Building Blocks of Mathematics

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Vision

- Cory puts 4 triangles together to make squares

Vision

Cory makes a new shape: A unit of units!

Another boy sees the square structure, but builds the wrong square

Vision

Finishing, Cory shows adult, who asks: "How many triangles did you use?"

Cory counts: "24"

"24 what?"

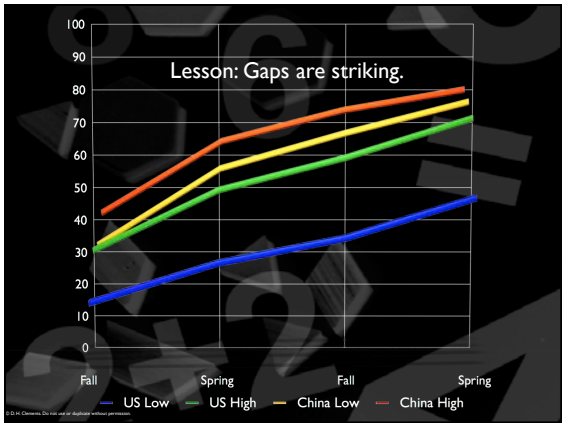
"Triangles."

"How many squares do you have?"

Puts 4 fingers on triangles in each new unit and counts each square: "6!"

Lessons from Research

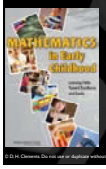
- Young children can learn deep mathematics
- Gaps are striking
- Less is more
- Use truly research-based education
- Include geometry
- **Use learning trajectories**

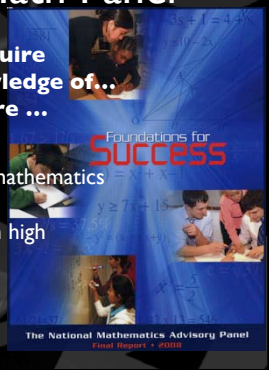


National Math Panel

"Most children acquire considerable knowledge of… mathematics before … kindergarten.

…related to their mathematics learning **for years thereafter** - even high school."

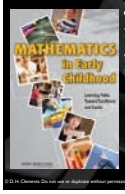


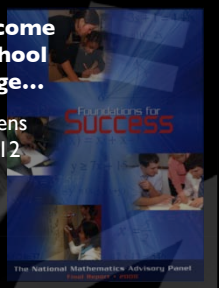


National Math Panel

Children from low-income backgrounds enter school with far less knowledge…

gap…progressively widens throughout their PreK-12 years"





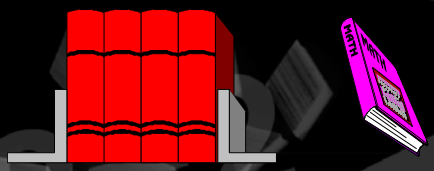
Young Children and Math

Surprising competencies

Discouraging lack of opportunities

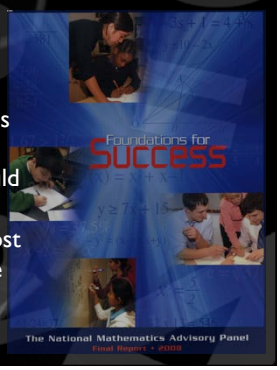
Lesson: Less is More

- Sustained time on ***fewer*** key ***concepts***



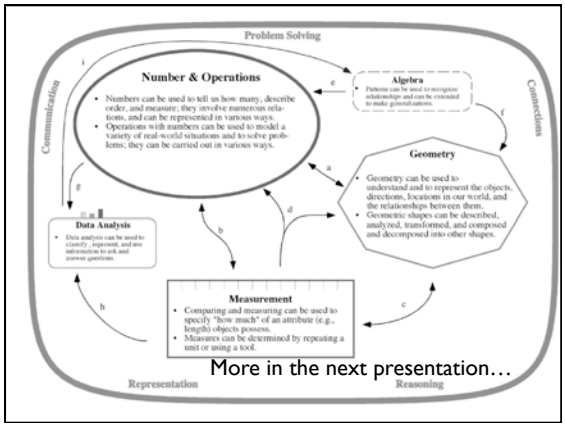
National Math Panel

"The mathematics curriculum in Grades PreK-8 should be streamlined and should emphasize a well-defined set of the most critical topics in the early grades."

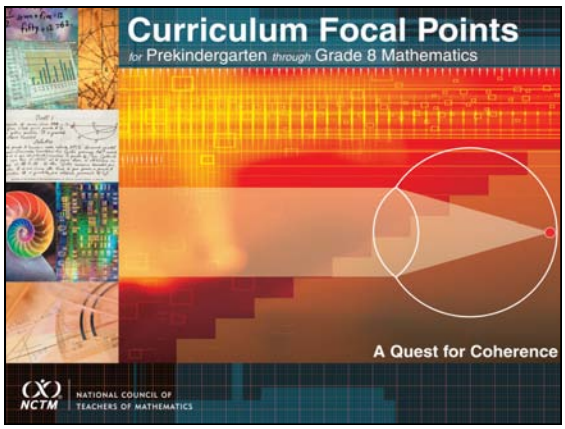


Conference on Early Math Standards

ExxonMobil Foundation



More in the next presentation…



COMMON CORE

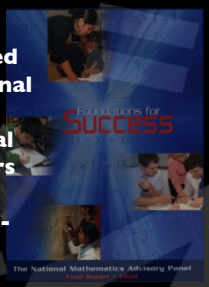
STATE STANDARDS INITIATIVE

PREPARING AMERICA'S STUDENTS FOR COLLEGE & CAREER

Questions?

National Math Panel

Fortunately, encouraging results have been obtained for a variety of instructional programs developed to improve the mathematical knowledge of preschoolers and kindergartners, especially those from low-income backgrounds.

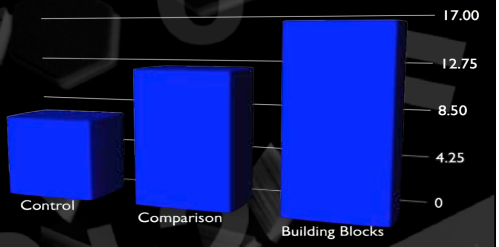


Curriculum Research Framework

Building Blocks

- 3 Categories, 10 phases
- Based on *learning trajectories*
- Qualitative until *phase 9*

First Evaluation



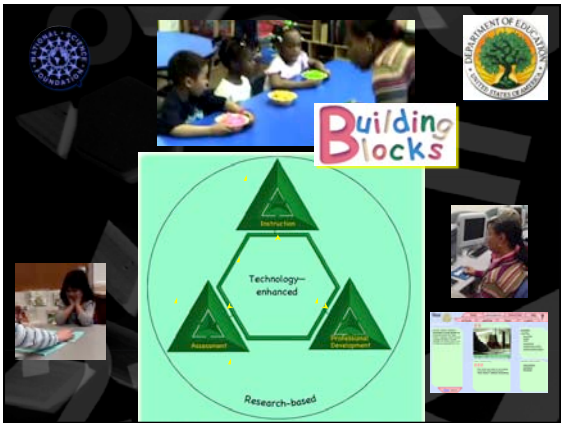
Clements, D. H., & Sarama, J. (2008). Experimental evaluation of the effects of a research-based preschool mathematics curriculum. *American Educational Research Journal, 45*, 443-494.

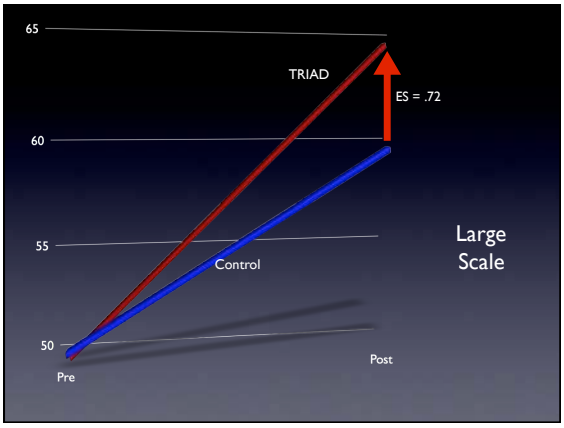
National Math Panel

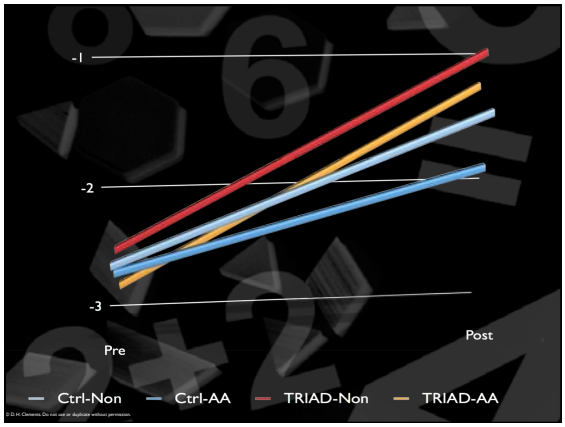
"Research that scales up early interventions capable of strengthening mathematical knowledge,

evaluates their utility in Pre-K and K, and examines long term effects

is urgently needed, with a particular focus on at-risk learners"







Language and Literacy

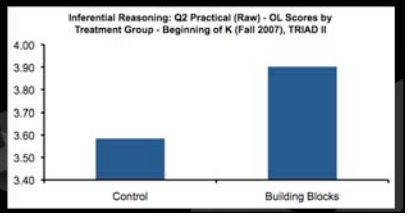
Does that area suffer?

Results

- Letter recognition: *ns*
- Bus Story, *ns* on:
  - Sentence length
  - Listening

Results

- *Sig. higher* for TRIAD on:
  - Information .29
  - Complexity .16
  - Independence .36
  - Inferential Questions .16



Lesson: Use truly research-based education.

Math and Literacy

- Large-scale research, predicting school success (Duncan et al., 2004)
- Early literacy predicted later reading (only)
- Early math predicts later math
  - And reading,
  - particularly for low SES & African-American

Geometry and Measurement




Effects of Neglect

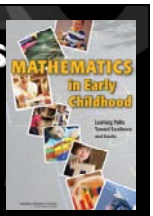
- …appear on student achievement
- TIMSS & PISA: U.S. students scored at or near bottom in every geometry task
- TIMSS 2007: *Lowest* area is geometry—20 points *below* international average
- Even among preschoolers in various countries: 4-year-olds from U.S. scored 55%; China 84%

What Children See

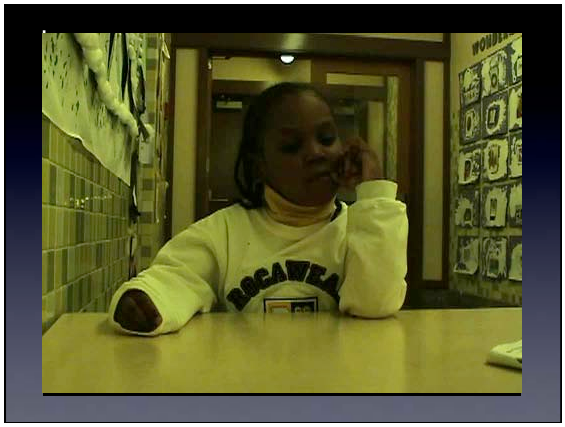
Lesson: Include *Geometry and Spatial Thinking*

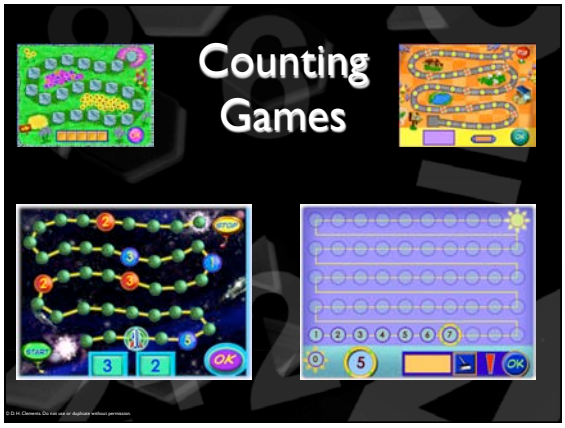
- Critical for spatial thinking—for all areas
- Provides meaningful and motivating setting for number, logic, later calculus…
- Little to lose, and much to gain, by fostering that development

Learning Trajectories



- Formative assessments need paths for concepts, skills
- Teachers who succeed do not "cover" curriculum, but move through LT
- *Building Blocks*—remember Meg




Counting
Games

Road Race: Counting in Two "Worlds"

- Count the dots and move that number of jumps
- Connecting different concepts of number

Road Race Shape Counting - Another Variation

- Count the sides of a shape and move that number of jumps
- Connecting new concepts of number

Space Race Number Choice

- Choose the "better" of two numbers
- Comparing but also reasoning: Which is better in this case?

The Power of Asking "Why?" and "How did you know?"

You present problems, and they figure out what to do. Then you ask what *process* they used. I'm amazed…they learn to! They'll use this knowledge to answer science questions. They really do critical thinking. Asking, "How do you know?" starting at Pre-K is very powerful.

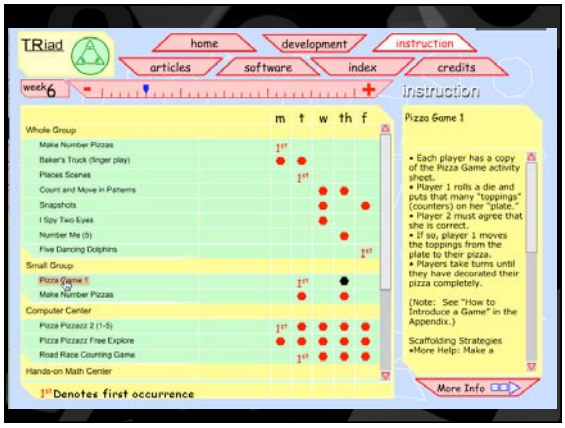
—Anne

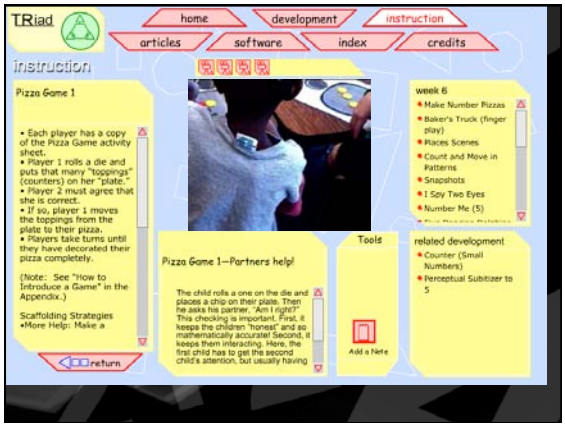
Professional Development

- *Key* component of TRIAD; critical guideline
- All organized around *learning trajectories—all 3 components*

Professional Development

- Follow-up practice *with coaching*
  - Mentors 1-2 times per month
  - Peer coaches
- *More on PD in the following presentation*





Formative Assessment

- All PD, including coaches, helps teachers use learning trajectories and instruments to do *complete* formative assessment
- This is PD that *lasts:* A main goal—they will never teach the same way again.

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- Gaps are striking
- Less is more

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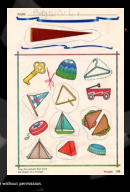
- Include Geometry



Lessons from Research

- Use learning trajectories, in
  - Teaching
  - Choosing curricula
  - Professional development

Questions?

Web Sites (and article download)

UBTRIAD.org

UBBuildingBlocks.org

"If we teach today as we taught yesterday, we rob our children of tomorrow." –John Dewey

https://www.sraonline.com/products.html?

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