

How Many Aliens? Developing Algebraic Thinking in the K-6 Classroom

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Agenda

- Problem solving
- Algebraic thinking
- Research
- Video examples

Essential Question

- How do you understand your individual student's algebraic thinking?

Aliens and Spaceships

A group of spaceships are flying to Mars. Each spaceship has seven aliens. How many aliens will land on Mars if there are. . .

- 5 spaceships?
- 7 spaceships?
- 10 spaceships?
- 100 spaceships?

Adapted from Maria Blanton's work

Representations

What are representations?

Aliens and Spaceships

A group of spaceships are flying to Mars. Each spaceship has seven aliens. How many aliens will land on Mars if there was. . .

- a huge fleet of spaceships?

Adapted from Maria Blanton's work

Algebraic Reasoning

What is Algebraic Reasoning?

8 Mathematical Practices

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning

MAAP

Making Algebra Accessible Project

ITQ 08-502

MAAP: Project Team

- Stacy Brown, Project & Research Director
- Wayne Snyder, Project Co-director
- Kristen Baldrige, Research Associate
- Lorelei Coddington, Research Associate
- Becky Orona, Research Associate
- Loris Fagioli, Senior Data Analyst

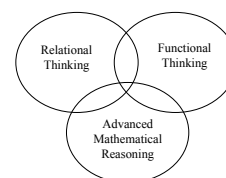
MAAP: School District Partner

- Urban, Southern California
- Large school district (44,000 students)
- Predominantly minority-status students
- Majority English language learners (ELL)
- Predominantly free or reduced lunch (FRL)

MAAP: Content Focus

Early Algebraic Reasoning:

- Relational Thinking
- Functional Thinking
- Advanced Mathematical Reasoning



MAAP PD Goals

Teachers will grow in their capacity to:

- Engage in algebraic thinking
- Create opportunities for students to engage in early algebraic reasoning
- Recognize instances of early algebraic reasoning

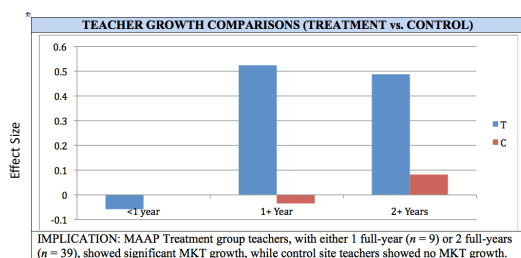
MAAP

- Whole school model
- Grade-level cohorts (K-3 & 4-6)
- Monthly teacher seminars (2 hrs)
- Monthly classroom observations (video recorded)
- Summer Mathematics Institutes (1- week)

AERA 2012 Presentation

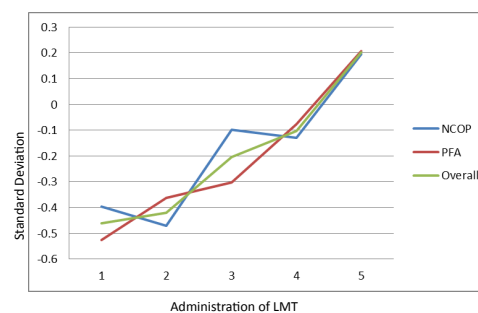
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Treatment vs. Control Change LMT Results



15

K-6 Teachers with 2-Years PD



16

A Closer Look At Students' Thinking

CRA

“... Studies, conducted with both adults and children, show that it is the ability to represent a given word problem and the ability to identify the appropriate computation, rather than algorithmic skill, that determines success in solving word problems.”

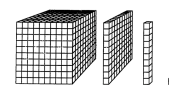
Journal for Research in Mathematics Education (May, 2009).

Concrete-Representational-Abstract (CRA) Approach

- Research based approach
- Graduated instruction that corresponds with NCTM's recommendations for instruction
- Produced greater accuracy in students' responses than traditional methods (Maccini & Hughes, 2000; Maccini & Ruhl, 2000; Witzel et al., 2003)

Concrete-Representational-Abstract (CRA) Approach

- I. Concrete Stage
 - The “doing” stage
 - Teacher begins with explicit modeling of the math concept using concrete materials
 - Examples: fraction bars, algebra tiles, base ten blocks



Concrete-Representational-Abstract (CRA) Approach

- II. Representational Stage
 - The “seeing” stage
 - Teacher transforms the concrete model into a representational level
 - Examples: drawing a picture, tallies



an array $5 \times 5 = 25$

U. S. Office of Special Education Programs, The Access Center: Improving outcomes for all students K-8. (2004). *Concrete-Representational-Abstract approach*.

Concrete-Representational-Abstract (CRA) Approach

- III. Abstract Stage
 - The “symbolic” stage
 - Teacher models using only numbers, notations, and mathematical symbols
 - Examples: numbers ($\frac{1}{2}$, 298), operation symbols ($+$, $-$, \times , \div), other mathematical symbols (\neq , $=$, $>$, $<$)

$$5X - 3 = 17$$

Closing

- Algebraic Reasoning
- CRA Approach
- Classroom Discourse

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