Improving Instruction to Close the Achievement Gap in Math

KS MTSS Symposium

2009

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Our Learning Gap

- Every 29 second and American high school student gives up on school (www.silentepidemic.org)
- Nearly ½ of all African American, Hispanics and Native Americas fail to graduate from public high schools with their class (www.silentepidemic.org)
- The government would reap $45 billion in extra revenues and reduced costs of public health, of crime and justice, and in welfare is the number of drops outs among 20 year olds were cut in half (www.silentepidemic.org)

Our Learning Gap

- NAEP scores in 8th grade math have slightly increased in 2005 from 1999 (www.ncec.ed.gov)
- Gap between White and Hispanic 4th grade achievement and 8th grade achievement remains the same in 2005 as in 1999 (www.ncec.ed.gov)
- Gap between White and African American 8th grade achievement declined in 2005 from what it was in 1999 where the 4th grade achievement gap remained the same (www.ncec.ed.gov)

Common Characteristics of "the Kids" that struggle

Retaining Information

- ✓Not good with high procedural knowledge demands
- ✓Need more explicit connections between topics
- ✓Need more systematic practice on the right topics

Learning Strategies

- ✓Don't persist at tasks for a long time
- ✓Need additional and new ways to build understanding of a concept or topic
- ✓Need to be taught a variety of classroom behaviors
  - •Self management, classroom talk doing homework

Vocabulary Knowledge

Language Coding

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Improving Instruction to Close the Achievement Gap

- Effective Strategies for Low Achievers
  - Visual/graphic depictions, systematic/explicit instruction, student think a-loads, peer assisted learning activities
- Principals of Effective Teaching
  - Big ideas; Clear, Explicit Strategies; Mediated Scaffolding; Strategically Integrated Instruction: Background Knowledge: Judicious Review
- Characteristics of a Balanced Math Program

Effective Strategies for Students with Mathematics Difficulties

- Visual and Graphic Depictions of Problems (.50 effect size)
  - Concrete (manipulatives) – representation – abstract (symbols)
- Systematic and Explicit Instruction (1.19 effect size)
  - Providing highly explicit models of steps and procedure and/or questions to ask to solve a problem
- Student Think-Alouds (.98 effect size)
  - Encouraging students to verbalize their thinking through talking, writing or drawing the steps they used to solve a problem
- Peer Assisted Learning Activities (.42 effect size)
- Formative Assessment Data (.32 effect size)

NCTM Research Brief
Gersten and Clarke (2007)

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Visuals and Representations

Using Models Appropriately

- Develop new concepts
  - Students think and reflect on new ideas when variety of models are used
- Connect Symbols and Concepts
  - Use model to connect the formal symbolic notation
- Assessing Children's Understanding
  - Use models to have students demonstrate their understanding of a concept

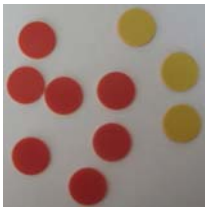
- **John Van de Walle**
- **Elementary and Middle School Mathematics**

Visuals and Representations

Integers

- Transferring Model to Symbols
  - Students need to show the model and connect it to the symbolic notation

physical model



representation

symbols

-7 + 3 =
-4 + -3 + 3 =
-4 + 0=
-4

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Effective Strategies Learning Strategies

Defined as reasonably efficient and intentional routines that leads to the acquisition and utilization of knowledge

- Diverse learners reluctant to give up a successful strategy for more powerful one
- Inactive learners
- Use strategies to compensate with difficulties in fundamentals
- Use strategies with less efficiency

Instructional considerations include

- Ensure skills and underlying use of strategies are fine
- Provide multiple examples of when to use and not use use a strategy
- Make each step of a strategy explicit

Visuals and Representations

Percents

- Elijah walks 2 miles to school. Bethany walks 80% of this distance. How far does Bethany walk?
- Jay's term paper is 18 pages long. DJ's paper is 175% of this. How many pages long is DJ's paper?
- The ticket agency is considering reducing the ticket price from $50 to $40. What percent can they advertise as their decrease in price?

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Visuals and Representations

Properties

- What does this mean?

  2(c + 5)

What if this represents 2 boxes of stuff?

What is in the box?

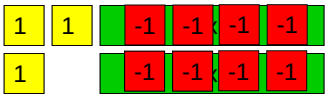
How many boxes are there?

How much of each thing in the box do you have overall?

Visuals and Representations

Substitution

a) 3 + 2x let x = -4



So when x = -4,
3 + 2x = 3 + -8 = -5

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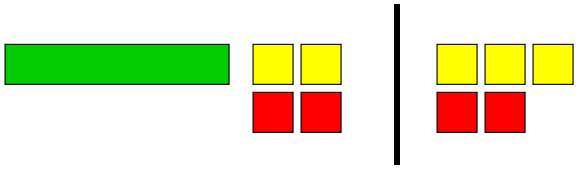
Visuals and Representations

Solving Equations

$x + 2 = 3$



1.Add -2 to both sides of the equations

2. Remove any zeros

3. Interpret your solution

4. Work with symbols

$x + 2 = 3$

$-2 \quad -2$

$x = 1$

Effective Strategies
Retaining Information

Defined as how the learner receives, organizes, and retrieve information to which they have been exposed characterized as

- Problems with working memory (rehearsing and categorizing)
- Problems with long term (storing on permanent basis)
- Naming, recalling, and recognizing objects different

Instructional considerations include

- Explicit instruction of effective use of rehearsal and categorizing
- Have learners active in new learning
- Emphasize connections between pieces of information
- Connect new knowledge to learners experiences
- Systematically monitor retention of info and knowledge

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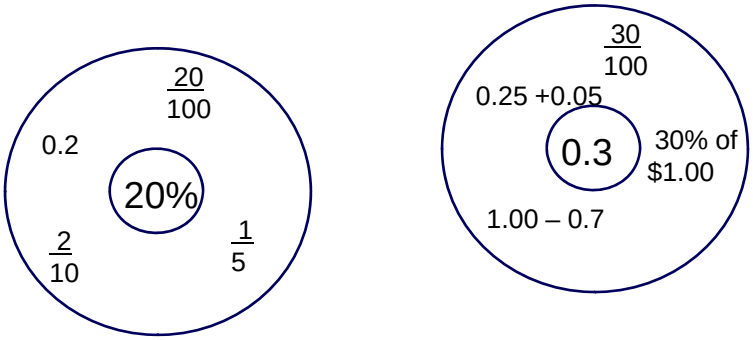
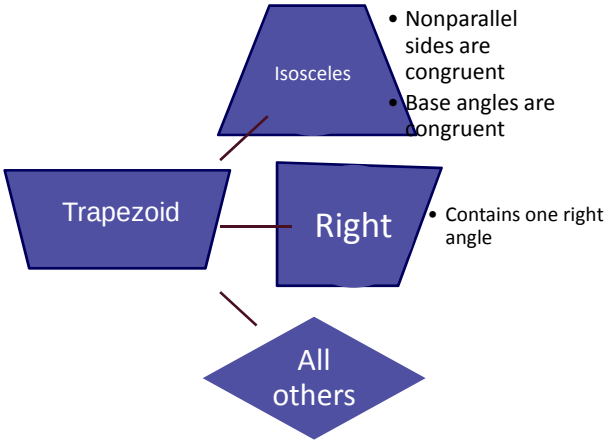
Retaining Information
Graphic Organizers – Supporting Memory

- Supports number sense



Retaining Information
Graphic Organizers – Supporting Memory

- Content – steps and their differences



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Retaining Information
Graphic Organizers – Supporting Memory

- Content – builds understanding of "rules"

	Addition	Subtraction	Multiplication	Division
WHOLE NUMBERS				
FRACTIONS				

Effective Strategies
Vocabulary Knowledge

Must occur in multiple curricular areas and in the context of multiple instructional techniques because

- 3000 words/year (2003)
- Word learning is linked to exposure (quantity exposed)
- Difficulty is apparent early
- Number of words diverse learner needed to learn to catch up to peers is too great to expect direct instruction alone will make a serious impact.

Instructional considerations include

- Address early and comprehensively
- Match vocabulary goals with instruction
- Combine direct instruction with techniques to help students become independent
- Set goals for students
- Have students link vocab to own experiences

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Multiple Strategies for Building Vocabulary

- Graphic organizers
- Academic vocabulary throughout the instruction (looping)
- Putting the word into a meaningful context vs. direct instruction
- Vocabulary learning activities (e.g., word play, Connect Two)

Vocabulary: Learning Activity

- If a triangle is upside down, is it still called a triangle?
- If we turn a square 90º, what do we call it?
- Draw each of the shapes. Which shape is not possible to draw?
  - rhombus parallelogram
  - acute scalene triangle
  - obtuse equilateral triangle

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6 Principles of Effective Teaching

- Teaching focuses on BIG IDEAS
- CLEAR, EXPLICIT STRATEGIES are used to deliver full and clear directions and explanations
- MEDIATED SCAFFOLDING moves the learner from full support to faded support over time
- Instruction is planned to STRATIGICALLY INTEGRATE to connect or show difference between prior knowledge and new knowledge
- BACKGROUND KNOWLEDGE (primer knowledge) is used to learn new knowledge
- Learners apply and develop knowledge through JUDICIOUS REVIEW that is adequate, distributed, cumulative and varied.

Coyne, Kame'enui, and Carnine (2007)

Begin with a Balanced Approach

- ✓ Highly interactive, classroom discussions and dialogues
- ✓ **Use of manipulatives to build conceptual understanding and provide concrete anchors for student understanding**
- ✓ Alternative strategies presented and modeled to clearly demonstrate the various approaches to solving problems
- ✓ **Immediate re-teaching, reinforcement, and feedback of concepts and skills**
- ✓ Frequent teacher modeling and student practice

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Intervention

- Before, during and after instruction
- Concept development moves from manipulatives to pictures to symbols
- Provide support and practice in moving active learning to pencil and paper assessment tasks
- Include practice and student use of vocabulary

Ways to Think About Intervention

		Differentiate by Grade					
	Grade Level	K	1	2	3	4	5
Content	Big Idea	Whole number relationships *pulling numbers apart and putting them together *various forms of equivalent values			Fractional relationships Multiplication		
	Content/skills that students must have	-Understand number combinations to 5 ie. 4 + 1 5 + 0 2 + 3 7 - 2	-Write and solve number sentences from problem situations	-Sums and difference of 3 digit numbers -Classify and describe shapes and their attributes	-Place value -Multiplication and its relation to division -Solve problems using 2 or more skills	-Interpretation of fractions **parts or a whole **equivalent fractions -Decimals -Perimeter and area formulas for rectangles and squares and their relationships and differences	-Operations of fractions -Derive, use and compare area formulas
Structure	In-class Intervention Strategies	• Good first teaching • Use oral descriptions, words, pictures, models prior to symbol notation • Work with addition and subtraction problems simultaneously • Vary the placement of when the unknown is given. (It should not always be the last fact of a problem) • Work within a child's understanding of number sets • Work simultaneously with values that do and do not require regrouping			• Good first teaching • Explain and clarify vocabulary • Teach the notation as well as how the notation is read • Use manipulatives prior to teaching the procedure • Work with units that are composed of more than one object (ex: 2/3 of a six pack of soda, 1/5 of a pack of gum, 1/2 of a dozen of eggs) • Draw fractional relationships using multiple shapes (not just a circle) • Work with fractions as measurement, operator, part-whole, and quotient relationships		
	Supplemental Instructional Options	Extended day		Divided teaching or regrouping of students for highly engaged practice that are focused on specific targets and include pre- and post-testing.		Divided teaching or regrouping of students for highly engaged practice that are focused on specific targets and include pre- and post-testing.	

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Learning Must ……

- ✓ Make Connections
- ✓ **Use Visual Representations**
- ✓ Stress Number Sense and Strategies
- ✓ **Emphasize Conceptual Understanding (curb procedural enthusiasm)**
- ✓ Be Clear on What Needs to Be Known Fluently
- ✓ **Actively Engage Students – questions, high expectations, use of technology**

Mathematical Understanding

	Strands for Mathematical Proficiency[2]				
	Understanding	Computing	Applying	Reasoning	Engaging
Dimensions In the Classroom that Promote Understanding [1]	-Comprehend concepts, operations and relation -Knows what mathematical symbols, diagrams, and procedures mean	-Carries out mathematical procedures with flexibility, accuracy, efficiency, and appropriateness.	-Formulates mathematical problems -Devises strategies for solving them using concept and procedure appropriately	-Uses logic to explain and justify a solution to a problem -Extends something known to something not yet known	-Willing to do the work -Sees math as sensible, useful, and doable
nature of the tasks -Make mathematics problematic -Connect with where students are -Engage student thinking	How did your lesson help student build understanding?	How did you determine the skills student needed to have to be successful in today's lesson?	What problems would help student know when to apply these skills and concepts?	What questions might you pose to get students to talk about their thinking?	What other tasks, manipulatives, problems would engage additional students?
role of the teacher -Select tasks with goals in mind -Share essential information -Establish classroom culture	What did you use to determine the activities you had students do to build understanding?	How might you plan a warm-up to help students practice prerequisite skills needed today?	What connections did this lesson have to other math strands? Would this be important for students to know?	How might you use a student error as a moment of learning and reasoning for all?	What other methods could be used in the next lesson to engage learners?
social culture of the classroom -Ideas and methods are valued -Mistakes are learning for everyone -Correctness resides in mathematical argument	What strategies do you use to get multiple students to share their thinking?	How might you have students work with one another to improve their accuracy on this skill?	What criteria do you use for students to know that their strategy or thought process is accurate?	How would your feedback change students depth of explanations?	What allowed students to be involved in the lesson? How long were they engaged? For how long?
mathematical tools that are available -Used with purpose -Essential resource -Meaning constructed through use of tool -Used to record, communicate, and think	What tools do students need to make sense of the concepts in the lesson? Why did you select _____ to use in this lesson?	How are students keeping track of their progress towards accuracy and efficiency?	How often do you have tools available for students to use in developing strategies?	How are students explaining how the uses of mathematical tools relate to the concepts and procedures? Are they using grade appropriate vocabulary?	What types of reflection questions would help students process today's lesson? Connect to yesterday? Connect to a bigger idea?
the extent to which all students can participate fully -Tasks are accessible to all students -Every student is heard -Every student contributes	How did you scaffold the lesson for all students to access the learning? How was the warm-up designed to build from prior leaning?	What types of problems are you suing to allow all students access to learning?	In what ways are all students asked to formulate new problems or share strategies?	How often is metacognition a part of a lesson? How often do students get feedback on their thinking? How is this delivered?	What structures, questions, problems in your lesson helped all student be successful?

[1]Hiebert, J., Carpenter, T.P., Fennema, E., Fuson, K. C., Wearne, D., Murray, H., Olivier, A., & Human, P. (1997). *Making sense: Teaching and learning mathematics with understanding.* Portsmouth, NH: Heinemann.

[2]National Research Council. (1998). *Helping children learn mathematics.* Mathematics Learning Study Committee, J. Kilpatrick & J. Swafford, Editors. Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press.

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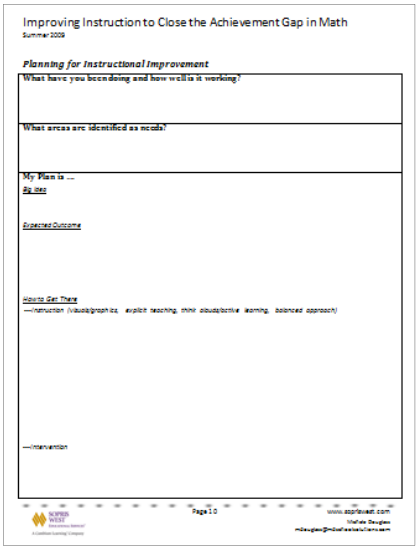
Cycle For Learning

- Know the learning outcome
- TEACH IT WELL
- Assess
- Intervene (targeted and specific)
- Integrate Review

Next Steps

- Assess where you are
- Identify greatest needs
- Develop a Plan



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Summer 2009

Planning for Instructional Improvement

What have you been doing and how well is it working?

What areas are identified as needs?

My Plan is ...

Big Idea

Expected Outcome

How to Get There

—Instruction (Visuals/graphics, explicit teaching, think aloud/active learning, balanced approach)

—Intervention

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