ADDRESSING NUMERACY WITH THE STRUGGLING LEARNER K-2

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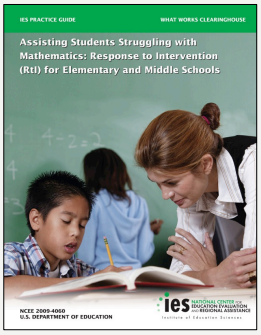
BASED ON RESEARCH: THE INSTITUTE OF EDUCATIONAL RESEARCH



Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools
(IES Website)

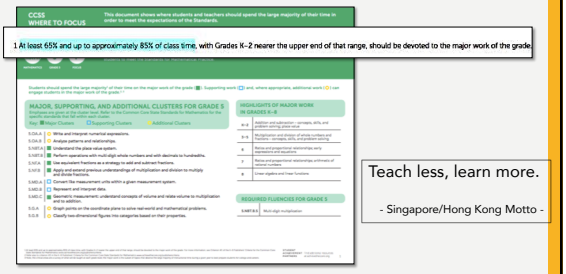
RECOMMENDATIONS

1. Screen all students to identify those at risk for potential mathematics difficulties and provide interventions to students identified as at risk.

INSTRUCTIONAL MATERIALS

2. Instructional materials should focus intensely on in-depth treatment of whole numbers K-5 and rational numbers in grades 4-8.

MAJOR CLUSTERS



Teach less, learn more.

- Singapore/Hong Kong Motto -

PRIORITIZES THE MAJOR CLUSTERS

Grade	Focus Areas in Support of Rich Instruction and Expectations of Fluency and Conceptual Understanding
K–2	Addition and subtraction-counting concepts, skills, place value and problem solving
Grade	**Focus Areas in Support of Rich Instruction and Expectations of Fluency and Conceptual Understanding**
3–5	Multiplication and division of whole numbers and fractions – concepts, skills, and problem solving

Major Clusters – areas of intense focus, where students need fluent understanding and application of the core concepts (approximately 70%)

NUMERACY

- Subitizing regular and irregular dot patterns
  - Perceptual and Conceptual
- Counting and Cardinality
- Identifying Numbers
- Counting forward and backward
- What comes before/After
- Developing addition and subtraction strategies developmentally
- Working towards fluency – composing and decomposing numbers

INSTRUCTION

3. Instruction should be explicit and systematic; providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.

WHAT IS *EXPLICIT* INSTRUCTION?

The National Mathematics Advisory Panel defines *explicit instruction* as follows (2008, p. 23):

- *"Teachers provide clear models for solving a problem type using an array of examples."*
- *"Students receive extensive practice in use of newly learned strategies and skills."*
- *"Students are provided with opportunities to think aloud (i.e., talk through the decisions they make and the steps they take)."*
- *"Students are provided with extensive feedback."*

MATH PRACTICES

Math Practice		Explanations and Examples
Habits of Mind	MP. 1 Make sense of problems and persevere in solving them.	Mathematically proficient students in Grade 2 examine problems and tasks, can make sense of the meaning of the task and find an entry point or a way to start the task. Grade 2 students also develop a foundation for problem-solving strategies and become independently proficient in using those strategies to solve new tasks. In Grade 2, students' work continues to use concrete manipulatives and pictorial representations as well as mental mathematics. Grade 2 students also are expected to persevere while solving problems; that is, if students reach a point in which they are stuck, they can reexamine the situation in a different way, consult with classmates, try a different strategy and continue to work constructively. Lastly, mathematically proficient students complete a task by asking themselves the question, "Does my answer make sense?"
	MP. 6 Attend to precision.	

Math Practice		Questions that Elicit the Desired Behavior
Habits of Mind	MP.1 Make sense of problems and persevere in solving them.	• What do you think that problem is asking? • How would you describe this problem in your own words? • What might you do to get started? • Share your thinking with the person next to you. What does your partner think? • Did your partner get the same answer? If not, can the two of you figure out why not?
	MP.6 Attend to precision.	• What's the word we use for any shape with 4 sides and 4 vertices? • What measuring tool would give you the most precise answer? • Does your answer seem reasonable? Why or why not? • What can you do to double-check your answer?

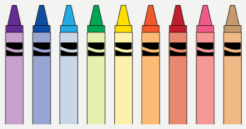
WORD PROBLEMS

4. Interventions should include instruction on solving word problems that is based on common underlying structures.

Neesha has 15 crayons. She gave 9 to Marta. How many crayons does Neesha have left?

Neesha has 15 crayons. She gave 9 to Marta. How many crayons does Neesha have left?

15 – 9 =



Neesha gave 6 crayons to Marta. Neesha now has 9 crayons left. How many crayons did Neesha have to begin with?

Neesha gave 6 crayons to Marta. Neesha now has 9 crayons left. How many crayons did Neesha have to begin with?

6 + 9 =

ACHIEVE THE CORE

Table 2: Addition and subtraction situations by grade level.

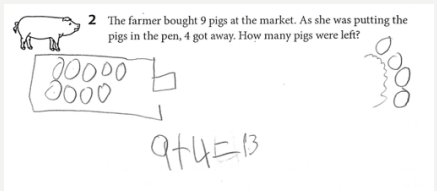
	Result Unknown	Change Unknown	Start Unknown
Add To	*A* bunnies sat on the grass. *B* more bunnies hopped there. How many bunnies are on the grass now? $A + B = \square$	*A* bunnies were sitting on the grass. Some more bunnies hopped there. Then there were *C* bunnies. How many bunnies hopped over to the first *A* bunnies? $A + \square = C$	Some bunnies were sitting on the grass. *B* more bunnies hopped there. Then there were *C* bunnies. How many bunnies were on the grass before? $\square + B = C$
Take From	*C* apples were on the table. I ate *B* apples. How many apples are on the table now? $C - B = \square$	*C* apples were on the table. I ate some apples. Then there were *A* apples. How many apples did I eat? $C - \square = A$	Some apples were on the table. I ate *B* apples. Then there were *A* apples. How many apples were on the table before? $\square - B = A$
	Total Unknown	Both Addends Unknown[1]	Addend Unknown[2]
Put Together /Take Apart	*A* red apples and *B* green apples are on the table. How many apples are on the table? $A + B = \square$	Grandma has *C* flowers. How many can she put in her red vase and how many in her blue vase? $C = \square + \square$	*C* apples are on the table. *A* are red and the rest are green. How many apples are green? $A + \square = C$ $C - A = \square$
	Difference Unknown	Bigger Unknown	Smaller Unknown
	"How many more?" version. Lucy has *A* apples. Julie has *C* apples.	*"More" version suggests operation.* Julie has *B* more apples than Lucy.	*"Fewer" version suggests operation.* Lucy has *B* fewer apples than Julie.

www.achievethecore.org

WORD PROBLEM TYPES

- Review the types of problems primary students are required to solve (handout)
  - Change problems (add to/take from)
  - Group problems (put together/take apart)
  - Compare problems
- Consider *what* is unknown in the context of the problem.

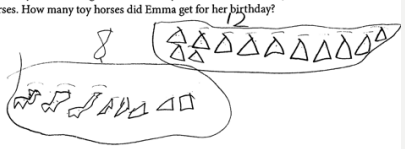
CHANGE PROBLEMS



Take From: Result Unknown
9 – 4 = ____

WHAT KIND OF PROBLEM?

4 Emma had 8 toy horses. She got some more toy horses for her birthday. Now she has 12 toy horses. How many toy horses did Emma get for her birthday?

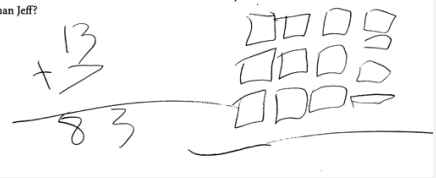


Equation: 8 + 12 = 20

Add to: Change Unknown
8 + ____ = 12

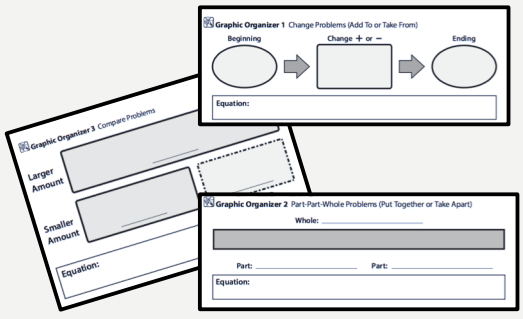
WHAT KIND OF PROBLEM?

6 Jeff has 13 balloons. Rosa has 7 balloons. How many fewer balloons does Rosa have than Jeff?



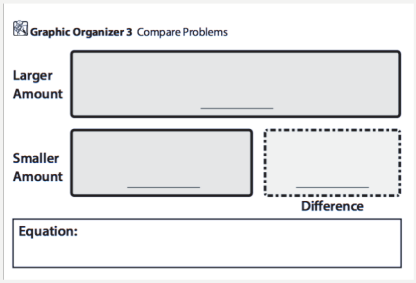
Compare: Difference Unknown
13 – 7 = ____ OR ___ + 7 = 13

GRAPHIC ORGANIZERS



COMPARE PROBLEM

Mrs. Douglas made 17 treat bags and Ms. Johnson made 10 treat bags for the party. How many more treat bags did Mrs. Douglas make than Ms. Johnson?



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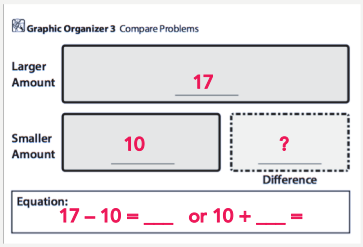


VISUAL REPRESENTATIONS

5. Materials should include visual representation of mathematical ideas and interventionists should be proficient in the use of these materials.

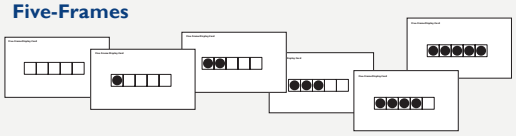
SEEING AS UNDERSTANDING: THE IMPORTANCE OF VISUAL MATHEMATICS FOR OUR BRAIN AND LEARNING ~ JO BOALER

- When students learn mathematics through visual approaches, mathematics changes for them, and they are given access to deep and new understanding.
- When we work on mathematics…brain activity is distributed between many different networks which include two visual pathways.
- The brain uses representations of fingers, well beyond the time and age that people use their fingers to count.
- "If students are not learning about numbers through thinking about their fingers, numbers "will never have a normal representation in their brain." (Butterworth 1999)

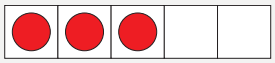
MODELS FOR THINKING

Finger Patterns

Five-Frames

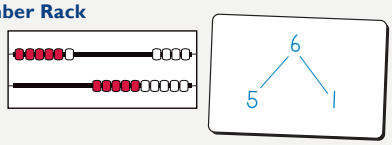


Flashing

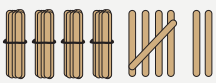


MODELS FOR THINKING

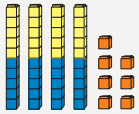
Number Rack



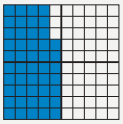
Bundles & Sticks



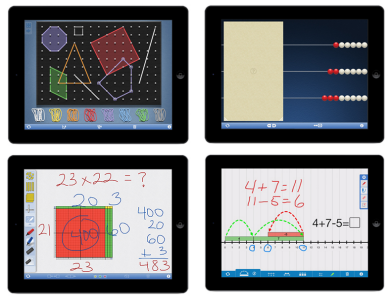
Unifix Cubes



Hundreds Grid



HTTP://WWW.MATHLEARNINGCENTER.ORG



COMPUTATIONAL FLUENCY

6. Devote 10 minutes each session to build fluency with basic arithmetic facts. Promote extensive practice with strategy retrieval.

COMPUTATIONAL FLUENCY

Efficiency

Efficiency implies that the student does not get bogged down in many steps or lose track of the logic in the strategy. An efficient strategy is one that the student can carry out easily, keeping track of sub-problems and making use of intermediate results to solve the problem.

Accuracy

Accuracy depends on several aspects of the problem-solving process, among them, careful recording, the knowledge of basic number combinations and other important number relationships, and concern for double-checking results.

Flexibility

Flexibility requires the knowledge of more than one approach to solving a particular kind of problem. Students need to be flexible and choose an appropriate strategy for solving the problem at hand. They can use one method to solve a problem and another method to double-check the results.

FLUENCY STRATEGIES

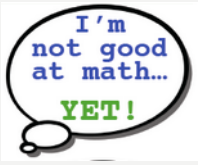
- Counting on, doubles, make ten, ten and some more
- Subtraction as comparisons or difference, inverse operations, and missing addends
- Jumping & splitting on the empty number line
- Modeling and notating student thinking

PROGRESS MONITORING

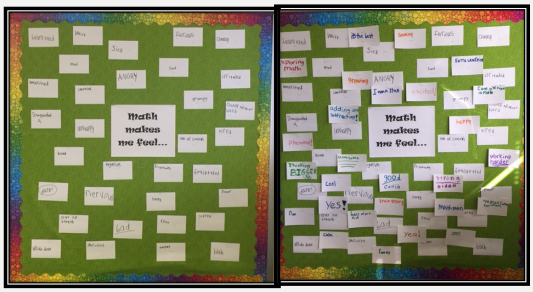
7. Monitor student progress at least once a month, using grade appropriate outcome measures.

MOTIVATIONAL STRATEGIES

8. Include motivational strategies in interventions that promote a growth mind-set.



HOW DO STUDENTS FEEL ABOUT MATH?



Thank you for joining me today!