

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."

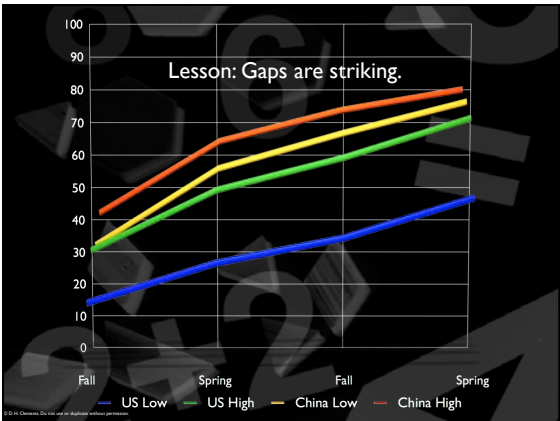
"How many squares do you have?"

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



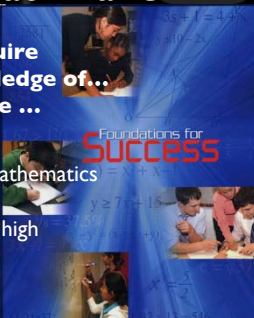
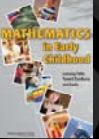
Lessons from Research

- 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

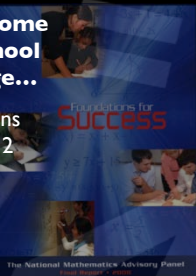
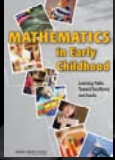
"Most children acquire considerable knowledge of... mathematics before ... kindergarten.
...related to their mathematics learning for years thereafter - even high school."

The National Mathematics Advisory Panel
Final Report • 2008

National Math Panel

Children from low-income backgrounds enter school with far less knowledge...
gap...progressively widens throughout their PreK-12 years"

The National Mathematics Advisory Panel
Final Report • 2008

Young Children and Math

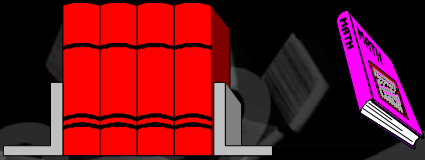
Surprising competencies



Discouraging lack of opportunities

Lesson: Less is More

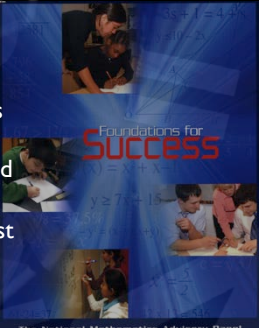
- Sustained time on **fewer** key **concepts**



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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.”



The National Mathematics Advisory Panel
Final Report, 2008

Conference on Early Math Standards.



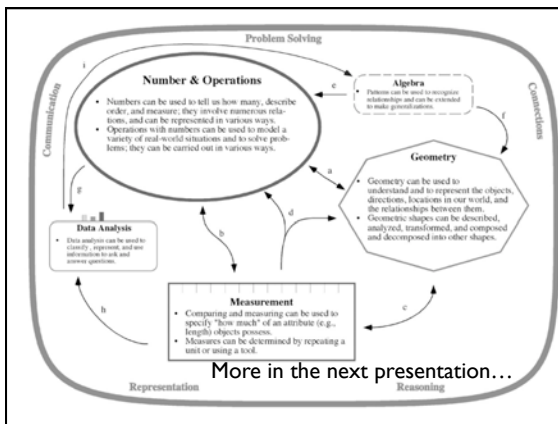
UNIVERSITY AT BUFFALO
Graduate School of Education

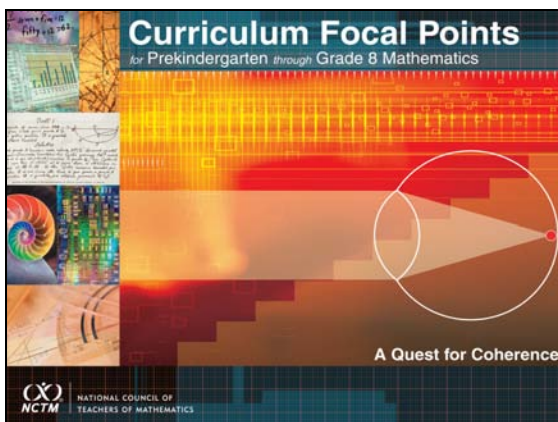
ExxonMobil Foundation

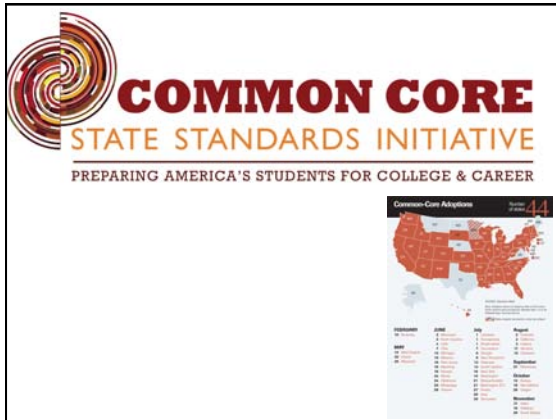
NATIONAL SCIENCE FOUNDATION

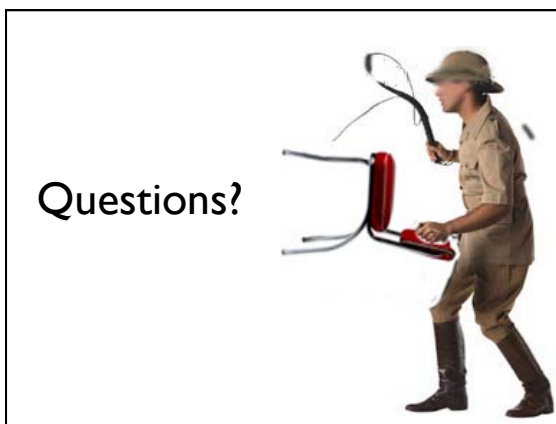
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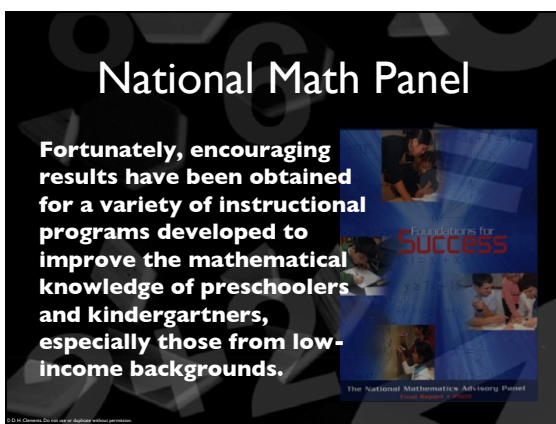


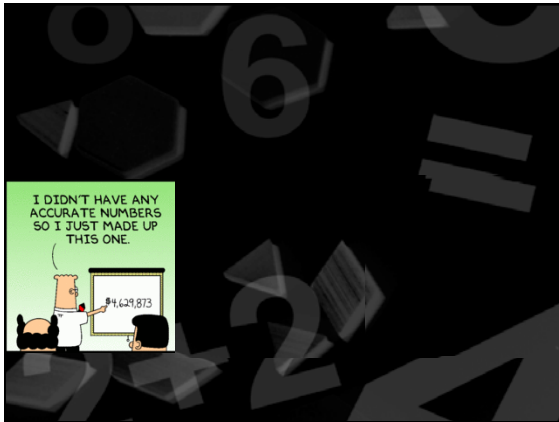








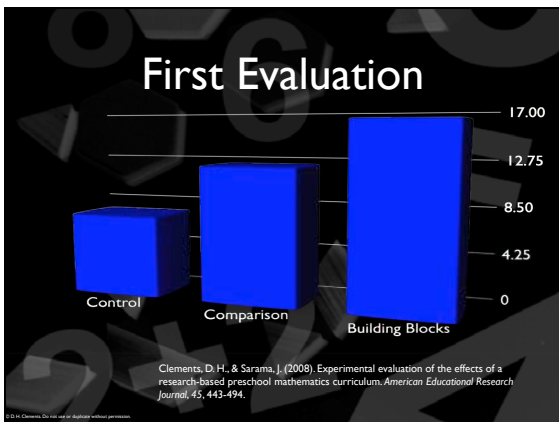




Curriculum Research Framework

Building Blocks

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



National Math Panel

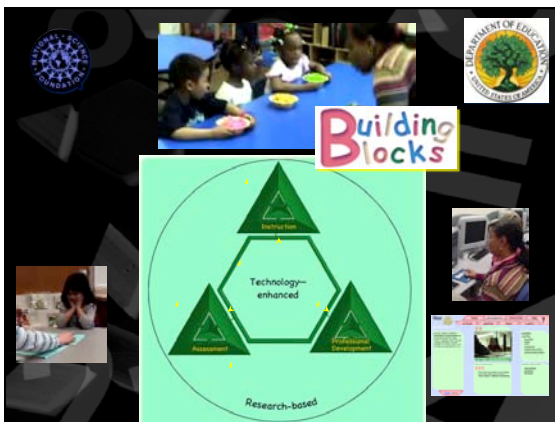
“Research that scales up early interventions capable of strengthening mathematical knowledge,

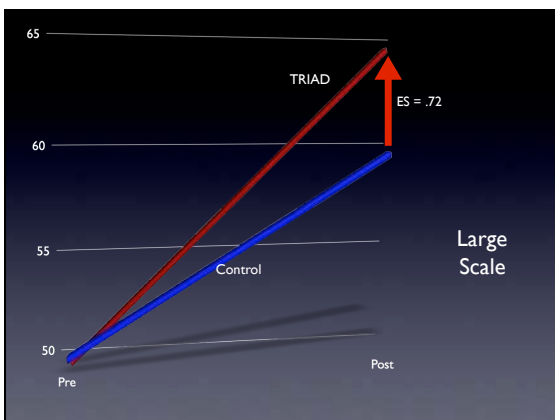
evaluates their utility in Pre-K and K, and examines long term effects

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

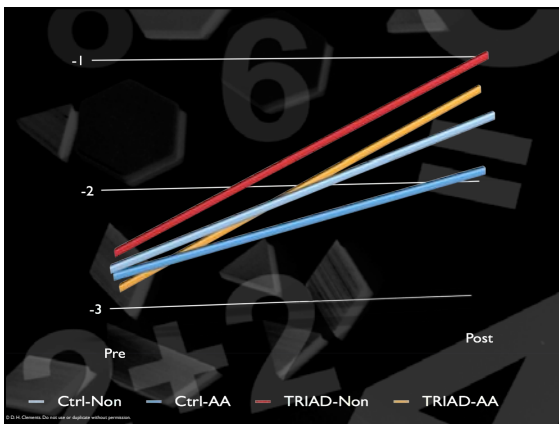


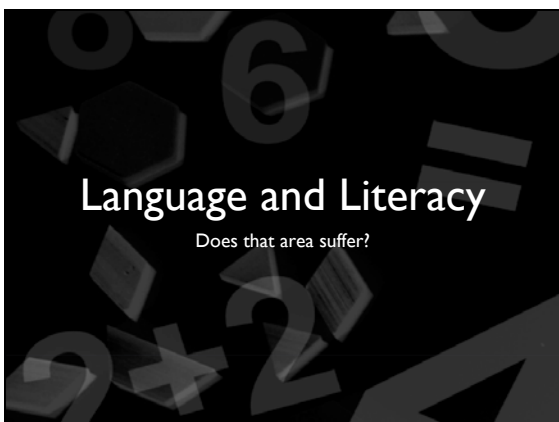
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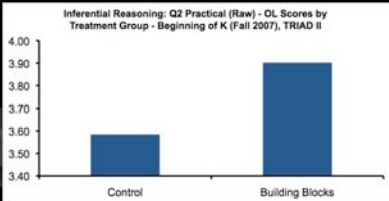

Results

- 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



Treatment Group	Score
Control	3.58
Building Blocks	3.90

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

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Geometry and Measurement



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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%

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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

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- [illegible]

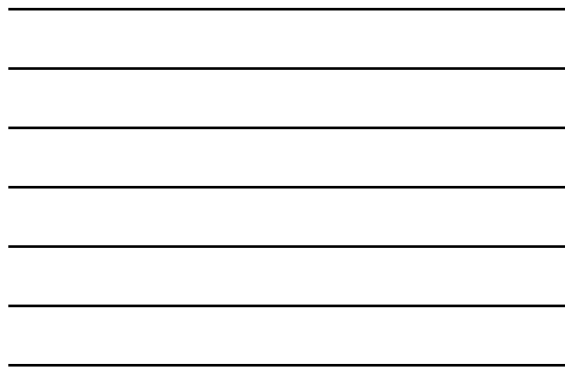
Learning Trajectories

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



Mathematics in Early Childhood
Learning Paths, Assessment, and Instruction
Susan B. Branson and David K. Dickinson

© 2004, Cambridge University Press and the National Academy of Sciences













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



TRIAD (Professional) Development

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*

TRIad

home development instruction

articles software index credits

week 6

Instruction

	m	t	w	th	f
Whole Group					
Make Number Pizzas		1 st			
Baker's Trick (finger play)			1 st		
Pizza Scones				1 st	
Count and Move in Patterns					1 st
Snapshots					
I Spy Two Eyes					
Number Me (5)					
Five Dancing Dolphins					1 st
Small Group					
Pizza Game 1					
Make Number Pizzas			1 st		
Computer Center					
Pizza Pizzazz 2 (1-5)		1 st			
Pizza Pizzazz Free Explore			1 st		
Road Race Counting Game				1 st	
Hands-on Math Center					

1st Denotes first occurrence

Pizza Game 1

- Each player has a copy of the Pizza Game activity sheet.
- Player 1 rolls a die and puts that many "toppings" (counters) on her "plate."
- Player 2 must agree that she is correct.
- If so, player 1 moves the toppings from the plate to their pizza.
- Players take turns until they have decorated their pizza completely.

(Note: See "How to Introduce a Game" in the Appendix.)

Scaffolding Strategies

More Help: Make a

More Info

TRiad

home development instruction

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Instruction

Pizza Game 1

- Each player has a copy of the Pizza Game activity sheet.
- Player 1 rolls a die and puts that many "toppings" (counters) on her "plate."
- Player 2 must agree that she is correct.
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- Players take turns until they have decorated their pizza completely.

(Note: See "How to Introduce a Game" in the Appendix.)

Scaffolding Strategies

- More Help: Make a

return

Pizza Game 1—Partners help!

The child rolls a one on the die and places a chip on their plate. Then he asks his partner, "Am I right?" This checking is important. First, it keeps the children "honest" and so mathematically accurate. Second, it keeps them interacting. Here, the first child has to get the second child's attention, but usually having

Tools

Add a Note

week 6

- Make Number Pizzas
- Baker's Truck (finger play)
- Pages Scenes
- Count and Move in Patterns
- Snapshots
- I Spy Two Eyes
- Number Me (5)

related development

- Counter (Small Numbers)
- Perceptual Subitizer to 5

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development

Counter (Small Numbers)

Accurately counts objects in a line to 5 and answers the "how many" question with the last number counted. When objects are visible, and especially with small numbers, begins to understand cardinality. For example, the child might count as follows:

"1, 2, 3, 4, 5, five!"

Example of Counter (Small Numbers)

This girl knew immediately that the last number word counted told how many there are in all, one sign of this level.

Tools

Test Yourself

Add a Note

number

counting

- Five-Counter
- Charter
- Recler
- Recler(10)
- Corresponder
- Counter (Small Numbers)
- Producer (Small)

related instruction

- Number Me
- Make Buildings
- Find the Number
- Shape Hunt
- Pizza Game 1
- Pizza Game 2
- Pizza Pizzas 2 (1-5)
- Find Groups
- Find the Number

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.

Lessons from Research

- Young children can learn deep mathematics
- Gaps are striking
- Less is more



Lessons from Research

- Use truly research-based education
- 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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