zeno Math (see profile on p. 29) demonstrate that organizations can develop and disseminate resources tailored to this community of child care providers, and COFI suggests that door-to-door campaigns might be a useful strategy to reach caregivers in communities that include dual language families. As with K-12 classroom teachers, community leaders should consider a comprehensive strategy to reach and train early care providers who care for young DLL children.

Policy

At the most basic level, the road toward creating policies that support the early math development of DLLs begins with fostering a mindset shift among policymakers and the general public. Experts consistently point out that there is 1) a lack of public awareness around the importance and impact of developing strong early math skills; and 2) a need in American society to shift to a view of bilingualism as an asset — recognizing that bilingual families bring unique resources to the table — rather than a problem. Creating greater awareness and understanding on these issues in order to advocate for more beneficial policies will require a multipronged approach, including strategies such as developing a public awareness campaign, organizing and training DLL parents to be their own advocates, and educating policymakers.

In order to ensure that policies advance equity for DLLs, policymakers need accurate and timely data about the educational experiences and growth of young learners.

In order to ensure that policies advance equity for DLLs, policymakers need accurate and timely data about the educational experiences and growth of young learners. To monitor the quality of early childhood settings, many states have implemented Quality Rating and Improvement Systems (QRIS) — frameworks that outline standards for assessing and communicating the quality of early care and learning programs. These QRIS systems, such as Quality Counts California, typically consist of indicators related to factors such as teacher behaviors, classroom environment, and program administration and leadership. Few QRIS systems include statewide standards for working with DLLs, even in states with high DLL populations like California. Including information about how well programs serve DLLs in the QRIS would help policymakers identify and address inequities in DLL children's preparation for kindergarten.

Most states also need policies to increase the pool of educators (both early care and K-12) who are effectively prepared to support the specific learning needs of DLLs and their families in all subjects, including math. For example, there is an urgent need to recruit more bilingual educators into the workforce, especially as research continues to reveal the benefits of dual language instruction and demand for such programs grows. States and districts may consider developing "grow-your-own" teacher certification initiatives that provide an alternative pathway to certification for paraprofessionals, who are often more likely to represent the linguistic diversity of their local communities.[49] States may also consider other incentives, such as increasing compensation for educators in early education in order to attract more diverse candidates into the profession.

States also need to consider ways to ensure that the latest research on supporting young DLLs is incorporated into teacher preparation and professional development. In California, for example, early childhood educator certification standards do not require any training specifically related to supporting the needs of DLLs. Changing the certification requirements would ensure that more educators enter the workforce prepared to serve DLLs well. Similarly, states must invest in providing in-service training related to supporting DLLs to teachers of young children. In California, advocates successfully lobbied to include funding specifically for statewide training for early education teachers on the EL Roadmap. Unfortunately, due to school closures, research on the effectiveness of these trainings cannot be completed this year, and the future of this funding remains in question as a result of the pandemic.

Recommendations

The time is ripe for increased investment in promoting early math learning among DLLs. The current context in the country shapes considerations about where and when to focus investments. In the face of the global pandemic currently affecting every aspect of life, the most pressing need for DLLs in the next 18 months will be ensuring that their families' educational, economic, and socioemotional needs are protected in pandemic response efforts. Beyond COVID-19, states will need to think strategically about how to invest in and support DLL communities in light of tightening state budgets. Below, we offer a set of recommendations to improve early math for DLLs across policy, practice, and research.

POLICY

Recommendations for Policymakers and Advocates

1 **Engage and listen to DLL families to better understand their needs.** As we emphasize throughout this report, one simple, but essential strategy to support DLL families and children is to listen to and learn about their communities. Policymakers should actively seek perspectives from DLL families, by building relationships with community advocates and within communities of families directly, potentially leveraging opportunities such as roundtable discussions, community meetings, surveys, and interviews to hear directly from DLL families. Similarly, advocates working more broadly on early childhood, family, or educational advocacy should ensure that the voice and perspectives of DLL families are included in their engagement and advocacy. Having these conversations early can build trust and help policymakers craft policy tailored to meet the needs of DLLs and their families.

2 **Include attention to specific needs of DLLs in COVID-19-related funding and policies.** As policymakers rush to bolster the economy and support continued schooling during the pandemic, it is easy for the needs of DLL populations to be overlooked. Furthermore, as budgets are cut, programs that serve DLLs and ELs may be in danger of losing funding. Additionally, a higher percentage of DLLs live in low-income households compared to their monolingual same-age peers. As a result, DLLs are less likely to have access to the digital devices necessary for effective virtual or hybrid schooling. DLLs and their families will need targeted services and resources to combat learning loss, address socioemotional needs, and ensure engagement in learning opportunities regardless of setting.[50]

3 **Include DLL-related reporting and capacity-building in QRIS systems.** As discussed earlier, it is currently difficult to truly understand the performance and needs of DLLs relative to their peers due to a lack of data. Currently, few states have statewide standards for serving DLLs in early childhood settings. States can set the stage for making more evidence-based decisions in the future by incorporating a specific focus on DLLs into their early learning program quality evaluation and improvement systems. For example, policymakers should develop a uniform way of defining, identifying, and reporting data on DLLs across the state's early learning system. States can also ensure that when financial incentives and funding are provided for capacity building and technical assistance to improve early childhood program quality, these supports include training specifically related to DLLs.

States can set the stage for making more evidence-based decisions in the future by incorporating a specific focus on DLLs into their early learning program quality evaluation and improvement systems.

4 **Support development of grow-your-own bilingual educator certification pathways.** Experts and advocates point to a pressing need for a larger pool of bilingual educators nationwide — and especially in states like California with large populations of DLLs and ELs. In many communities, paraprofessionals and parents are more likely to be bilingual; streamlining the process of teacher certification for such candidates could help expand the pipeline of teachers who share a second language with their DLL students. Policymakers may consider incentivizing districts and higher education institutions to work together to design partnerships that allow paraprofessionals and other community members to earn a certification while interning in schools.

5 **Establish and sustain funding for educators to learn best practices while working with DLL students.** Policymakers need to ensure that adequate funding is set aside so that educators have the ability to develop skills and learn best practices for working with DLL children. California, for example, took a critical step toward improving the quality of education for DLLs and emerging bilingual students statewide by creating its EL Roadmap, and now the state should set aside funding to ensure that teachers can incorporate the recommendations from the roadmap into their daily practice. Furthermore, educators around the country need immediate support to determine how best to meet the needs of

DLLs while COVID-19-related social distancing measures continue. Continued funding for DLL-focused professional development is critical, and vigorous advocacy is needed to help policymakers understand how this type of training will help early educators meet the needs of DLLs, especially in light of COVID-19.

6 **Advocate for and establish educator certification requirements to include training related to DLLs.** As described above, many states do not require candidates preparing for early childhood certification to participate in any coursework about evidence-based strategies for serving DLLs. Communities can support the efforts of advocates like Early Edge, whose policy platform calls for revision of California's Child Development Permit to "include explicit competencies for serving DLLs."[51]

Recommendations for Early Care Providers, State and District Education Leaders, Community-Based Organizations, and Philanthropy

PRACTICE

1 **Raise awareness about the importance of early math through strategies like family math nights.** Schools and day cares can host in-person or virtual family math events, like those organized by COFI (see p. 26), to inform parents about early math development and provide them with fun, practical strategies for supporting early math learning at home. For DLLs in particular, it is important for educators to partner with parents to lead such events; organizers observe that families are often more responsive to strategies and tips offered by other parents than by educators or researchers. Educators could identify a core cadre of parent leaders who participate in training, who then lead workshops or family fun nights with other parents. Other community organizations and institutions, such as libraries, museums, and nonprofits, can also partner with local educators and advocates to host family math workshops and provide materials. For example, Public Media Group of Southern California (PBS SoCal) has a Family Math initiative in which it partners with local stakeholders to connect families to "hands-on curriculum, interactive games, take-home activities," and virtual events to help them incorporate fun math learning opportunities into daily life.[52]

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2 **Develop a public campaign around early math targeted to DLL families.** Communities around the country have launched public campaigns to raise awareness about early literacy; the same approach can be effective for promoting early math. An awareness campaign could be launched through a collaboration among local stakeholders such as schools, community-based organizations, libraries, and philanthropic organizations. To reach DLL families, it is important to engage institutions that have an everyday presence in local communities, including public transportation, businesses such as clinics and barbershops, and ethnic media such as radio stations and newspapers targeted toward various language communities.

3 Develop and pilot training tools related to DLL instruction and family engagement. As awareness about the importance of early math grows, recent years have seen programs like Fresno's AIMS Center and the Lighthouse for Children Center begin researching and piloting strategies for training teachers and engaging families in early math. Other communities can replicate programs like these to develop and test resources specifically aimed at training teachers to teach math to DLLs, or training teachers to work with families to promote early math learning. For example, New York State released a "Blueprint for English Language Learner Success" in 2014 and was identified in expert interviews as a national leader in supporting implementation of effective practices for ELs. New York's experiences rolling out the blueprint to educators may offer valuable lessons for other states.[53]

4 Invest in community organizing efforts for families of DLLs around education equity. Like all parents, parents of DLLs care deeply about their children having an equitable opportunity to thrive in school and beyond, but in many of these communities parents aren't yet aware of the connection between early math and future success. Messaging research provides evidence that parents are more invested in early math learning when they understand it as an equity issue.[54] Correspondingly, organizations interviewed for this report find that when they engage with families to organize around educational equity, they build relationships that can *then* serve as a foundation for introducing the importance of early math as a key ingredient for educational success. This strategy could involve partnering with community organizations (for example, libraries partnering with community-based organizations) that already work with parents of DLLs on education issues, but are not necessarily currently focused on math. To build a successful early math campaign, it is critical that advocates make the explicit connection between early math and other educational justice issues parents are already thinking about.

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5 Support the development of a professional learning community for preparation program providers interested in providing training on educating DLLs. Because the field of early math education is relatively new, institutions that train teachers and early care educators may face challenges in developing coursework and practicum experiences for their students. These programs, including institutions of higher education, could benefit from a regular opportunity to share effective practices and research to understand how best to prepare educators to serve California's large DLL population in early math.

RESEARCH

Recommendations for Institutions of Higher Education, Philanthropic Organizations, Nonprofits

1 **Conduct rapid-cycle research on effective distance learning strategies for DLL families in the COVID-19 era.** Some advocates we interviewed expressed concern about the distance learning needs of DLL families, who are more likely to be low-income and essential workers during the pandemic. Because their time and attention are likely to be more focused on meeting basic needs, they will need ways to support their children's learning that are meaningful but do not require intensive time investment each day. Given that it is difficult to know what strategies will work best for different DLL families, it may be worth investing in rapid-cycle pilots of different distance learning initiatives to understand what families' needs are and what at-home learning activities are easiest for parents to support.

2 **Conduct effectiveness research on specific early math instructional strategies for DLLs.** As noted previously, an emerging body of research focuses on understanding and describing beneficial strategies for promoting early math learning for DLLs. However, more large-scale, systematic research is needed to investigate the potential link between specific early math instructional strategies and the math learning outcomes of DLLs of different backgrounds and under different conditions. Especially given the current disruptions to existing effectiveness studies due to COVID-19, there will be an urgent need for targeted research related to DLLs in the next one to five years. As more research findings emerge about promoting early math skills for DLLs, they can be used to inform both classroom practice and advocacy for educational equity.

More large-scale, systematic research is needed to investigate the potential link between specific early math instructional strategies and the math learning outcomes of DLLs of different backgrounds and under different conditions.

3 **Refine training tools for DLL instruction and family engagement, based on ongoing research.** As research about effective math instructional strategies for DLLs advances, it will be important to ensure that the findings inform teacher professional development. Consider developing partnerships between or convenings of early math researchers and community-based organizations that are developing and piloting teacher education tools, in order to ensure valuable exchange of information between fields.

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