

Welcome!

Looking at Tier 1 Instruction and Tier 2 Interventions: Supporting Students who Struggle

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Topics for Today

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



Foundational Questions

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

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

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



Differentiation versus Intervention

- **Differentiation**
 - Occurs during Tier 1 instruction
 - Allows for different abilities in the same instructional session with grade level content – **IN** the curriculum
 - Hides the fact that students are working on different tasks
- **Intervention**
 - Occurs during Tier 2 instruction
 - Develops specific skills and concepts for a targeted group of students to address areas of identified weakness by building on students' strengths
 - Provides intentional foundational support that may not be grade level – may **NOT** be in the curriculum



Why aren't Tier 2 Interventions Helping? Recent Studies Reveal:

- Teachers providing Tier 2 mathematics interventions to elementary and middle grade students largely used computational **worksheets** (Foegen & Dougherty, 2010; Swanson, Solis, Ciullo & McKenna, 2012)
- Studied **reading** with 20,000 students in 13 states and found "students who received RtI performed worse than a similar peer group that did not receive the interventions" - no match of intervention to child - RtI interventions were **rigid and standardized** for all students – is that also true for math?
- In my travels to classrooms and schools many use a **one-size-fits-all generic computer program** (a worksheet on a computer).

Worksheets + computer programs ≠ understanding for students who struggle



What might a student's brain look like?

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



Task Analysis? Maybe Not?

- When you or the materials you use break skills down into small pieces, it requires students to put the pieces together to form the whole.
- Are students who struggle good at that?

Dougherty 2012 Access for All – Using Response to Intervention Techniques, NCTM Algebraic Thinking



Intervention Recommendations from Research

- Concrete--Semi-Concrete--Abstract (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, R., & 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 at the right are always true.
- If the rule 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.**



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*) TCM article of the YEAR!



What do we know?

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



Let's Start with Word Problems

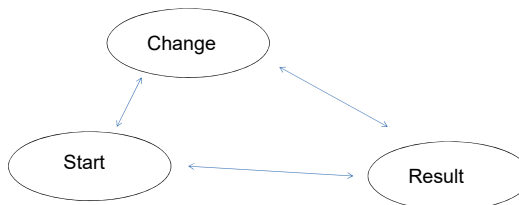
At all grades students who struggle see each problem as a **separate endeavor**

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



Distinguish Between the Behavior of the Operations

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: $11 + 6 = \square$

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

$11 + \square = 17$ or an equivalent equation $17 - 11 = \square$

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

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.

The Infamous Shepherd Problem

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

Other options?

Would your students be able to discern which of the following three options would be the correct answer?

- The shepherd is 30 years old
- The shepherd is 125 years old; and
- It is not possible to tell the shepherd's age from the information given in the problem.

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

Van de Walle, J., Karp, K., & Bay Williams, J. (2016). *Elementary and Middle School Mathematics: Teaching developmentally*. New York: Pearson.  NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

Which number sentences would students say are True? False?

$$7 = 7$$

$$2 + 5 = 4 + 3$$

$$5 + 1 = 7$$

$$7 = 2 + 5$$

- Which equation formats would confuse your students?

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Diagnostic Interviews

- Collect **in-depth** information about an individual student's knowledge and mental strategies.
- Provide evidence of **students' prior knowledge, naïve understandings** and **ways of thinking**
- Focus on a task/problem where students are asked to verbalize their thinking and/or demonstrate ideas through **multiple representations**
- Is **not a teaching opportunity**
- Use errors to **identify barriers to understanding** and to **inform instructional decisions**

Van de Walle, J., Karp, K., & Bay Williams, J. (2016). *Elementary and Middle School Mathematics: Teaching developmentally*. New York: Pearson.  NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

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 students see the equal sign as relating to the symbols for “greater than,” “less than,” and “not equal to?”

Van de Walle, J., Karp, K., & Bay Williams, J. (2016). *Elementary and Middle School Mathematics: Teaching developmentally*. New York: Pearson.  NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

Well-Child Checkup

- All students in your building need to have their temperature taken on this important concept
- Must identify students who harbor this misconception about the equal sign

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Diagnostic Interview – Translation Task

Equation	Word Problem
Model/Illustration	Explain your Thinking

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Translation Task at the Middle School Level

Algebraically	Graphically
Numerically in Tables	Explain your Thinking

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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

Karp, Bush & Dougherty (2016) *Establishing The Whole School Agreement*. NCTM.



We emphasized

- ❖ Action and the importance of “doing mathematics”
- ❖ By carrying out the actions – mental residue results!!
- ❖ MAKE MATH MEMORABLE



References and Contact Info

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