DISCLAIMER
Any content or opinions expressed in this webinar are not that of the U.S. Department of Education nor an endorsement of any products, program, or policies mentioned herein.

QUESTIONS patti.curtis@ed.gov
Submit questions to: patti.curtis@ed.gov
Christina Chhin, PhD  
christina.chhin@ed.gov

My Background:
• BA in Psychology → MS → PhD in Human Development and Family Studies
• Research Area: Gender differences in math & science achievement; Role of parent and peer socialization on academic and social outcomes
• Program Officer, STEM Education at IES/NCER for 14 years

Sarah Brasiel, PhD  
Sarah.Brasiel@ed.gov

• My Background:
• PhD in Mathematics Education
• Prior K-12 Math, Science and Special Education Teacher (18 years), college faculty/instructor (4 years)
• Research Area: STEM teacher professional development, STEM interventions for students with or at risk of disabilities, Education Technology
• Program Officer, STEM in Special Education at IES/NCSER for 4 years
Early Math Resources and Funding Opportunities at the Institute of Education Sciences

Sarah Brasiel  
National Center for Special Education Research

Christina Chhin  
National Center for Education Research
What Works Clearinghouse Practice Guides

Teaching Math to Young Children
This practice guide provides five recommendations for teaching math to children in preschool, prekindergarten, and kindergarten.

Resources for Educators of Young Children

Developing Fractions Instructions for K-8
This practice guide presents five recommendations intended to help educators improve students’ understanding of fractions.

Resources for K-8 Educators
Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools:
Taking early action may be key to helping students struggling with mathematics.

Resources for Educators

Coming in Early 2021 - Assisting Students Struggling with Mathematics: Interventions in the Elementary and Middle School Grades

Encouraging Girls in Math and Science
The objective of this guide is to provide teachers with specific recommendations that can be carried out in the classroom without requiring systemic change.
## 26 Results filtered by:

<table>
<thead>
<tr>
<th>Evidence of effectiveness</th>
<th>Intervention</th>
<th>Grades examined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Teach for America (TFA)</td>
<td>K-12</td>
</tr>
<tr>
<td></td>
<td>Pre-K Mathematics</td>
<td>PK</td>
</tr>
<tr>
<td></td>
<td>Building Blocks for Math (SRA Real Math)</td>
<td>PK</td>
</tr>
<tr>
<td></td>
<td>Lindamood Phoneme Sequencing® (LiPS®)</td>
<td>1-4</td>
</tr>
<tr>
<td></td>
<td>Everyday Mathematics®</td>
<td>3-5</td>
</tr>
<tr>
<td></td>
<td>DreamBox Learning</td>
<td>K-1</td>
</tr>
<tr>
<td></td>
<td>Literacy Express</td>
<td>PK</td>
</tr>
</tbody>
</table>
Additional Resources

- IES STEM page
- A Compendium of Math and Science Research Funded by NCER and NCSER: 2002–2013
- Mathematics Reports and Resources from the Regional Educational Laboratories (RELs)
# Early Math Grants Funded by NCER & NCSER

<table>
<thead>
<tr>
<th>Grades</th>
<th># of Math Grants</th>
<th>Budget Total</th>
<th># of Math Grants</th>
<th>Budget Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades PK-3</td>
<td>123</td>
<td>$223,576,470</td>
<td>33</td>
<td>$68,785,141</td>
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<tr>
<td>Grades 4-Adult</td>
<td>187</td>
<td>$313,962,801</td>
<td>24</td>
<td>$44,249,009</td>
</tr>
<tr>
<td>Total Math Grants</td>
<td>310</td>
<td>$537,539,271</td>
<td>57</td>
<td>$113,034,150</td>
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</tbody>
</table>
Funding Opportunities
## FY2021 IES Grant Competitions

<table>
<thead>
<tr>
<th>National Center for Education Research (NCER)</th>
<th>National Center for Special Education Research (NCSER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Training Programs in the Education Sciences (84.305B)</td>
<td>Research Training Programs in Special Education (84.324B)</td>
</tr>
<tr>
<td>Research Grants Focused on Systematic Replication (84.305R)</td>
<td>Research Grants Focused on Systematic Replication in Special Education (84.324R)</td>
</tr>
</tbody>
</table>

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**Note:** The table above lists the FY2021 IES Grant Competitions organized by the NCER and NCSER. Each program is identified by its Federal Award Number (FAA).
## Important Dates for Research Grant Programs

<table>
<thead>
<tr>
<th>Application Deadline (Grants.gov)</th>
<th>Letter of Intent Due Date (iesreview.ed.gov)</th>
<th>Application Package Posted (Grants.gov)</th>
<th>Start Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 20, 2020 No later than 11:59:59 p.m. Eastern Time</td>
<td>June 11, 2020</td>
<td>June 11, 2020</td>
<td>July 1, 2021 to Sept 1, 2021</td>
</tr>
</tbody>
</table>
• I’m the founding Executive Director of CME Group Foundation. The Foundation is affiliated with CME Group, the world’s largest and most diverse futures exchange.

• My mother was a kindergarten and first grade teacher. She instilled a love of math in me at an early age.

• I have a BA in Retail Merchandising from Stephens College and an MBA in Marketing from Loyola University Chicago.

• I spent the first half of my career in fashion merchandising, using math everyday.

• I’ve been fortunate to spend the second half of my career in grantmaking – corporate, community foundation and state government.
Sparking System-wide Change to Help Students from Cradle to Career
Our Mission

CME Group Foundation strives to empower future generations through education, equipping today’s students to meet tomorrow’s challenges. They will shape the future of the world’s most important industries – including our own – so we give them the tools they need to achieve their full potential, including:

• Ensuring disadvantaged young children become proficient at math at the appropriate grade or developmental level;

• Providing low-income K-12 students with computer science and financial education;

• Using technology to personalize learning and improve outcomes for disadvantaged students; and

• Helping low income students succeed in college and career.
CME Group Foundation Early Math Education Initiative

**Rationale:** 2008 research indicated preschool children’s knowledge of math predicts later school success into high school and is a better predictor of later reading achievement than early reading skills. An NSF report indicated preschool and elementary teachers math content and pedagogy knowledge was quite limited.


The Foundation has invested over $11 million through 2020 in:

- Professional Development for Teachers of Young Children
- Family Engagement in the Math Learning of Young Children
- Influencing Early Childhood Mathematics Policies
- Early Childhood Teacher Preparation in Mathematics
Early Math Initiative – What Did We Learn?

• “It All Adds Up” report by Voices for Illinois Children 2014

• PD should be intensive and sustained.

• PD should include teams of teachers from the same schools and grade levels.

• Principals/school leaders should participate in PD, too.

• Coaches should provide in class support and reflection.

• Schools should provide time for teachers to participate in professional learning communities within their schools.
Elementary Math Specialist Pilot Program

• Initiated by CPS Office of Mathematics in 2016.

• After several years of train-the-trainer PD with university partners for CCSS–Math, CPS wanted to launch a pilot.

• CPS, DePaul University, UChicago and University of Illinois Chicago planned a 5 semester, 7 quarter curriculum.

• Each university trained 15 teachers in the two-year pilot. Teachers were selected by their principal.

• Universities met monthly with CPS and the Foundation to align their work.
EMS Landscape Study Design

• Mixed methods, quantitative and qualitative

• Three surveys
  - EMS District Survey
  - EMS School Survey
  - EMS Teacher Cohort Survey

• Interviews with key Illinois stakeholders
  - Educator organizations
  - Regional Offices of Education/Intermediate Service Centers
  - Universities

• Interviews with EMS leaders in other states
  - California
  - Maryland
  - Oregon
  - Pennsylvania
EMS Cohort Teachers Collaborating and Supporting Colleagues

Teacher Survey

I feel more confident to collaborate with other teachers about mathematics teaching and learning. 84% Strongly Agree 16% Agree

I feel more prepared to help a peer teacher with a math lesson. 84% Strongly Agree 16% Agree

I have gained useful information that will help me work productively with other teachers to improve mathematics teaching and learning. 80% Strongly Agree 20% Agree

I feel more confident to advocate for supports teachers in my building need to improve mathematics instruction. 76% Strongly Agree 24% Agree

I feel more prepared to support other teachers’ teaching of mathematics. 76% Strongly Agree 24% Agree
Overwhelming District Support for Elementary Mathematics Specialist Endorsement

District Survey

- 86% Support
- 14% No Support
School Leaders Indicated Illinois Should Offer the Elementary Mathematics Specialist Endorsement

School Survey

- 90% (Yes)
- 10% (No)
Elementary Math Specialist Program Today

• UChicago presented the Landscape Study to the Illinois State Board of Education (ISBE) in February. ISBE agreed to consider micro-credentials (endorsements) for EMS and EMT.

• UChicago is designing a report to present to a wider audience later this year.

• DePaul University, UChicago and University of Illinois Chicago and Governors State University are all training cohort 2 and pivoted to remote instruction in March.

• CPS has convened a PLC of cohort 1 teachers for monthly meetings and bi-monthly meetings with their principals and a teacher colleague.
A Decade in the Making: Early Math Education Initiative Seeks Broad Impact. Principles for Effective Education Grantmaking. Case Study No. 18

To learn more about our grantees, please visit cmegroupfoundation.org or contact a member of our team.
Jennifer McCray, Ph.D.
Associate Research Scientist
Principal Investigator, Early Math Collaborative
Erikson Institute
jmccray@erikson.edu
https://earlymath.erikson.edu

• Former preschool teacher and devotee of cognitive developmental science
• Got my master’s and doctoral degrees both at Erikson….I just never left!
• Love to walk, cook, and read
• Got a birdbath for Mother’s Day and am trying to become ornithologically aware, but it is slow going
• Married to a social worker, with two daughters—one is just post-college and is the horse wrangler at a summer camp, the other will be a high school junior next year and just received her driver’s permit
• Pandemic-inspired new hobbies include gardening and sketching
Why Does Early Math Matter?

Department of Education STEM Webinar
July 8, 2020

Jennifer McCray, Ph.D.
Associate Research Scientist
Principal Investigator, Early Math Collaborative
Why does early math matter?
Positive outcomes in math strongly predict a wide variety of other good outcomes

- Number System Knowledge
- Functional Numeracy
- Retention Rate
- Employability and Wages

1st Grade

7th Grade

High School

Adulthood

(Geary, et al., 2013)
Power of math to predict outcomes begins early

Kindergarten entry

Early reading skills

Early math skills

3rd to 8th grades

Later reading achievement

Later math achievement

(Duncan, et al., 2007)
Access to mathematics in the United States varies along socio-economic lines

Math Scores At Kindergarten Entry in the U.S.

Average Math Scale Scores (ECLS-B)

(Denton Flanagan & McPhee, 2009)
Things we can do to improve early access to math

• Enhance early childhood teacher preparation and support

• Work to shift attitudes
What is “early math?”
Which of the figures below are the same?
How many?

#unitchat
Things we can do to improve early access to math

• Enhance early childhood teacher preparation and support

• Work to shift attitudes
Let’s talk about teacher preparation and support.

I love children, but I hate math....

That’s ok, you can teach early childhood. The math there is just numbers and shapes....

Good thinking. I can do first and second grade math, no problem!

Well-meaning teacher educator

Honest applicant to teacher ed program
Pedagogical Content Knowledge (PCK): A Different Kind of Content Knowledge

(Shulman, 1986, 1987)
• What is the best model, analogy, or representation to get this new idea across?
• Which student questions and comments are more likely to generate discussion that is helpful for everyone?
• What are the likely mistakes a learner may make while learning this material, and how can I use those errors to enhance everyone’s learning?
Improving preparation of and support to teachers

“three” = \[\text{blocks} \] = 3
Attitudinal shifts

I’m just not a “math person.”
I'm too pretty to do math.

Early Math Collaborative
Reading = Girl

Math = Boy

(Beilock, et al., 2010)
A

**Teacher Math Anxiety**  \[\beta = -0.21^*\]  \[\rightarrow\]  **Girls’ Math Achievement**

B

\[\beta = 0.31^*\]  \[\rightarrow\]  **Gender Ability Beliefs**  \[\beta = -0.23^*\]  \[\rightarrow\]  **Girls’ Math Achievement**

\[\beta = -0.16, ns.\]

*P < 0.05

(Beilock, et al., 2010)
The need to reduce ANXIETY about mathematics

25% of students in four-year colleges and 80% of students in community colleges report moderate to high math anxiety (Chang & Beilock, 2016)

Children as young as six can suffer from math anxiety (Ramirez, et al., 2016)

Math anxiety interferes with access to working memory, and impedes math performance (Ramirez, et al., 2016)
Families, math anxiety and math achievement

• Children as young as preschool are susceptible to gender stereotypes in math (Ambady et al., 2001)
• Parents’ anxiety plays a role in children’s math anxiety and the variables interact to predict several math education outcomes, including math self-efficacy, math GPA, math behavioral intentions, math attitudes, and math devaluing (Casad, Hale & Wachs, 2015)
• Interventions involving parents and children together can have powerful lasting effects on children’s academic achievement (Berkowitz, et al., 2015; Schaeffer, Rozek, Berkowitz & Levine, 2018)
Look for (and enjoy!) math in everyday tasks
Play math games!
Thanks for listening.....

Now go have some fun with math!!

FOR MORE INFORMATION: Jennifer McCray
jmccray@erikson.edu
https://earlymath.erikson.edu
Lynn S. Fuchs, Ph.D.
Vanderbilt University (lynn.fuchs@vanderbilt.edu)

- **Areas of expertise**
  - Learning disabilities
  - Mathematical cognition
  - Classroom assessment
  - Academic intervention

- **Interesting experience**
  - As a member of the 2007 U.S. Presidential delegation to the World Special Olympics, I spent a week in Shanghai with Margaret Spellings (Secretary of Education), Michelle Kwan (ice skating champion), and Ernie Banks (National Baseball Hall of Fame; Chicago Cubs).
Intervention to Build

*Early Understanding of Fractions*

A Second Wave of Foundational *Early Math*

IES STEM Briefing

Lynn Fuchs
Vanderbilt University
July 8, 2020

IES R324D130003
Understanding of Fractions: A Second Wave of Foundational Early Math

- At preschool and the primary grades, a major focus of early math is whole numbers.

- Even when the preschool and primary-grade focus on whole numbers is strong, the whole-number achievement gaps of children with mathematics learning disabilities (MLD) widen over time.

- The vulnerabilities associated with MLDs, along with these children’s widening whole-number achievement gaps, make them vulnerable to severe difficulty with a second wave of foundational early math.
Fractions:
A Second Wave of Foundational *Early Math* at Third Grade

- This occurs at third grade, when schools first allocate systematic, sustained attention to the meaning of fractions.

- Yet, the dominant model in intervention for students with MLD involves remediation of skill deficits. Support for learning grade-level content is rarely provided.

- Without support for early understanding of fractions at third grade, students with MLD enter fourth grade with debilitating gaps in fraction knowledge, which can undermine long-term success in school mathematics and the work force.
In 2013, the IES National Center on Special Education Research (NCSER) funded the A3 Initiative to develop *Next-Generation Interventions* for students with learning disabilities.

One of the A3 goals is to address challenging academic standards, like fractions in third-grade intervention. The hope is that students with MLD complete third-grade intervention with fraction performance in the range of typically developing classmates.

In my portion of today’s briefing, my focus is the A3 randomized controlled trial that assessed the efficacy of this third-grade fraction intervention.

I’ll briefly summarize the nature of the intervention, the research design for studying its efficacy, and what we learned about teaching challenging fractions content in third-grade intervention for this population.
The A3 Fraction Intervention

- Major instructional focus is fraction magnitude understanding.
  - Students connect & apply understanding of individual fraction magnitudes to compare and order fractions, place fractions on number lines, find fraction equivalencies, and solve word problems that involve fraction comparisons & fraction addition and subtraction.

- Instruction relies on learning principles for building understanding & strategic competence. This includes, for example,
  - Teaching students to understand problems as belonging within problem types
  - Introducing solution strategies with worked examples
  - Providing cumulative review with a mix of problem types
  - Teaching students to use strategies to check the reasonableness of answers
  - Having students use goal-setting and monitoring strategies take turns to explain their thinking as they solve problems
The A3 Fraction Intervention Efficacy Study: Overview of Methods

- 3rd-grade students, with very low whole-number skill, were randomly assigned to
  - Receive the A3 fraction intervention or
  - Continue in their typical school program (including the school’s math intervention for some students).

- The A3 fraction intervention was conducted in small groups 3 times per week for 35 minutes per session over 13 weeks.

- To index achievement gaps at the end of intervention, we included a follow-along sample of not-at-risk classmates.

- Students completed fraction measures before and after intervention.
What We Found

- The fraction outcomes of students with MLD who received the A3 intervention were statistically significantly and dramatically stronger than those of students with MLD in the control group.

- Effect sizes (ESs*) were large (~1.0 for each outcome measure).
  - Multiplication, a whole-number foundational skill needed for success with fractions (ES = 1.06)
  - Estimating where fractions go on a number line: (ES = 1.03)
  - Ordering 3 fractions (ES = 1.13)
  - Fraction word problems (ES = 0.88)
  - Fraction addition & subtraction (ES = 1.00)
  - Released NAEP items (the study’s far-transfer measure) (ES = 1.29)

*An ES of 1.0 indicates the average posttest score for A3 students was 1 SD higher than the control group’s mean (e.g., On tests scaled with mean of 100 and SD of 15, a mean standard score of 100 for the intervention condition vs. 85 for the control group).
What about the End-of-Third-Grade Fraction Achievement Gap?

- The mean achievement gap closed for the MLD intervention group. Their end-of-study fraction performance was commensurate with their non-MLD classmates’ performance.

- By contrast, the mean achievement gap of the MLD control group remained substantial: 0.85 SDs.
Conclusions

- This study supports the efficacy of this A3 intervention for addressing “second wave of early math” by
  - Demonstrating significantly and substantially stronger fraction knowledge compared to the MLD control group
  - Demonstrating that students complete intervention with dramatically narrowed achievement gaps
Importance

- The mathematics curriculum includes a series of “waves” that represent major shifts in mathematics content. Here, the shift is from whole to rational numbers; another big one is algebra.

- Without dedicated intervention on these shifts at the time they’re incorporated into the school curriculum, MLD students accumulate a network of faulty mathematical platforms that undermine school and work success.

- This was demonstrated in the A3 study with the substantial fraction knowledge gaps of MLD control group students as they prepare to enter fourth grade.

- More broadly, findings of this A3 study suggest that students with MLD can succeed with challenging mathematics standards, when they receive high quality, structured intervention.
CHRISTINA CHHIN, PH.D.
NATIONAL CENTER OF EDUCATIONAL RESEARCH

SARAH BRASIEL, PH.D.
NATIONAL CENTER FOR SPECIAL EDUCATION RESEARCH

KASSIE DAVIS
CME FOUNDATION

JENNIFER MCCRAY, PH.D.
ERIKSON INSTITUTE

LYNN FUCHS, PH. D.
VANDERBILT UNIVERSITY
UPCOMING STEM WEBINARS

- Cyber Education – August 25, 1:30-3PM ET