Welcome

Response to Intervention: Strategies for Teaching Mathematics in Grades 1-5

Karen Karp

University of Louisville

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Topics for Today

- Brief overview of **RtI Model**, a multi-tiered system of support (MTSS)
- What helps students with disabilities build **cognitive structures** and **connections**?
- Research based **Interventions** to <u>try</u> (not buy)
- **Diagnostic interviews - a way to gather feedback on students' thinking**
- **Strategies that DON'T EXPIRE!!**

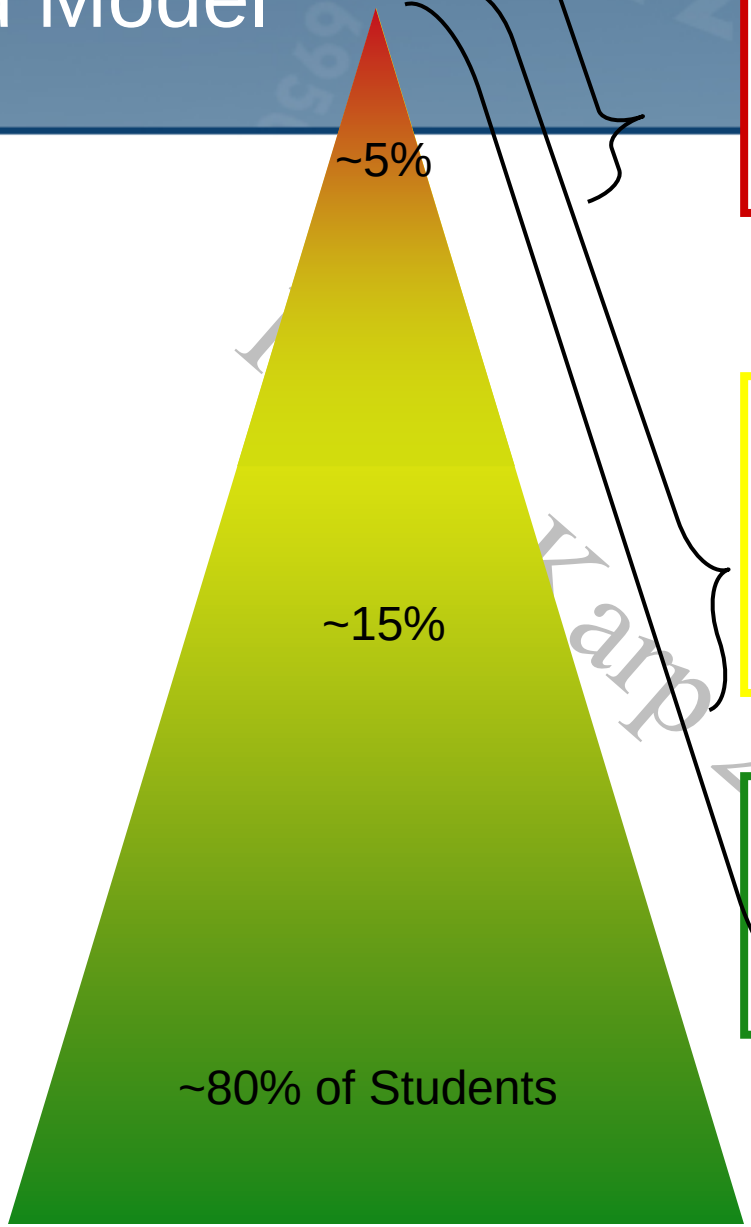
Foundational Questions

Content – what comes before the Common Core State Content Standards at your grade level?

What are the foundational ideas that students can build on? (not dead ends)

How do you teach these foundational concepts to students who struggle?

RtI:
3-Tiered Model



Tertiary Prevention:
specialized & individualized strategies for students who don't respond to Tier 2 supplementary support - INTENSIVE

Secondary Prevention:
supplementary strategies for students who do not respond to core instruction - TARGETED

Primary Prevention:
High quality engaging core instruction
- UNIVERSAL

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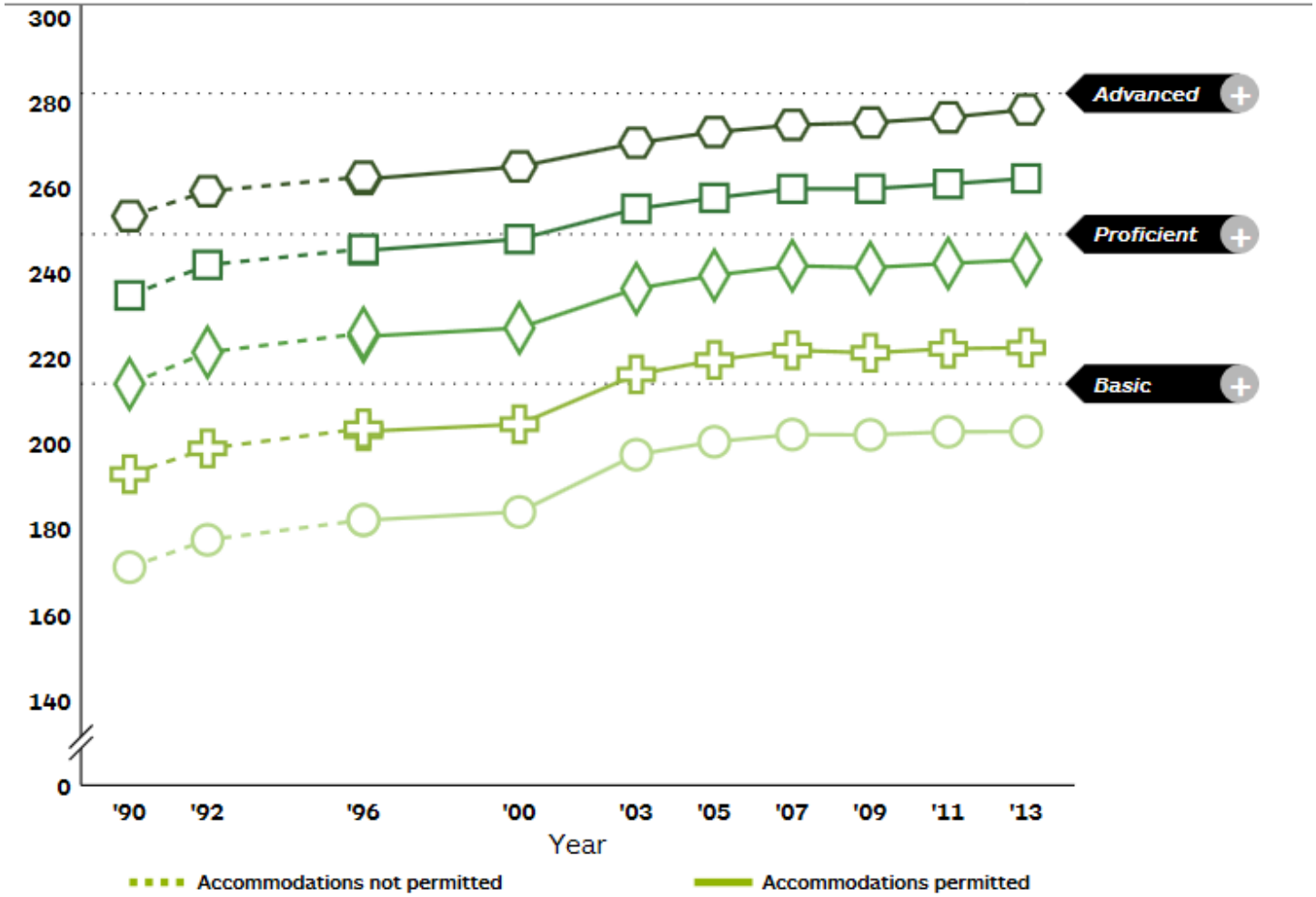
What might a student's brain look like?

What if one student had a good understanding of a concept and the other student had just memorized it (or lacked the ability to memorize – like a student with disabilities)?

Their brains might look very different!

Van de Walle, J., Karp, K., & Bay Williams, J. (2010). *Elementary and Middle School Mathematics: Teaching developmentally*. New York: Pearson.

Has RtI Implementation Closed the Gap? Let's look at 4th grade.



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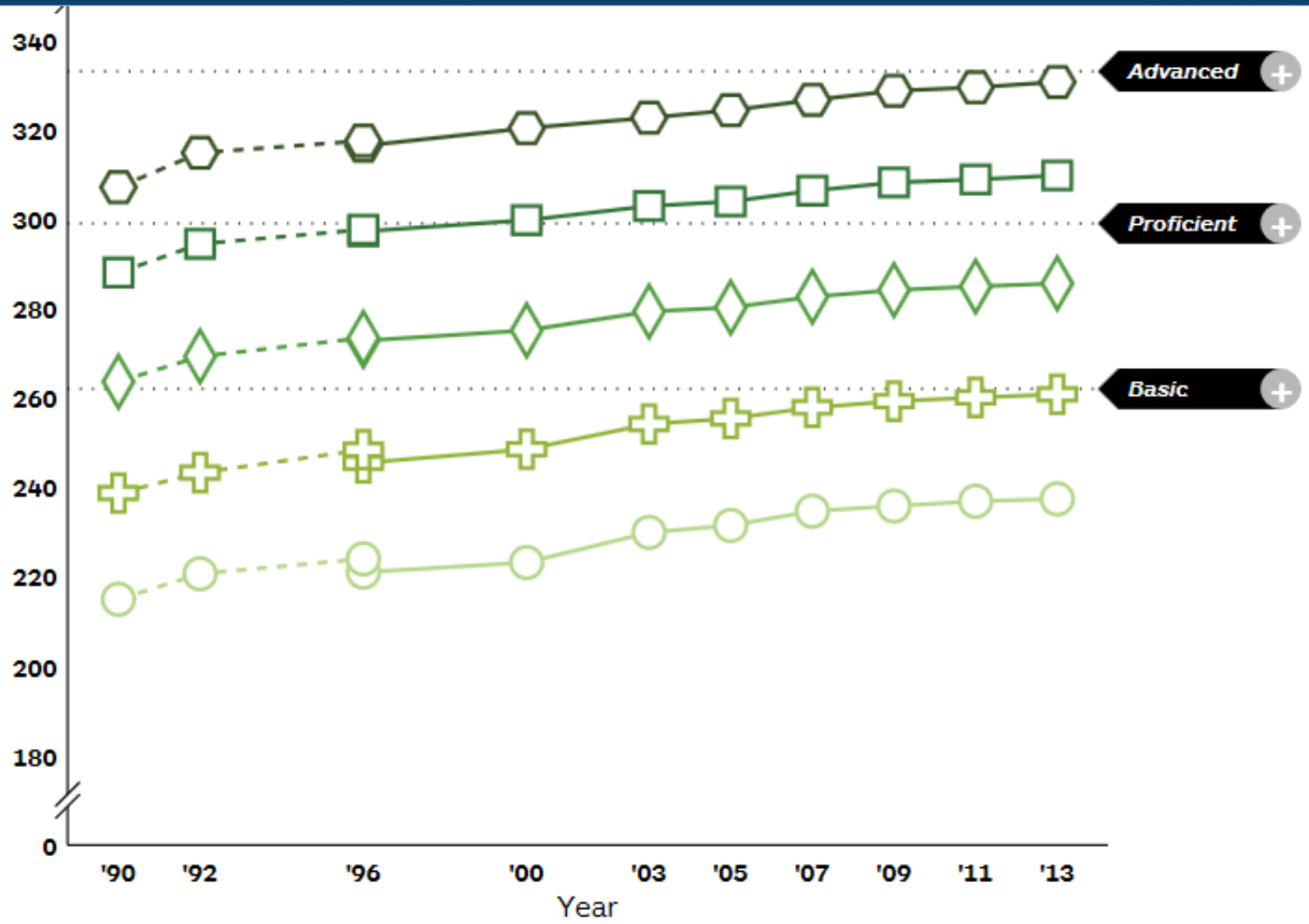
Are we doing any better at 8th grade?



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Mathematics Performance on NAEP 2013

4th grade

At or Above Proficient: 45% (+5%) of all students and **18% (+1%) of students with disabilities**

81% of students with disabilities need to move up

8th grade

- At or Above Proficient: 39% (+4%) of all students and **9% (=) of students with disabilities**
- 91**% of students with disabilities need to move up**

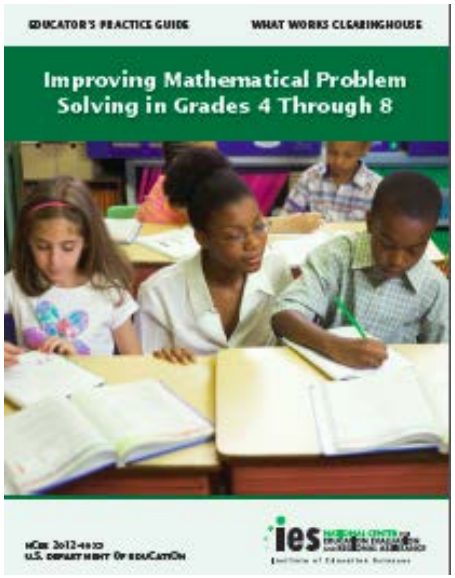
National Center for Education Statistics, 2013

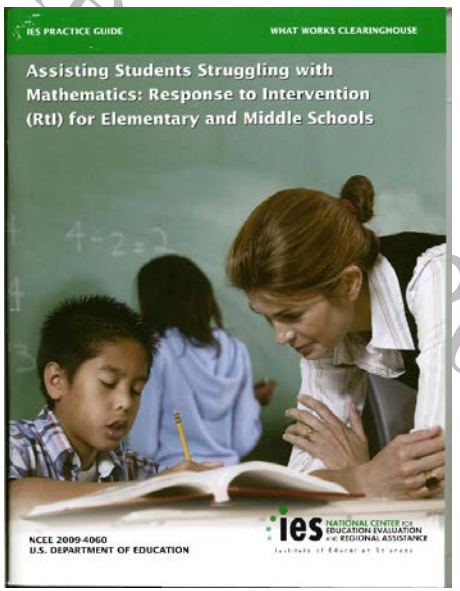
What about RtI? Why aren't Tier 2 Interventions Helping?

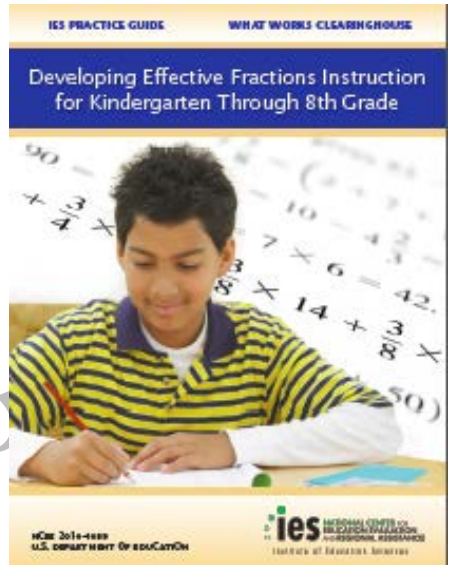
- Recent studies reveal that teachers providing Tier 2 mathematics instruction to elementary and middle grade students largely used worksheets (Foegen & Dougherty, 2010; Swanson, Solis, Ciullo & McKenna, 2012)
- In my travels to classrooms and schools many use a one-size-fits-all generic computer program.

Recommendations for supporting students struggling in mathematics

- Recommendations are based on strong and moderate levels of evidence resulting from comprehensive reviews of current research







Gersten, R., Beckmann, S., Clarke, B., Foegen, A., Marsh, L., Star, J. R., & Witzel, B. (2009). *Assisting students struggling with mathematics: Response to Intervention (RtI) for elementary and middle schools (NCEE 2009-4060). Washington, DC:* National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from http://ies.ed.gov/ncee/wwc/publications/practiceguides/.

Intervention Recommendations from Research

- **C**oncrete--**S**emi-concrete--**A**bstract (CSA) approach
- Explicit instruction
- Underlying mathematical structures
- Examples (and counterexamples)
- Feedback – Not teacher to student but students' feedback to teacher on what they know and don't know

Newman-Gonchar, R., Clarke, B., & Gersten, R. (2009). A summary of nine key studies: Multi-tier intervention and response to interventions for students struggling in mathematics. Portsmouth, NH: RMC Research Corporation, Center on Instruction.
Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement.* New York: Routledge.

So, What did you learn in school?

- With the person sitting next to or around you, decide if the rules shown are always true.
- If it is not always true, find a counterexample.

- Addition and multiplication make numbers bigger.
- When you multiply by 10, just put a 0 on the end of the number.
- The longer the number, the larger the number.

Addition and multiplication make “bigger”

$32 + 67 = 99$

$15 \times 10 = 150$

$-3 + (-14) = -17$

$\frac{1}{3} \times \frac{2}{7} = \frac{2}{21}$

$15 + 0 = 15$

When you multiply by 10, just put a 0 on the end of the number.

$15 \times 10 = 150$

$4.5 \times 10 = 45.0$

$4.5 \times 10 \neq 4.50$

The longer the number, the larger the number.

1,278,931 > 1,469

1.3 > 1.0118743

1.02 < 1.2

Impact of Rules

- Students use rules as they have interpreted them.
- They often do not think about the rule beyond its application.
- When even the best students find that a rule doesn’t work, it is unnerving and scary.

Goal – Try to AVOID DEAD ENDS

- "13 Rules that Expire" (Karp, Bush & Dougherty August 2014 in *Teaching Children Mathematics*)

What do we know?

- Telling isn't teaching.
- Told isn't taught.
- Explicit instruction isn't telling.

Let's start with Word Problems

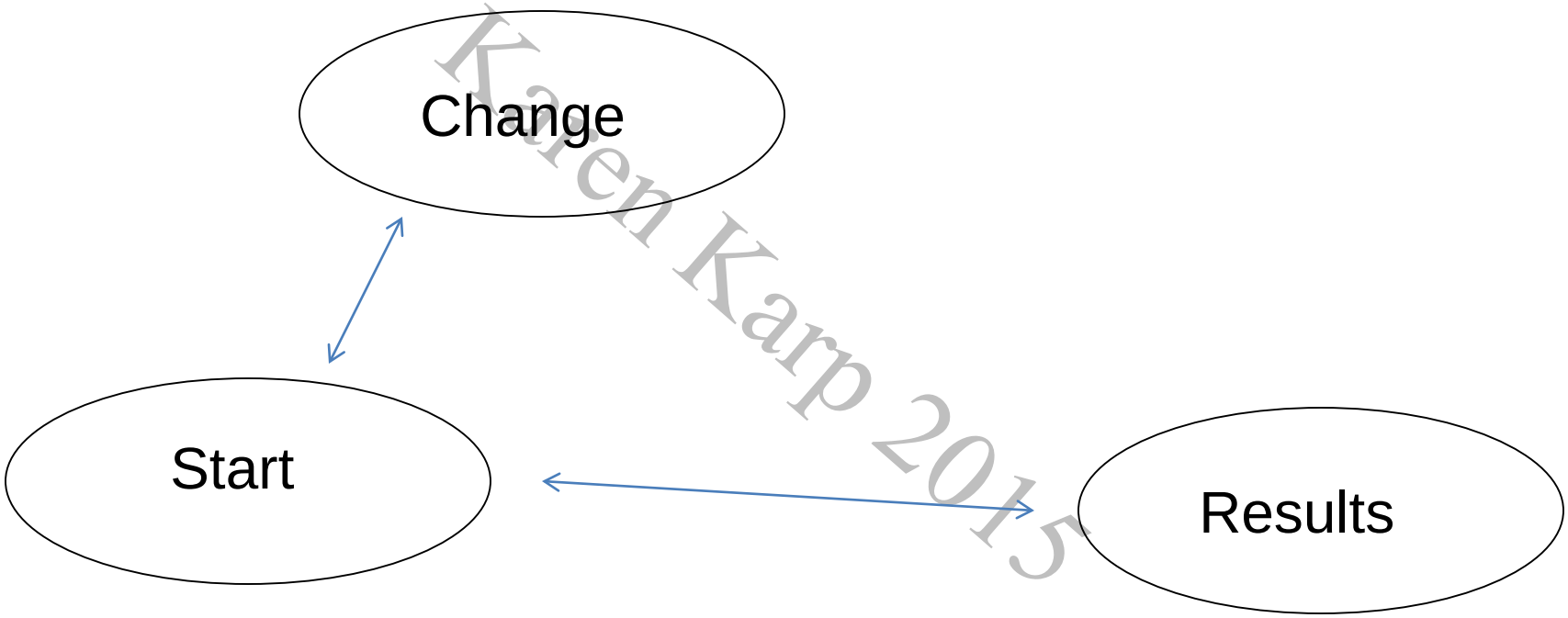
At all grades students who struggle see each problem as a **separate endeavor**

They **focus on steps** to follow rather than the behavior of the operations

They tend to use **trial and error** – (disconnected thinking – not relational thinking)

They need to focus on **actions**, **representations** and **general properties of the operations**

Explicit Schema for Additive Structures



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Carpenter, T., Fennema, E., Franke, M. L., Levi, L. & Empson, S.. (1999). *Children's mathematics: Cognitively guided instruction*. Portsmouth, NH: Heinemann.

Distinguish Between the Behavior of the Operations (yes , use the peas or counters!!)

Join Problems: Use two quantities to find the third

Louise has 11 baseball cards. Elliott gave her 6 more. How many baseball cards does Louise have now?

Connect the action to the equation: 11 + 6 = ☐

Louise has 11 baseball cards. Elliott gave her some more. Louise now has 17 cards. How many did Elliott give her?

11 + ☐ = 17 or an equivalent equation 17 – 11 = ☐

Louise has some baseball cards. Elliott gave her 6 more. Now she has 17. How many baseball cards did Louise have to begin with? ☐ + 6 = 17 or 17 – 6 = ☐

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Additive Structures – Separate Problems

Separate Problems: Start is the whole or the largest amount (not the result)

Mikal has 12 T-shirts. He gives 3 shirts to his brother Elron. How many T-shirts does Mikal have now?

Mikal has 12 T-shirts. He gives some shirts to his brother Elron. Now he has 9 left. How many T-shirts did Mikal give Elron?

Mikal has some T-shirts. He gives 3 shirts to his brother Elron. Now he has 9. How many T-shirts did Mikal have to begin with?

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Warm up task

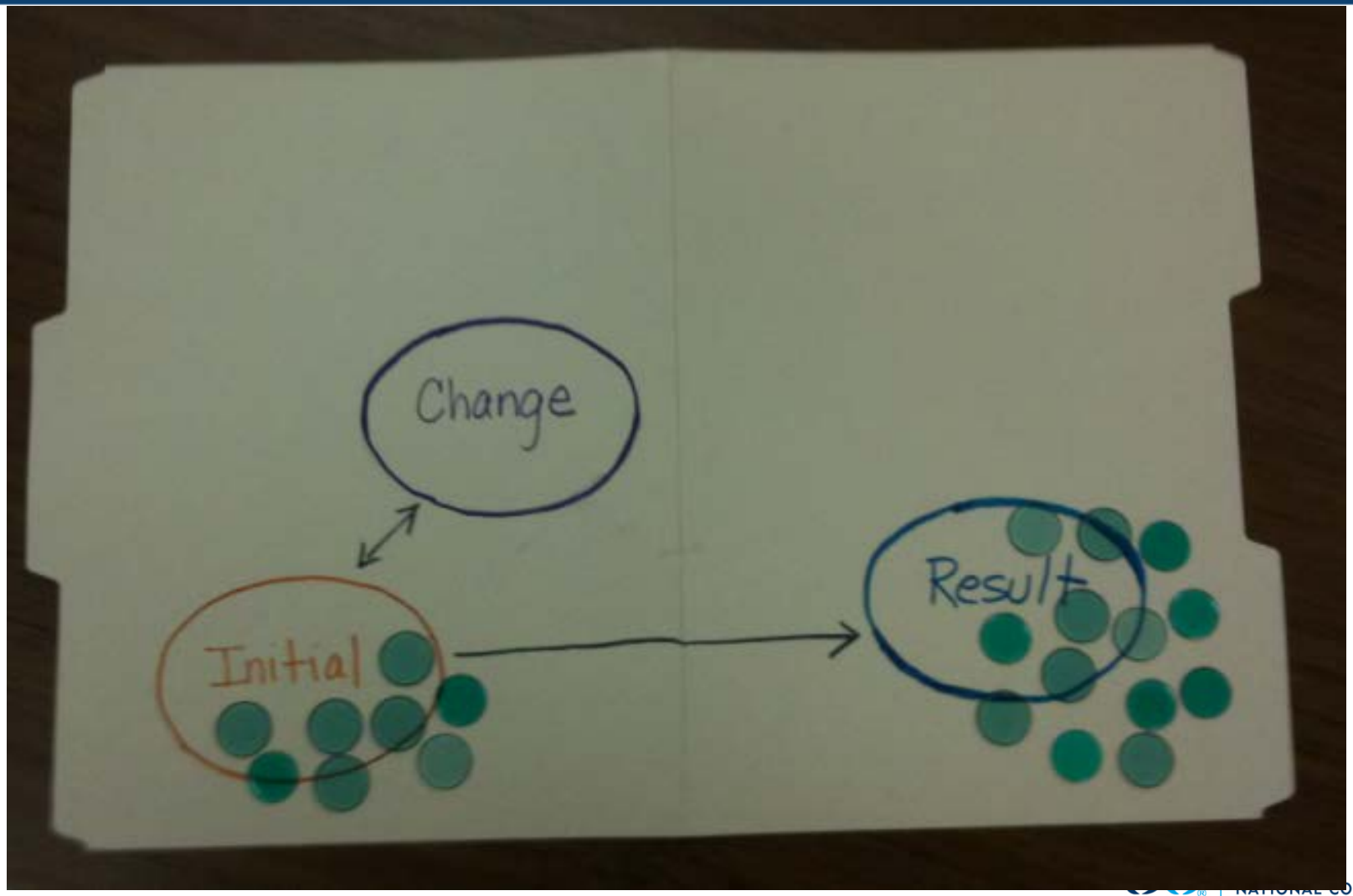
- Using a number family like 9, 6, 15, create an addition or subtraction story problem that you would have students in your classroom solve.

Creating Mental Residue

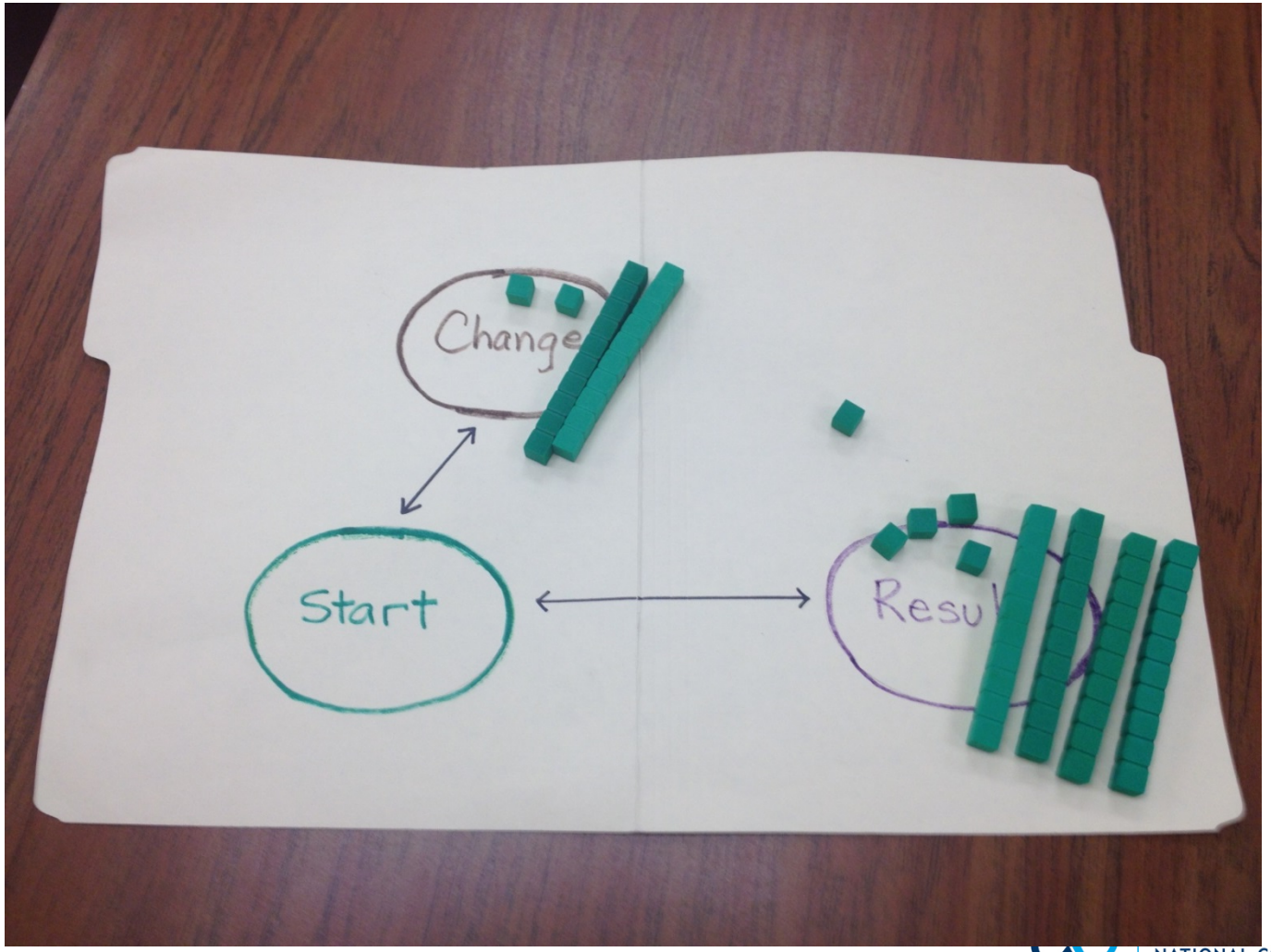
- Establishing foundational understanding
- Modeling the physical action is the important part and doesn't go away
- Acting and "doing" the process supports students' thinking about the operation

Dougherty, B. J. (2008). Measure up: A quantitative view of early algebra. In Kaput, J. J., Carraher, D. W., & Blanton, M. L. (Eds.), *Algebra in the early grades*, (pp. 389–412). Mahwah, NJ: Erlbaum.

Finding a Use for Old Folders



The Graphic Organizer that Keeps on Going!!!



The Infamous Shepherd Problem

:

There are 25 sheep and 5 dogs in a flock. How old is the shepherd?

Merseth, Katherine K. “How Old Is the Shepherd? An Essay about Mathematics Education.” *Phi Delta Kappan* 74 (March 1993): 548–54..

Danger - Key Words ahead

Mark has 3 packages of pencils. There are 6 pencils in each package. How many pencils does he have <u>in all</u>?

9

Explicit instruction - structure of word problems

The Myth of Keywords

- Keywords do not—
  - Develop of sense making or support making meaning
  - Build structures for more advanced learning
  - Appear in many problems

- Students use key words inappropriately

- Multi-step problems are impossible to solve with key words (and two step problems start in 2nd grade in CCSS)

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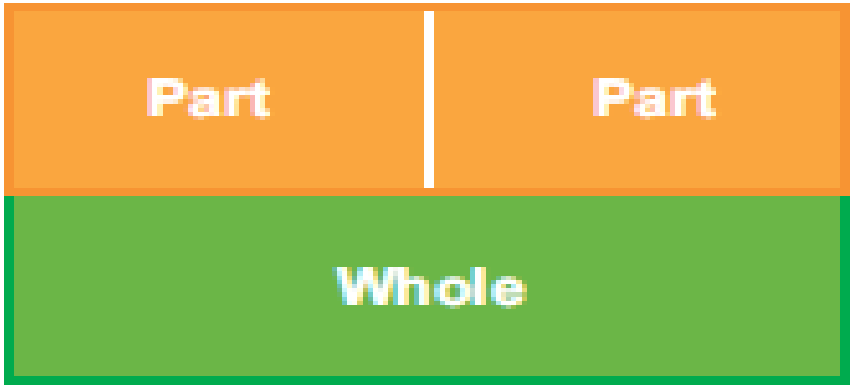
Part-Part- Whole Problem Structure



Two parts that are combined into one whole

Lynnette has 4 fiction and 3 nonfiction books. How many books does she have?

Lynnette and her friend Victoria put 7 books into a backpack. Lynnette put in 4 books. How many books did Victoria put in the backpack?

Van de Walle, J., Karp, K., & Bay Williams, J. (2010). *Elementary and Middle School Mathematics: Teaching developmentally*. New York: Pearson.

Two of Everything - Hong

From Doubling to In pot – and Out pot

Which number sentences would students say are True? False?

$7 = 7$

$2 + 5 = 4 + 3$

$5 + 1 = 7$

$7 = 2 + 5$

- Why?
- What would confuse them?

Diagnostic Interviews for Progress Monitoring

Give a task - collect student's mental strategies

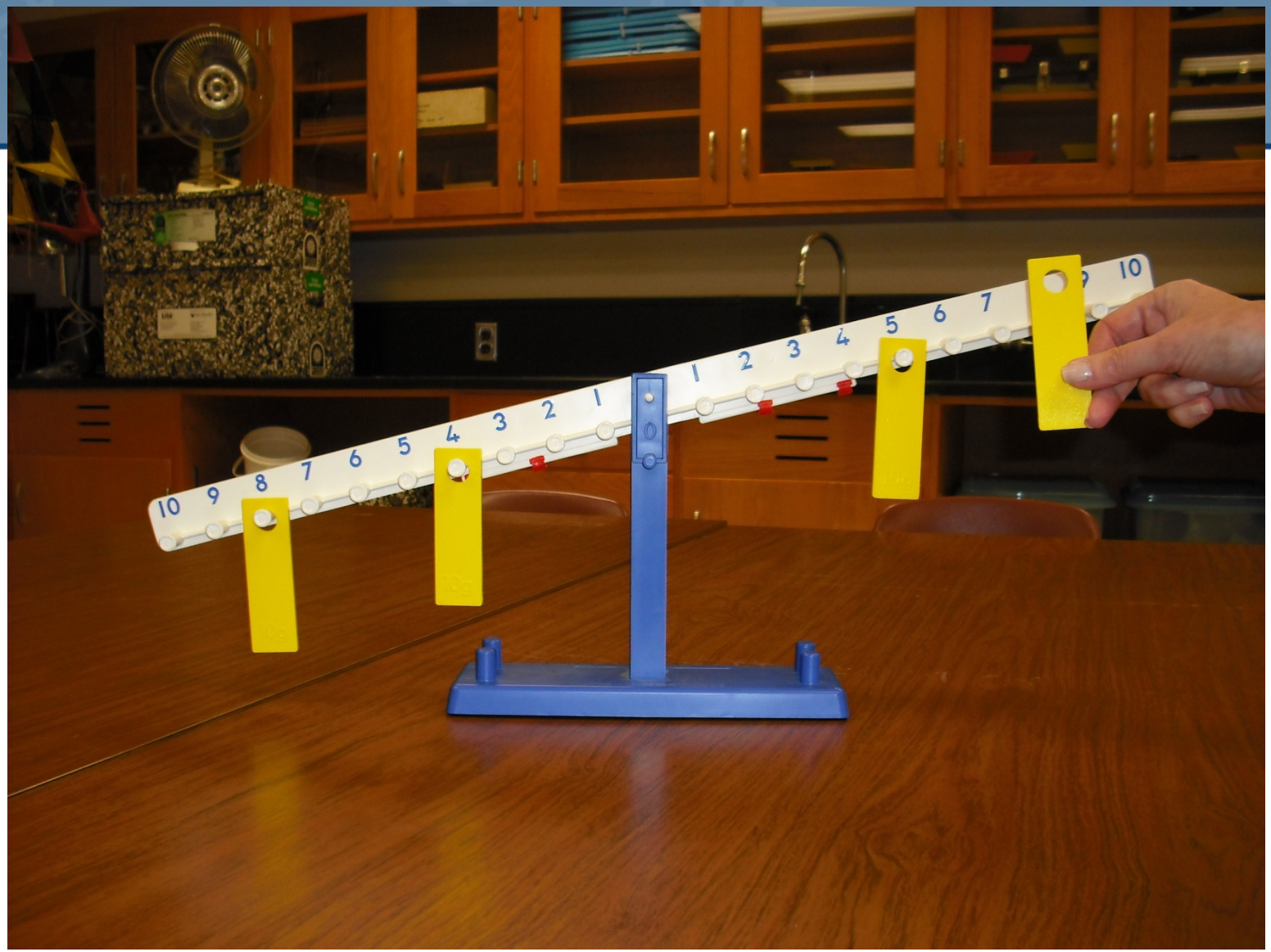
No instruction – just ask questions

Capture student feedback on their thinking

Let students use tools for reasoning

$$8 + 4 = \boxed{12} + 5$$

Use information gathered to improve instruction


10 9 8 7 6 5 4 3 2 1
1 2 3 4 5 6 7 8 9 10

Talk to your Neighbor

- Move a weight from one amount on each side of the balance to a new peg, can you maintain the equality?

- $2x + 3 = 17$?

Equal Sign - Two Levels of Understanding

Operational - students mistakenly see the equal sign as signaling something they must "do" with the numbers such as "give me the answer."

Relational - students use the relationships between the two quantities to balance the sides of the equation.

- Do students use relational thinking to generalize rather than actually computing the individual amounts.?
- Do they see the equal sign as relating to "greater than," "less than," and "not equal to."

Van de Walle, J., Karp, K., & Bay Williams, J. (2013). *Elementary and Middle School Mathematics: Teaching developmentally*. New York: Pearson

What is the long term danger?

- If middle grades students think the equal sign means "put the answer next," what happens when they move to algebraic equations such as $3x = 2x + 3$?

Common Core State Standards

Grade 1:
Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. *For example, which of the following equations are true and which are false? 6 = 6, 7 = 8 – 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.*

Multiple Representations

From *Teaching Student Centered Mathematics* (2014) (Volumes I - III)

Diagnostic Interview – Translation Task

Equation	Word Problem
Model/Illustration	**Explanation**

Van de Walle, J., Karp, K., & Bay Williams, J. (2013). *Elementary and Middle School Mathematics: Teaching developmentally*. New York: Pearson.

Translation Task at the Middle School Level

Algebraically	Graphically
Numerically in Tables	**Verbal Description**

Van de Walle, J., Karp, K., & Bay Williams, J. (2013). *Elementary and Middle School Mathematics: Teaching developmentally*. New York: Pearson.

Let's go back to Tier 1 Instruction Headline – *New York Times*

July 27, 2014

(New Math) – (New Teaching) = Failure

Last night's opening session speaker!!!

What were the Main Points?

- Common Core – Fosters intuitive thinking through real-world examples – that **is** the best way to teach math
- Real Problem – Teachers are being asked to teach in ways they've not experienced as students – or have not been taught
- America invented the best ways of teaching math as espoused by NCTM and supporting research – yet not enough teachers are using these methods

NCTM's Principles to Action Effective Teaching and Learning

- **Establish mathematics goals to focus learning.**
- **Implement tasks that promote reasoning and problem solving.**
- **Use and connect mathematical representations.**
- **Facilitate meaningful mathematical discourse.**
- **Pose purposeful questions.**
- **Build procedural fluency from conceptual understanding.**
- **Support productive struggle in learning mathematics.**
- **Elicit and use evidence of student thinking.**

What is the Whole School Agreement?

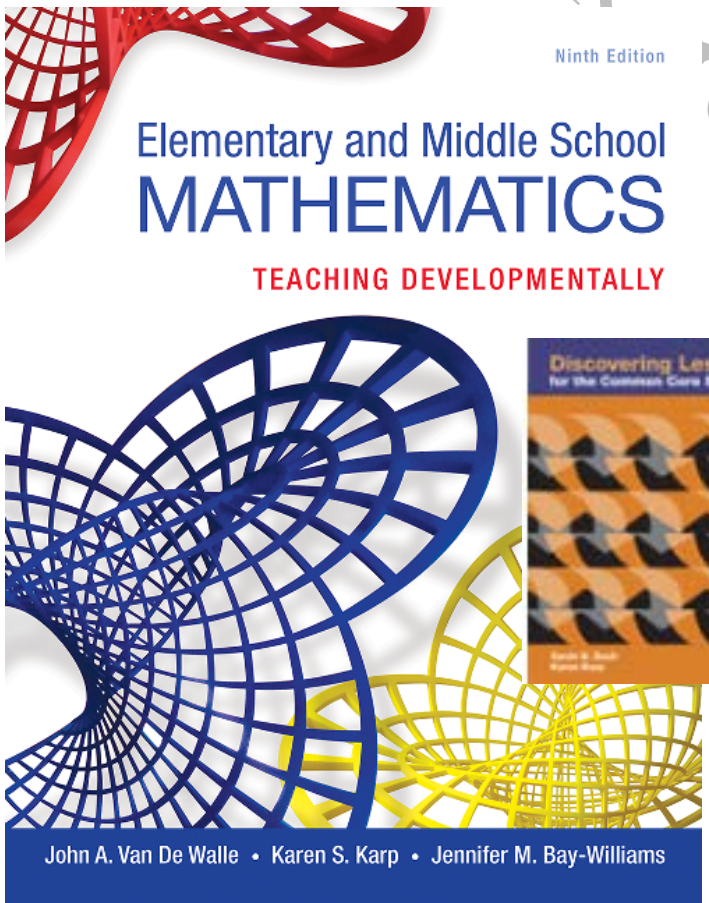
- Decide on the language and models everyone will use – be precise and consistent
- Prepare all students, from the beginning to walk out of the building
- Think about the level of teaching – are challenging students at the highest level?
- Get kids "doing mathematics" so they can build mental residue and long lasting understanding

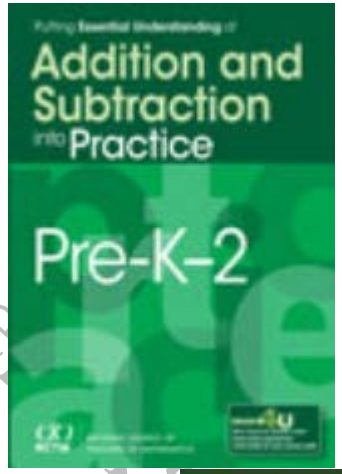
Shifts in Thinking

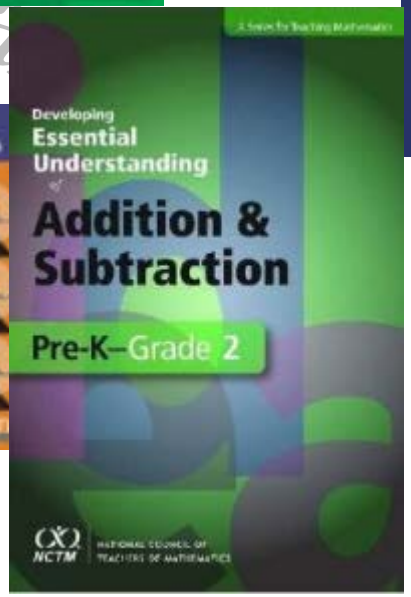
- Teacher talking and doing TO **students talking and doing – never say anything a kid can say**
- Using key words TO **building student understanding with reasoning and sense making**
- Learning disconnected rules and algorithms TO **engaging students in productive struggle with rich, high-quality problems**

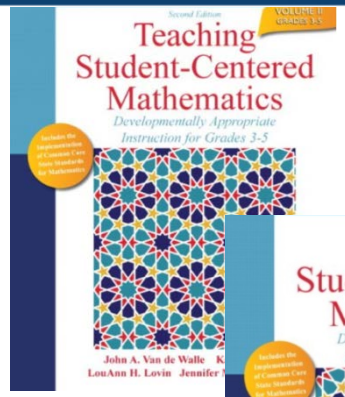
References and Contact Info

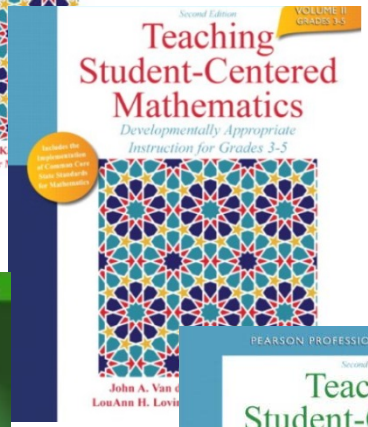
Karen@louisville.edu

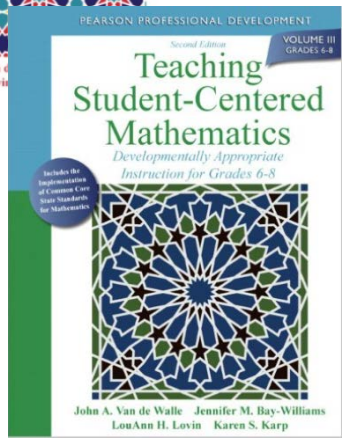












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