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DISCOVER THE POWER OF MATH

California Statewide Early Math Initiative

Why Invest in Early Math?

More than 50% of California students are not achieving state math standards.[1] As such, California's children are not acquiring the basic mathematical foundation needed for college and career success. Research shows that early math predicts later achievement in both math and reading.[2,3,4]

Many early childhood teachers report that they are uncomfortable with math.[5] They also report less knowledge about math than other areas of learning and development, such as language or social–emotional development.[6] Research indicates that teachers' knowledge, attitudes, and beliefs toward math are associated with their teaching practices, in that they spend less instructional time on math.[7] In fact, young children seldom receive adequate instructional support in math in their early childhood programs.[8,9]

Professional development can build educators' positive math identities, knowledge, and teaching practices, which has the potential to promote children's positive math outcomes.[10,11]

Goals of the California Statewide Early Math Initiative (CAEMI)

To support early math outcomes for California's children, Fresno County Superintendent of Schools and their partners: the AIMS Center for Math and Science Education (AIMS), the California Early Math Project, Les Mayfield III (feature film director), and WestEd (independent evaluator) collaborate to:

- Raise educators' and families' awareness of the importance of early math
- Build positive math identities for adults who care for and teach young children
- Build confidence and capacity of educators and families to support children's early math
- Promote young children's early math outcomes

The CAEMI strives for educators and families to engage children to "Count, Play, Explore: Discover the Power of Math."

Critical Components of the CAEMI

The CAEMI features three critical components:

Professional learning and coaching for agency facilitators

Early math resources for families and educators

Family engagement

To create a positive math experience for diverse learners, the initiative integrates the following guiding principles:

- Positive math identities and mindsets
- Play-based math
- Adults as learners
- Connection to California foundations and standards
- Culturally relevant pedagogy
- Family engagement

Lighthouse FOR CHILDREN

The Lighthouse for Children Child Development Center in Fresno serves as the demonstration site to pilot the key components of the CAEMI.

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Professional Learning and Coaching for Agency Facilitators

To kick off the professional learning, AIMS hosted a five-day CAEMI Summer Institute in July 2019 for 92 facilitators from agencies across the state. The in-person event allowed the four AIMS coaches to build relationships with the facilitators. The AIMS coaches continued to support the facilitators through quarterly community of practice (COP) sessions, which were offered in person to local agencies and virtually to agencies across the state. In addition, the facilitators participated in monthly virtual coaching with their AIMS coach. The year concluded with a virtual CAEMI Summer Institute in August 2020.

Advantage of Virtual Engagement: Virtual engagement allowed for a wide-reaching early math support system across the state. The use of technology also served as a model for how facilitators could engage educators during the COVID-19 pandemic.

The CAEMI Engages Diverse Agencies

30
Agencies

The CAEMI engages **agencies** across the state, including:
- County offices of education
- School districts
- Nonprofit organizations

92
Facilitators

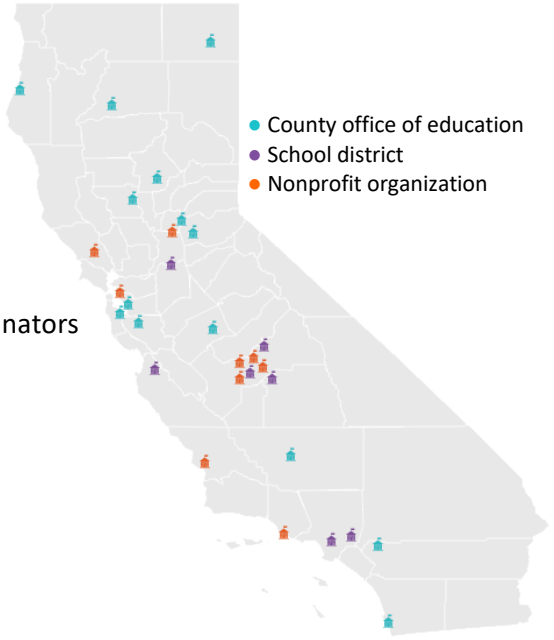
Facilitators hold different roles in their agency including:
- Trainers or coaches
- Teachers
- Directors or administrators
- Science, Technology, Engineering, Math (STEM) coordinators

1,411
Educators

Educators included:
- Teachers and family child care providers
- Trainers and coaches
- Parents

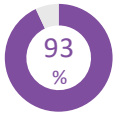
17,377+
Children

Agencies serve **children** ages birth to eight

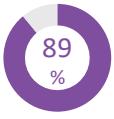


Percent of Agencies that Serve California's Most Vulnerable Children (N=27 agencies)

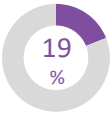
Serve low-income families



Serve dual language learners (DLLs)



Serve children with disabilities



Serve tribal communities

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Professional Learning and Coaching for Educators

As part of the grant, agencies were required to engage at least 20 educators in three professional learning sessions and six coaching conversations. Beyond these requirements, agencies had flexibility to develop the content and structure of their implementation plans to meet their local needs. Even though some agencies experienced obstacles in their implementation due to the COVID-19 pandemic, most agencies met or exceeded the minimum grant requirements.

Note: Due to missing data, the data below reflects anywhere between 27-30 agencies.

Professional Learning

- On average, agencies served 47 educators in professional learning (range: 15–181).
- Professional learning sessions primarily took place in person prior to the COVID-19 pandemic. During the pandemic, implementation shifted to virtual sessions.
- Learning objectives focused on:
  - Positive attitudes toward math
  - Early math development
  - Math pedagogy
- Agencies offered an average of 4–5 professional learning sessions, for a total of 140 sessions across the state.

Coaching

- On average, agencies engaged 27 educators in coaching (range: 8–127).
- Coaching conversations took place either in person or virtually through email, text, or video conferencing.
- Learning objectives focused on:
  - Implementing what was learned in professional learning sessions
  - Supporting and empowering educators
  - Encouraging reflection
- Agencies engaged educators in one-on-one and/or group coaching.

What Areas of Math Did Agencies Address?

Although agencies had the flexibility of selecting their math focus, most agencies addressed all math areas as part of their professional learning for local educators.

Agencies reported addressing math areas from the …

California foundations for infants, toddlers, or preschoolers		Common Core State Standards for elementary students
Number Sense (97%)		Counting and Cardinality (67%) Number and Operations (59%)
Geometry (96%)		Geometry (63%)
Algebra and Functions (82%)		Operations and Algebraic Thinking (63%)
Measurement (78%)		Measurement and Data (56%)
Mathematical Reasoning (96%)		

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Highlighting the Need for Professional Learning and Coaching on Math

Before the initiative, facilitators reported limited previous training and coaching experience on early math.

52% of facilitators reported they had **NOT** trained on math-related topics before the initiative.

50% of facilitators reported they had **NOT** coached on math-related topics before the initiative.

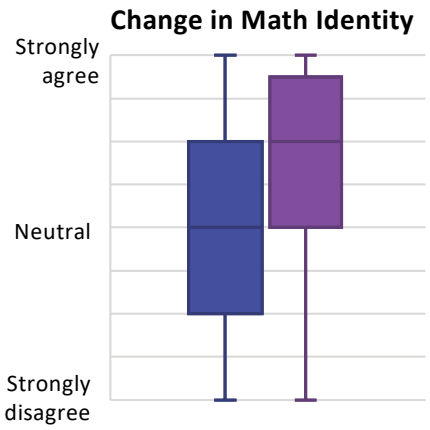
This data highlights the great need for an initiative to build the capacity of agency facilitators to train and coach on math.

Building Agency Facilitator Capacity in Math Training and Coaching

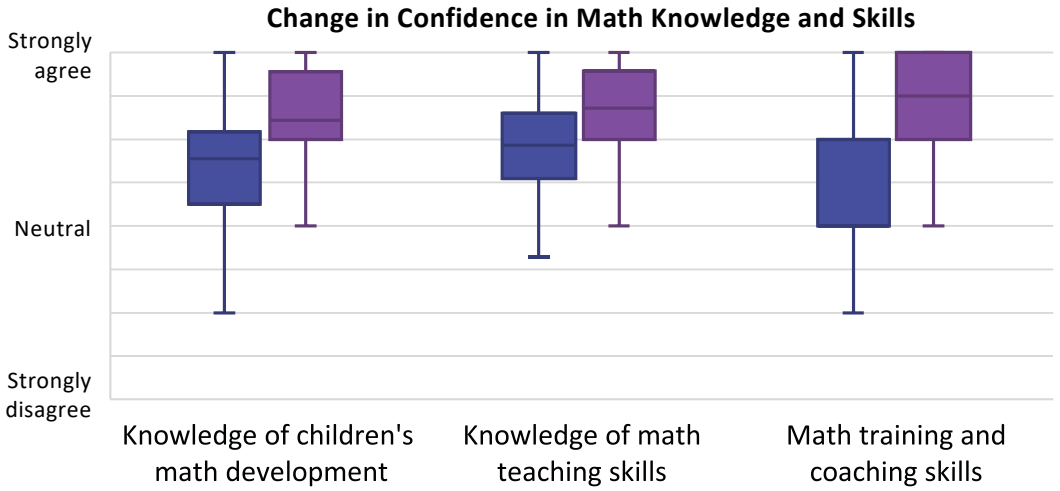
At the beginning of the initiative, facilitators were given a pre-survey of their **math identities** and **confidence** in their knowledge of children's math development, math teaching skills, and math training and coaching skills. At the end of the initiative, facilitators were given a post-survey to measure any changes in these same areas. Facilitators responded on a five-point scale of strongly disagree to strongly agree. Facilitators reported significant improvements in their confidence in their knowledge and skills. For the 69 facilitators who had complete data, the following box plots show the change in median scores from the beginning to the end of the initiative.

"The CAEMI work over the last year truly was some of the most rewarding work I have done in my 30-year ECE career. Thank you for this opportunity to participate in CAEMI. I think the way that each agency was allowed to create an implementation plan that was flexible and individualized to suit the needs of their participants was incredible."

Facilitator Survey Response



The initiative contributed to the positive math identities of agency facilitators. For example, after participating in the initiative, more facilitators began identifying themselves as a "math person."



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Building Educator Capacity in Local Communities

Agencies reported on their perceived level of impact on educators: awareness, knowledge, teaching practices, and child outcomes (N=28 agencies). Most agencies reported deepening educators' knowledge and supported implementation, while a small percentage reported more sustained changes in math teaching practices and observed changes in child outcomes in assessment data (N=28 agencies).

11% Reported a **sustained change in educator math teaching practices**, and they also observed **improved child outcomes**

68% Reported a **deepened educators' knowledge** of math and how to support it and were engaged in **ongoing implementation**

21% Reported **raising educators' awareness and knowledge** of math and were in **early implementation** of new math teaching practices

A Closer Look at Educator Outcomes in Two Communities

Two case studies were conducted to understand the planning and implementation of professional learning and coaching in local communities. The following examples highlight specific educator outcomes in these two communities.

Spatial Learning for All

In a large, urban county, three facilitators engaged 14 early childhood teachers, 27 family child care providers, and nine elementary teachers in professional learning on spatial reasoning. At the end of their participation, educators reported:

- Increased knowledge in all areas of math, with the largest growth in spatial reasoning
- Increased confidence in supporting spatial reasoning
- Increased frequency of spatial reasoning teaching practices
- More spatial language and concepts incorporated into daily routines, play, and activities

Coding and Beyond

In a small, rural county, four facilitators engaged 27 preschool teachers in professional learning and coaching on coding and robotics, number sense, measurement, geometry, and mathematical reasoning. At the end of their participation, teachers reported:

- Increased knowledge in all areas of math, with the largest growth in coding and robots
- High level of confidence in supporting early math
- Various coding, number sense, and geometry materials, interactions, and activities incorporated all throughout the learning environment

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Early Math Resources for Families and Educators

Literacy Activities to Build Math Concepts

Fifty-seven children's books with early math content are featured in a collection of book reviews with prompts for families and educators on how to read the book to promote early math understanding. Each book review also includes one or more activities designed to engage children in math through play in ways that relate to the content in the book. The books and related book reviews cover a wide variety of math areas for children birth to age eight. The book reviews and related activities are available for free on the Early Math Project website as well as on the Count, Play, Explore app.

Videos to Raise Awareness of Early Math

The **"I'm Ready!" Videos** are a series of creative videos to raise adults' awareness of ways they can support children's math knowledge and skills in daily routines and activities. These videos are accessible in English and Spanish.

Count, Play, Explore App

This early math app houses the videos and other resources and makes them easily accessible to educators and families.

Online Resources to Support Early Math

This review includes a compilation of over 40 online early math resources (e.g., articles, activities, videos) available for free.

Each resource includes a short description about the target age level (e.g., infants, toddlers, preschool, early elementary), the audience group (educators or families), and the math areas addressed.

Research Briefs on How Early Math Develops

Four briefs on the topics of arithmetic; counting; geometry and spatial reasoning; and engaging families summarize the research on children's learning and development of early math from infancy to the early elementary years. The briefs also provide age-specific strategies to support children's early math development. The briefs are available in English and Spanish.

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Family Engagement

Lighthouse FOR CHILDREN

Many of the family engagement resources and activities to support early math were piloted at the Lighthouse for Children Child Development Center.

Interactive Math Exhibits

Interactive math exhibits were set up in the entryway of the Lighthouse, where parents and children could engage in unique hands-on math activities at drop-off or pick-up time. For example, a wind tunnel was set up, and families constructed objects to see if, and how, they would float. Another exhibit allowed families to measure the heights of people and animals using various objects.

Family Math Night

Family Math Night at the Lighthouse provided families with strategies for engaging children in math at home using the children's book reviews and activities developed by the initiative. The opening session shared tips with parents on how to engage children in math thinking during reading time. Parents and children then participated in a variety of early math activities that spanned the birth to eight continuum and addressed different math areas.

What did the parents say?
94% of parents agreed that Family Math Night:

- Provided ideas for math activities to do at home
- Taught them how to talk about math during everyday activities
- Built their confidence in supporting their child's math learning

M.A.T.H. Packs at Home

The Math Activity Take Home (M.A.T.H.) Packs were created to equip families with ideas and materials to engage their children in math activities at home. Each M.A.T.H. Pack contained a children's book and the associated book review, activities, and materials to guide at-home early math experiences.

What did the parents say?
Survey results indicated:

- Children were very interested in the M.A.T.H. Packs activities.
- Parents found the M.A.T.H. Packs helpful in supporting children's math learning.

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Conclusion

This brief summarized the CAEMI components of professional learning and coaching, math resources, and family engagement. This conclusion provides an overview of the overall efficacy, engagement of diverse participants, feasibility, and sustainability of the initiative.

Efficacy of the Initiative

The CAEMI has made significant progress toward its goals in raising awareness of math, promoting positive math identities, and building the confidence and capacity of adults to support early math.

Agency facilitators reported improvements in confidence in their knowledge of children's math development, math teaching skills, and math training and coaching skills. Many also reported more positive math identities after participating.

Educators in the two case studies similarly reported an increase in their knowledge of all math areas and confidence in supporting early math. In addition, they shared many examples of implementing new math teaching practices and activities.

Families were supported by the CAEMI through a range of resources, such as children's book reviews, activities to do at home, videos, and a math app. Preliminary data from the Lighthouse demonstration site show that the resources built their confidence and knowledge of how to support their child's math learning.

Engagement of Diverse Agencies and Participants

Agencies included county offices of education, school districts, and nonprofit organizations across the state. They were intentionally selected to participate, with consideration of providing access to underserved populations, such as those working with tribal communities or family child care providers. All agencies reported serving low-income families, and many agencies served children who are DLLs and students with disabilities.

In addition, facilitators brought with them a range of experience and expertise. Some had strong training and coaching backgrounds, while others had solid math content knowledge. Others had less experience in these areas. The professional learning and coaching supported these diverse participants to make growth in their areas of need. In addition, 58% of agency facilitators were women of color, a group that has traditionally been underrepresented in the STEM field.[12]

Feasibility of the Initiative

The initiative was designed to support feasibility of implementation. The **flexibility of grant requirements** served the agencies well, allowing them to create professional learning and coaching to meet the needs of their communities. The flexibility of the grant requirements led to rich variation in implementation plans. Some agencies even exceeded grant requirements by serving more educators or offering additional professional learning and coaching opportunities.

Even prior to the COVID-19 pandemic, CAEMI featured **virtual supports** for agencies. The monthly coaching and COP were offered using video conferencing. This virtual engagement served as a model for how facilitators could engage educators during the COVID-19 pandemic.

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Sustainability of the Initiative

Overall, the CAEMI built agency capacity and developed concrete math resources that can extend long after the initiative. Agencies developed their capacity to train early childhood educators using adult learning strategies. Many of the tools agency facilitators learned through the initiative, such as engaging educators in hands-on math experiences, were implemented in their local communities and can be carried forward to future work to support children's early math. In addition, the early math app and math resources will provide some sustainable support for educators and families to integrate math into their everyday routines and activities.

Continued investment in professional learning, coaching, and early math resources is essential to sustain and extend educators' capacity to promote children's early math learning in local communities.

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