



Early Math

July 8, 2020



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QUESTIONS

patti.curtis@ed.gov





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Christina Chhin, PhD
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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
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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/NCER for 4 years

Early Math Resources and Funding Opportunities at the Institute of Education Sciences

Sarah Brasel
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

What Works Clearinghouse Practice Guides (cont.)



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.

Find What Works based on the evidence



Filter by topic

Literacy

Mathematics

Science

Behavior

Children and Youth with Disabilities

English Learners

Teacher Excellence

Charter Schools

Early Childhood

26 Results filtered by:

Mathematics x PK x K x 1 x 2 x 3 x

Evidence of effectiveness	Intervention	Grades examined	Compare
	Teach for America (TFA)	K-12	<input type="checkbox"/>
	Pre-K Mathematics	PK	<input type="checkbox"/>
	Building Blocks for Math (SRA Real Math)	PK	<input type="checkbox"/>
	Lindamood Phoneme Sequencing® (LIPS®)	1-4	<input type="checkbox"/>
	Everyday Mathematics®	3-5	<input type="checkbox"/>
	DreamBox Learning	K-1	<input type="checkbox"/>
	Literacy Express	PK	<input type="checkbox"/>

Additional Resources



- [IES STEM page](#)
- [Synthesis of IES-Funded Research on Mathematics: 2002–2013](#)
- [A Compendium of Math and Science Research Funded by NCER and NCSEER: 2002–2013](#)
- [Mathematics Reports and Resources from the Regional Educational Laboratories \(RELs\)](#)

Early Math Grants Funded by NCER & NCSEER

	National Center for Education Research (NCER) 2002-2019		National Center for Special Education Research (NCSEER) 2006-2019	
	# of Math Grants	Budget Total	# of Math Grants	Budget Total
Grades PK-3	123	\$223,576,470	33	\$68,785,141
Grades 4-Adult	187	\$313,962,801	24	\$44, 249,009
Total Math Grants	310	\$537,539,271	57	\$113,034,150

Funding Opportunities



Funding Opportunities at IES

Learn more about current funding opportunities at the Institute of Education Sciences.

The Institute of Education Sciences supports research that addresses important issues in education and develops solutions that improve school readiness and academic achievement for all students. [Learn more.](#)

Requests
for
Applications

Deadlines

Webinars

FY2021 IES Grant Competitions

National Center for Education Research (NCER)	National Center for Special Education Research (NCSEER)
Research Training Programs in the Education Sciences (84.305B)	Research Training Programs in Special Education (84.324B)
	Research Grants Focused on Systematic Replication in Special Education (84.324R)
Research Grants Focused on Systematic Replication (84.305R)	

Important Dates for Research Grant Programs

Application Deadline (Grants.gov)	Letter of Intent Due Date (iesreview.ed.gov)	Application Package Posted (Grants.gov)	Start Dates
August 20, 2020 No later than 11:59:59 p.m. Eastern Time	June 11, 2020	June 11, 2020	July 1, 2021 to Sept 1, 2021

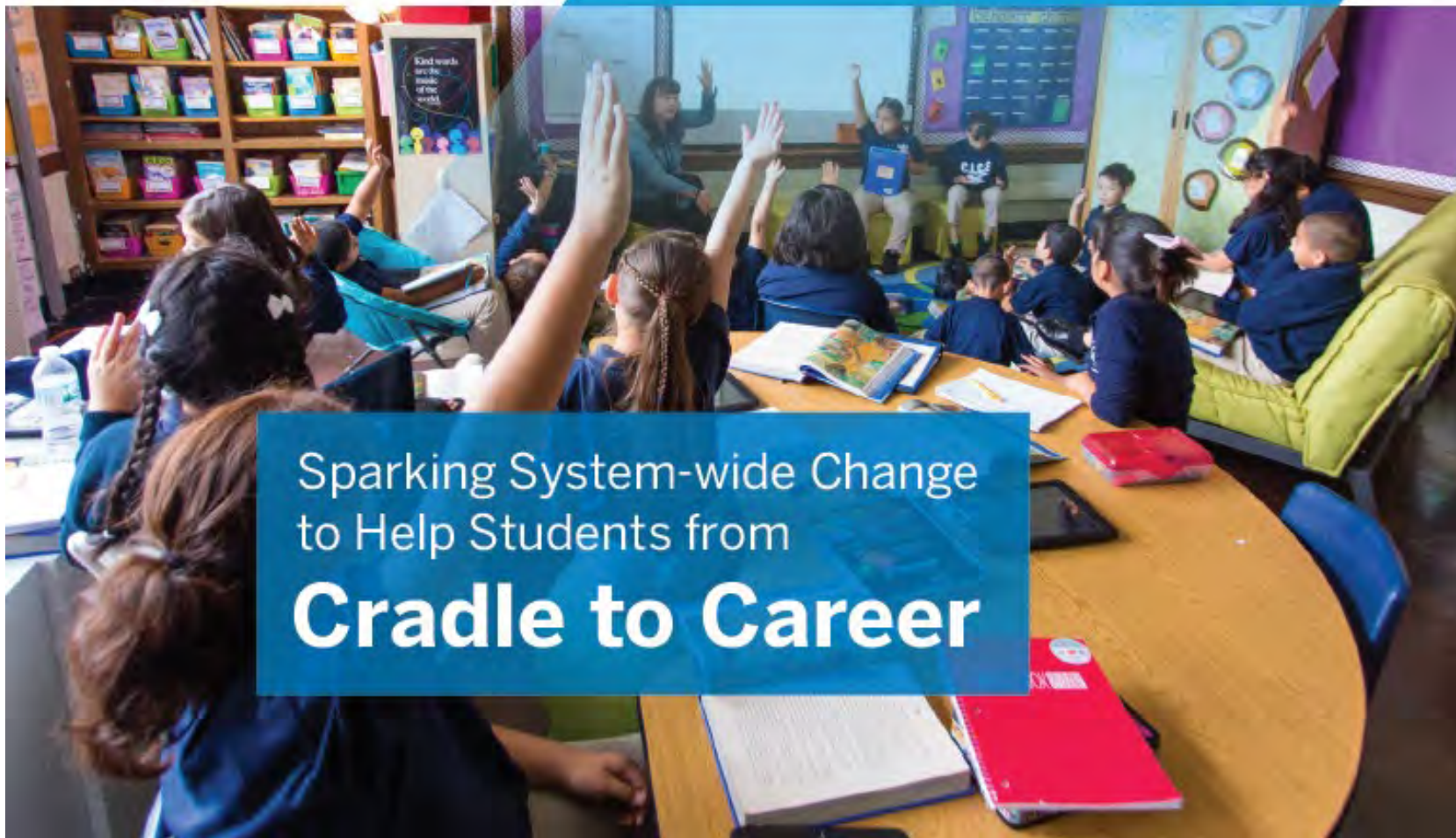
About Me



Kassie Davis

kassie.davis@cmegroup.com

- 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.



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.

CME Group Foundation began funding Early Math in 2008, and officially launched an initiative in 2010.

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

CME Group Foundation's 2018–2019 Early Math Initiative

Why we continue to invest in early math

While progress has been made, 4 in 10 third graders in Chicago are still performing below the national average in math.



Our commitment over the years

\$10.7MM Invested since 2010

Our investment this school year



Our grantees trained **775** educators **in-person**, the majority of whom work in school-based settings.



92% of the educators who trained **in-person** reported **improvement**.

In multiple areas, such as greater **confidence** in teaching early math, improved **pedagogical knowledge**, enhanced early math **instructional practice**, and greater awareness of how to **incorporate math** into their overall education practice.

Over the past 3 years, the CME Group Foundation also funded the creation and development of an innovative online professional development curriculum for early math educators.

9,711 educators were trained **online** through Math at Home, and together they completed **48,558** courses.



Research indicates that the courses had a statistically significant impact on early childhood educators' knowledge, confidence, and practice.



Our grantees supported

519 families

to engage in early math learning.

95%

of families reported increased awareness of everyday activities that can teach math-related skills to their kids.

Our grantees provided professional development opportunities to **39** leaders to help them support their colleagues in early math teaching.

The Early Math Initiative reached **16,623** children



CME GROUP
FOUNDATION

Data source: Arabella Advisors compiled this dashboard using data provided by the CME Group Foundation's 21 early math grantees. All data is from the 2018–2019 school year, except for the Math at Home data, which span from 2016 to 2019. Data about Chicago Public Schools come from its Northwest Evaluation Association Measure of Academic Progress results. For questions about these data, contact Khaira Issaoui-Mansouri at khaira.mansouri@arabellaadvisors.com.

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

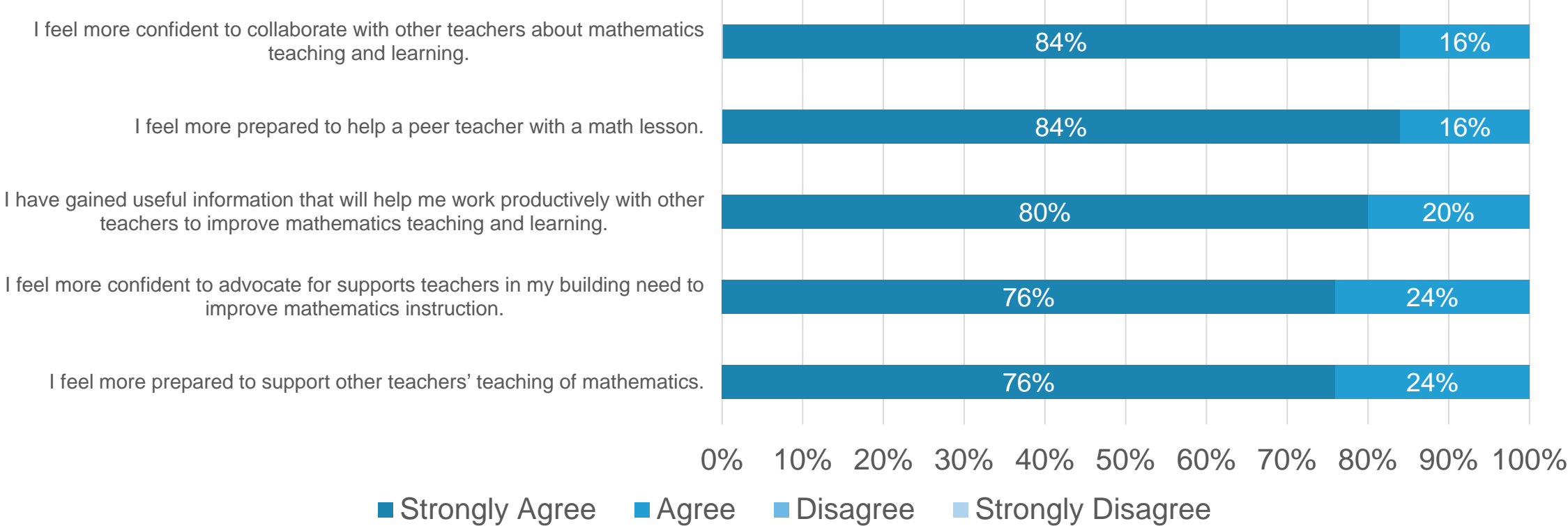
- Initiated by CPS Office of Mathematics in 2016.
- After several years of train-the-trainer PD with university partners for CCSS–Math, CPS wanted to launch a pilot.
- CPS, DePaul University, UChicago and University of Illinois Chicago planned a 5 semester, 7 quarter curriculum.
- Each university trained 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

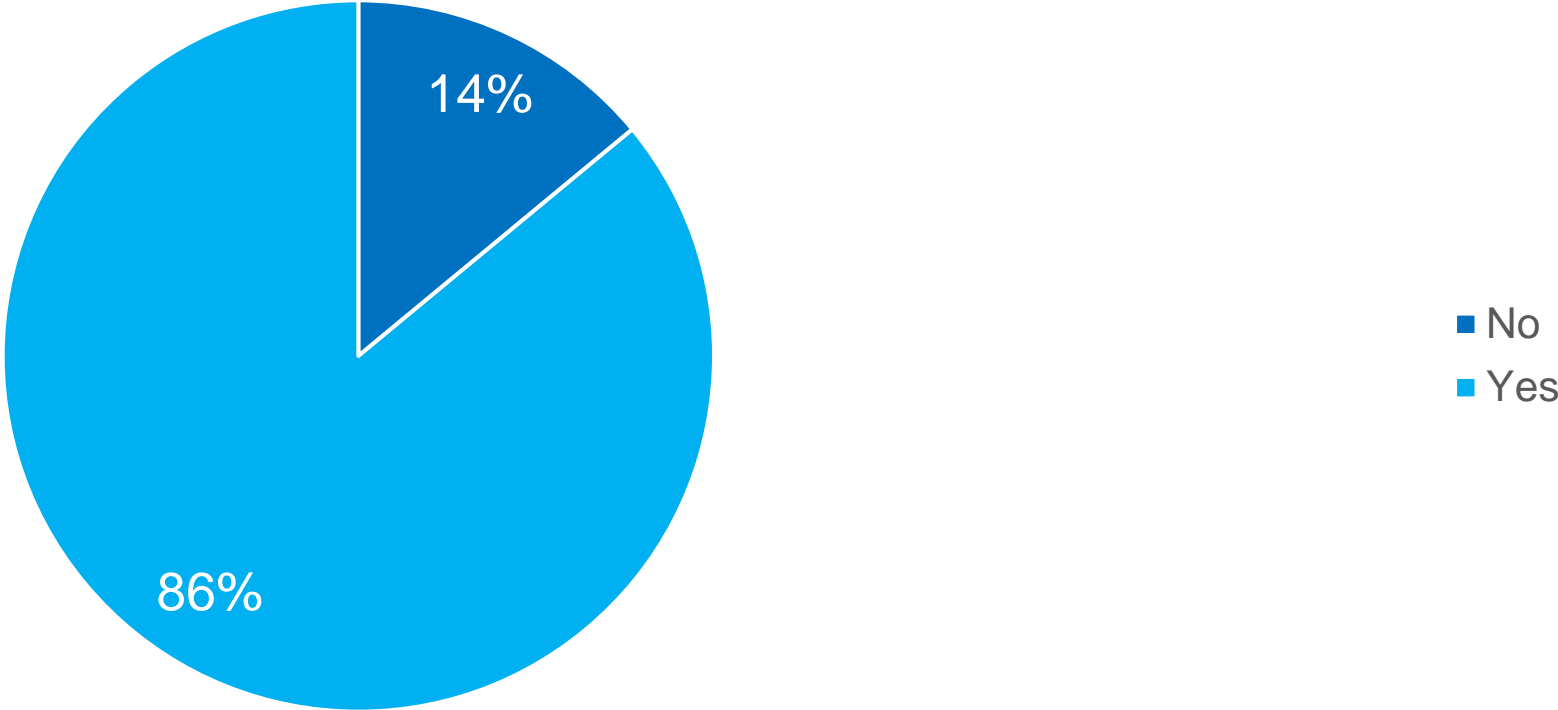
EMS Cohort Teachers Collaborating and Supporting Colleagues

Teacher Survey



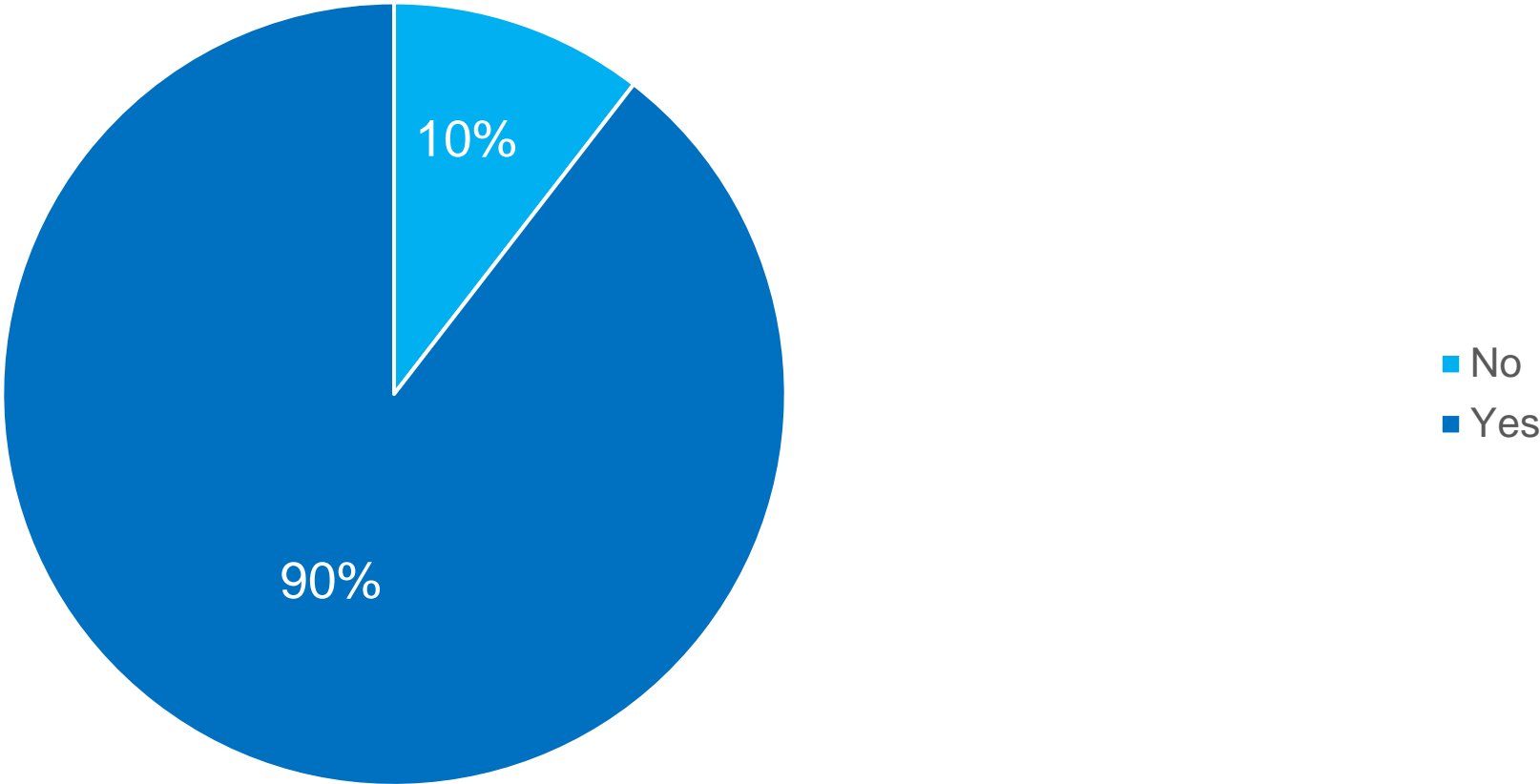
Overwhelming District Support for Elementary Mathematics Specialist Endorsement

District Survey



School Leaders Indicated Illinois Should Offer the Elementary Mathematics Specialist Endorsement

School Survey



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.



To learn more about our grantees,
please visit cmegroupfoundation.org or
contact a member of our team

[A Decade in the Making: Early Math Education Initiative Seeks Broad Impact. Principles for Effective Education Grantmaking. Case Study No. 18](#)



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

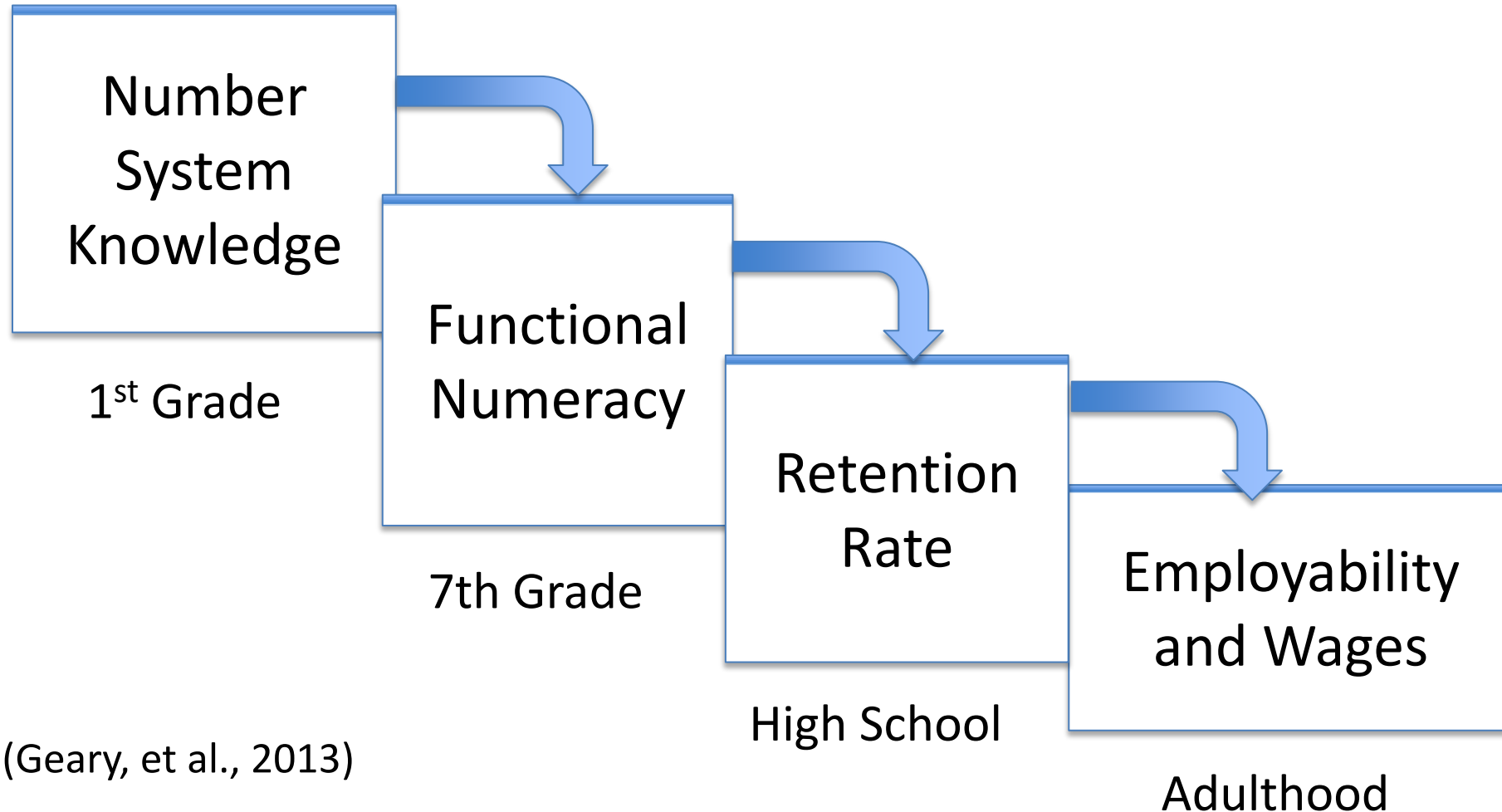
Why Does Early Math Matter?

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



(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

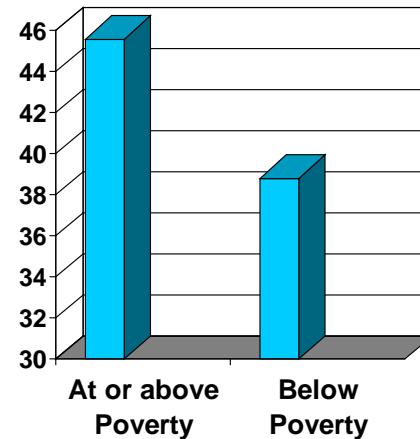
Later **math** achievement

(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?”



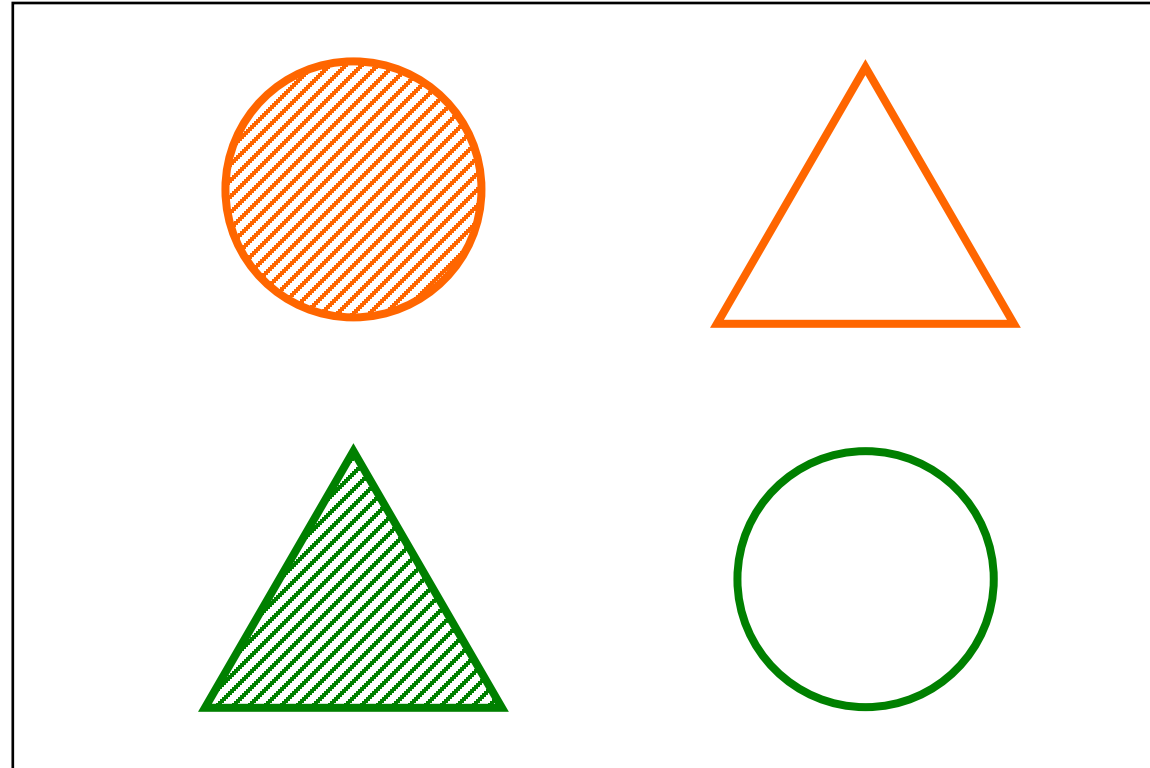
ONE LESS SHEET 6

Circle the number that is **one less** than the number of animals.

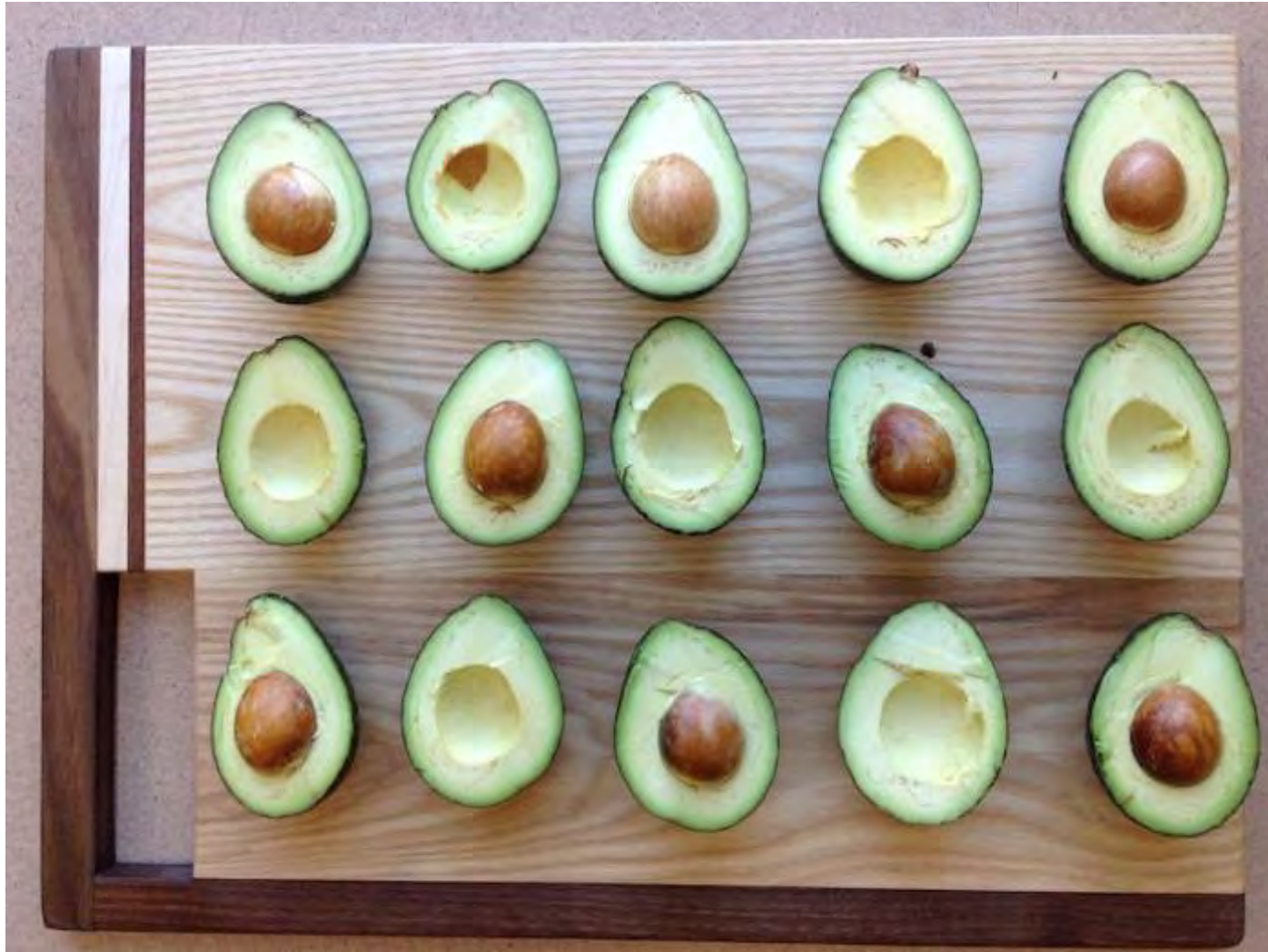
1)		6		4
2)		4	5	6
3)		9	8	7
4)		6		7
		10	9	8

Free Math Sheets, Math Games and Math Help
MATH-SALAMANDERS.COM

*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

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



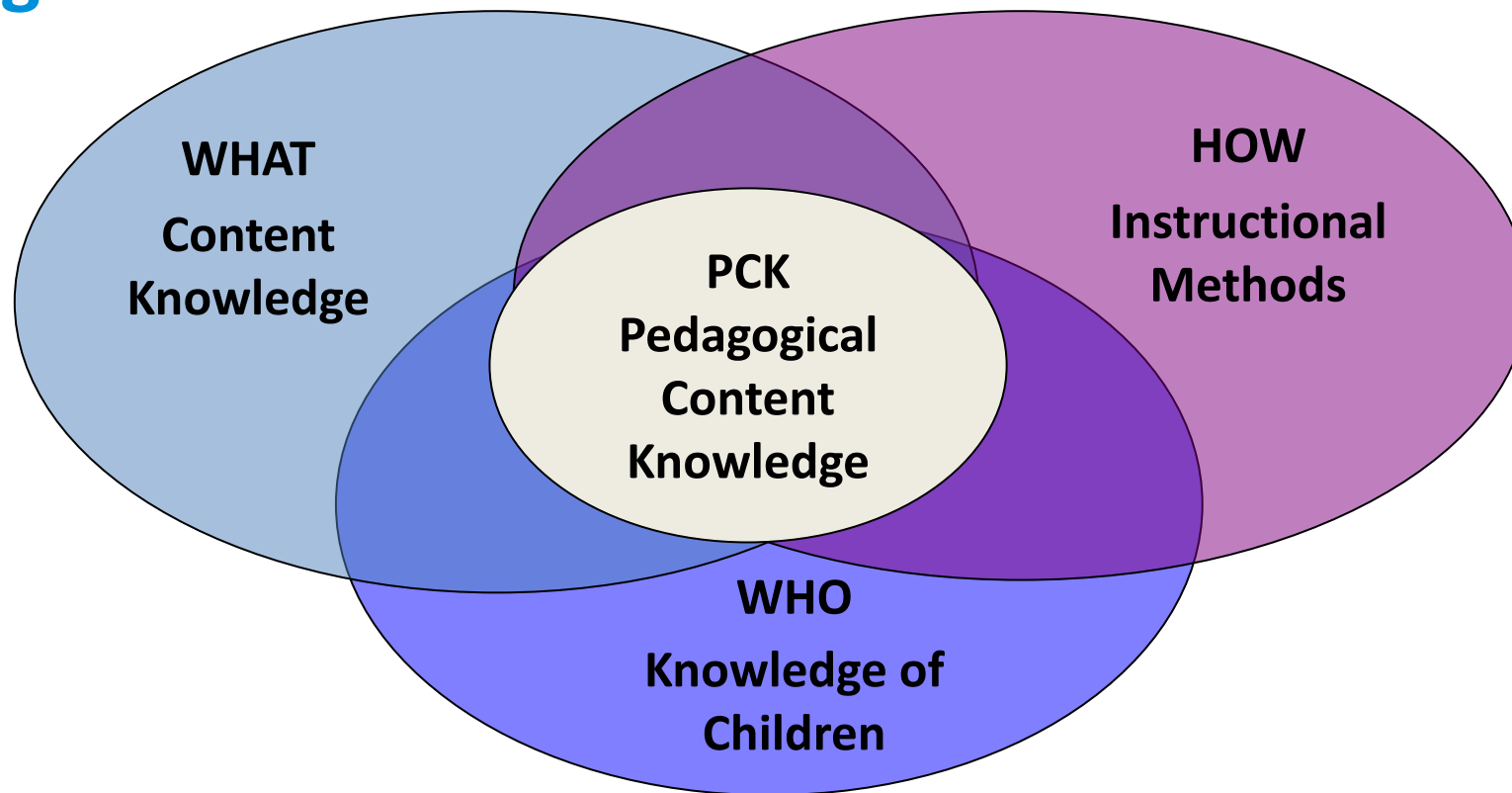
Well-meaning teacher educator

Honest applicant to teacher ed program

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

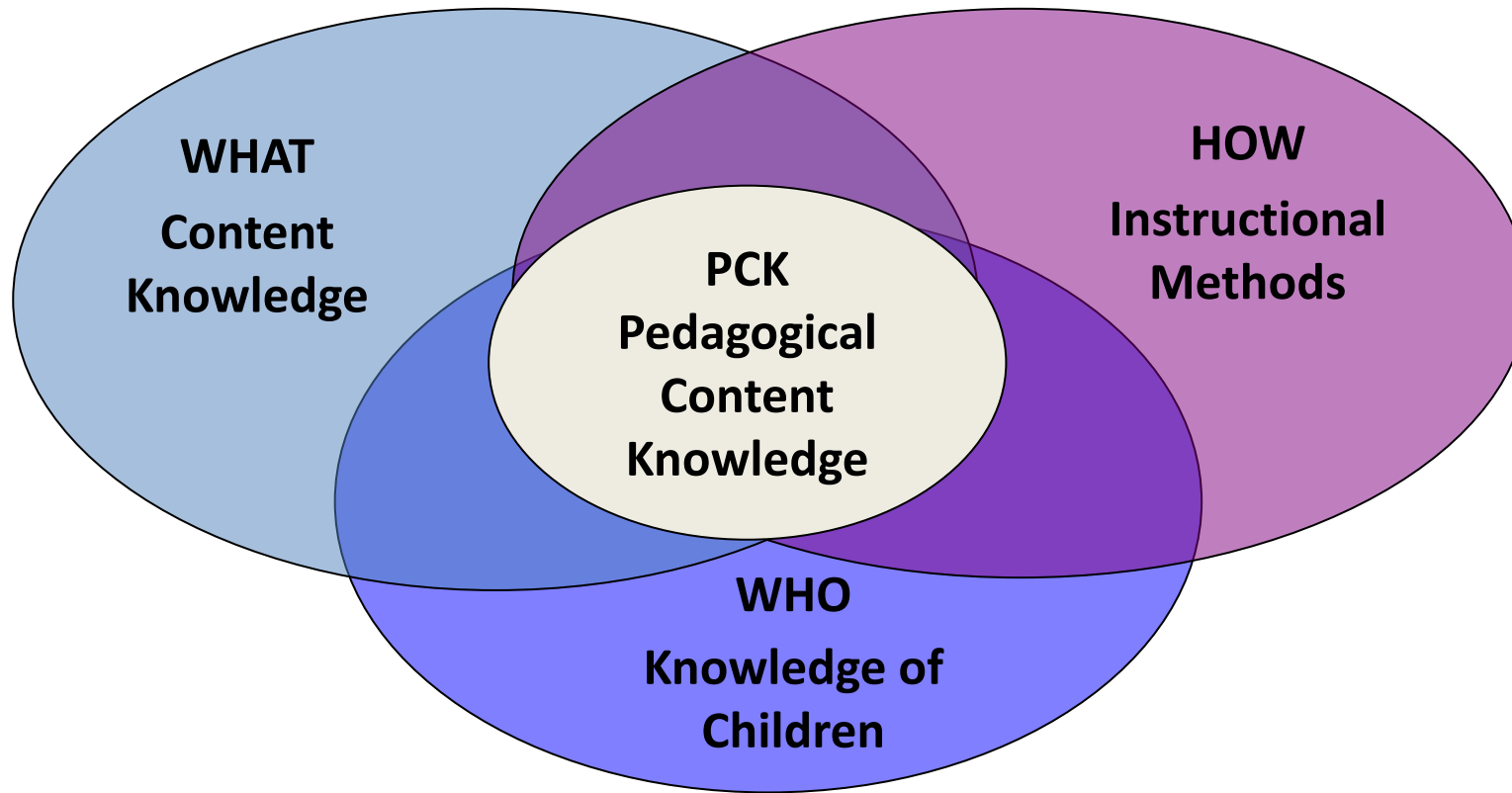
Good thinking. I can do first and second grade math, no problem!

Pedagogical Content Knowledge (PCK): A Different Kind of Content Knowledge



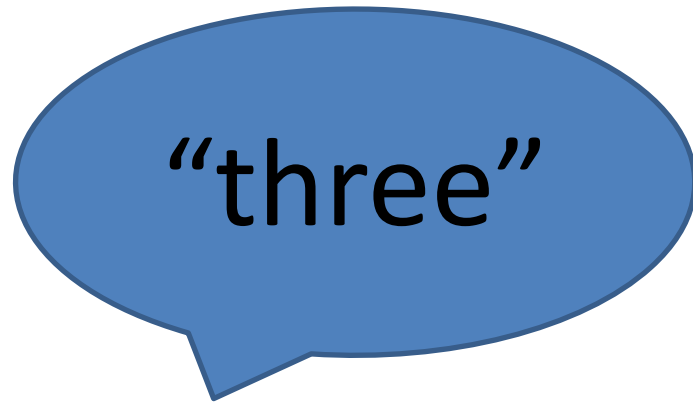
(Shulman, 1986, 1987)



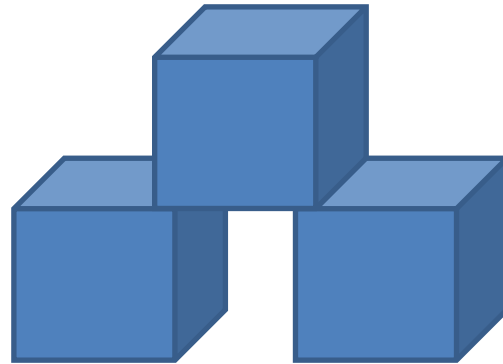


- What is the best model, analogy, or representation to get this new idea across?
- Which student questions and comments are more likely to generate discussion that is helpful for everyone?
- What are the likely mistakes a learner may make while learning this material, and how can I use those errors to enhance everyone's learning?

Improving preparation of and support to teachers



=



=

3

Attitudinal shifts

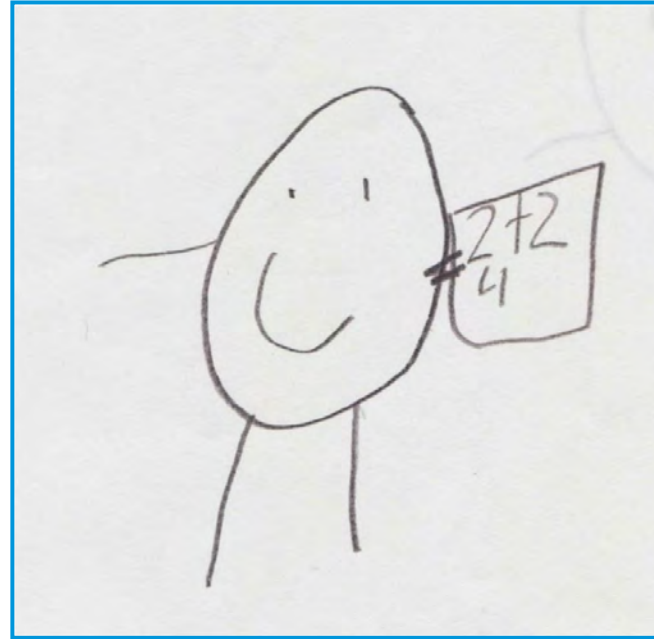
I'm just not a "math person."





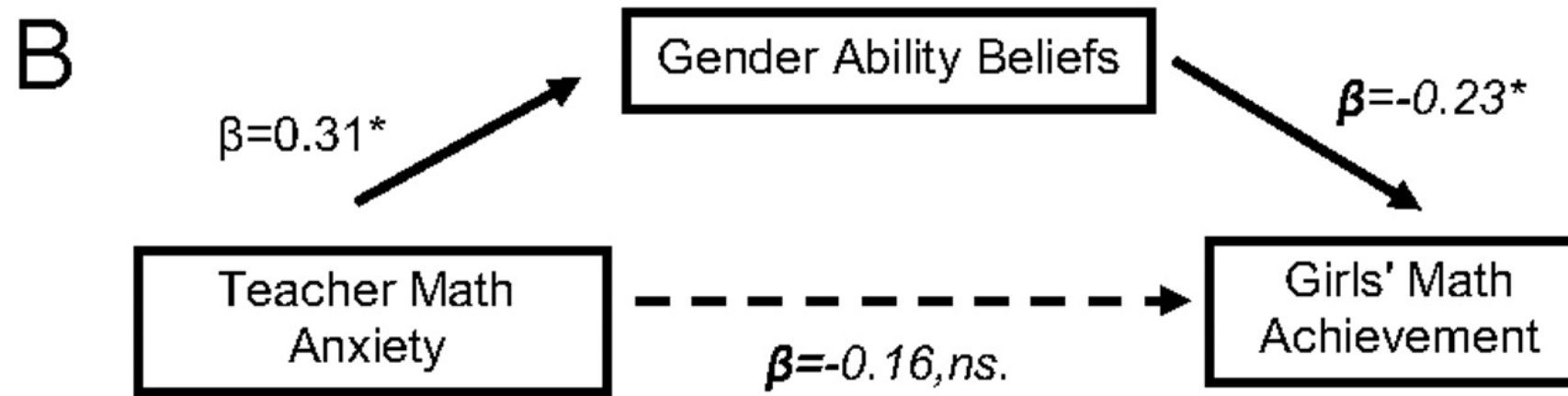
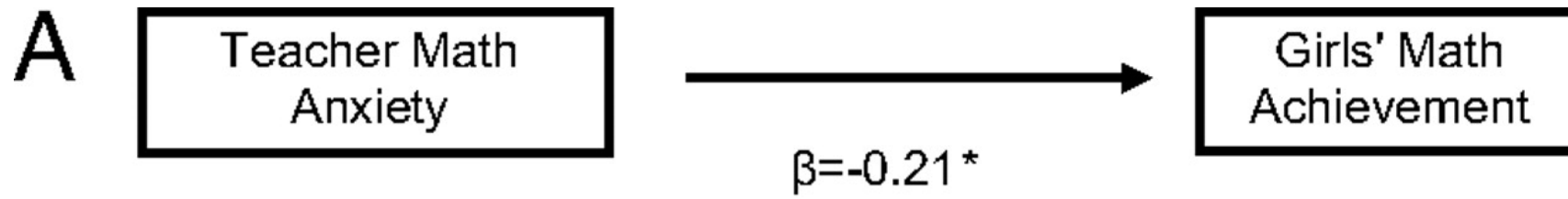


Reading = Girl



Math = Boy

(Beilock, et al., 2010)



* $P < 0.05$

(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



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Play math games!



Thanks for listening.....

Now go have some fun with
math!!!

FOR MORE INFORMATION:

Jennifer McCray

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<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.

The IES NCSEER A3 Initiative and Third-Grade Fractions Intervention

- In 2013, the IES National Center on Special Education Research (NCSEER) 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.



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QUESTIONS



UPCOMING STEM WEBINARS

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

