UNDERSTANDING RTI IN MATHEMATICS

Session 1: RTI in Math in the Context of the Common Core

New York State Webinars on RTI Mathematics
Tuesday, November 18, 2014
4:00 – 5:15 pm EST

Russell Gersten, Ph.D.
Director, Instructional Research Group
Professor Emeritus, University of Oregon

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TOPICS FOR WEBINAR SESSIONS 1 & 2

Webinar Title	Date/Time	Agenda
RtI in Math in the Context of the Common Core	Tuesday, November 18th 4:00-5:15 pm EST	• Effective Core Instruction in Mathematics
RtI Principles and evidence base (con) Why start early with RtI? Universal Screening	Tuesday, November 25th 4:00-5:15 pm EST	• Key Principles of RtI and Mathematics • Importance of mathematics growth in K and 1 • Importance of fractions for success in algebra • Screening ✓ Tools and measures ✓ Using Screening Data to Determine Who's At-risk • Roadblocks & Suggestions

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TOPICS FOR WEBINAR SESSIONS 3 & 4

Webinar Title	Date/Time	Agenda
Effective Instructional Practices in Mathematics for Tier 2 and Tier 3 Instruction	Tuesday, December 2nd 4:00-5:15 pm EST	• What to Teach • Nature of Instruction: Controversies and what we know about the nature of explicit instruction • Intervention Materials/Resources • Roadblocks & Suggestions
Progress Monitoring and its Use in intensive intervention	Tuesday, December 9th 4:00-5:15 pm EST	• Progress monitoring tools • Measures • Frequency • Using PM Data to Determine Response

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POLL ITEM 1: WHICH STATEMENT BEST TYPIFIES YOU?

1. I love mathematics
2. I like mathematics
3. I can live with it or without it.

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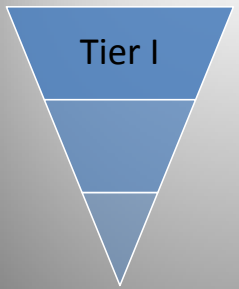
TIER I: CORE CLASS INSTRUCTION



Tier I is defined differently by experts.

Only common feature:

1. Universal screening of all students

Other possible components:

1. Ongoing professional development for classroom teachers on how to use research
2. Differentiated instruction
3. High quality mathematics instruction
4. Scientifically based mathematics instruction

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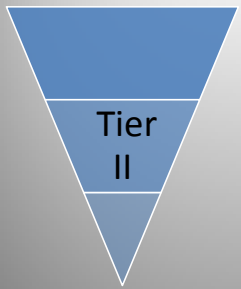
TIER II: SMALL GROUP INTERVENTION



1. Tier II is individual or small-group intervention in addition to the time allotted for core mathematics instruction.
2. Tier II includes curriculum, strategies, and procedures designed to *supplement, enhance, and support* Tier I.
3. Can backtrack and/or elaborate/reinforce classroom curriculum.
4. Progress monitoring of students "at-risk" on a monthly or weekly basis.

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EFFECTIVE CORE (TIER 1) IN MATHEMATICS IN THE ERA OF THE COMMON CORE

Beyond the Math Wars

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CONTEXT

1. RtI mathematics is relatively new
2. There are many divergent views
3. Goal here is to understand perspectives but also learn about the evidence base
4. Thus, a good deal of Session 1 will focus on evidence base and what it means
5. Will present a vision of effective explicit instruction that should be useful for Tier 1 and Tiers 2 and 3.

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GOALS OF THE SESSION

1. Provide a framework for understanding effective Tier 1 practice.
2. Introduce current research on Tier 1 mathematics and its limitations.
3. Elucidate areas of tension, confusion, void of evidence.
4. Provide an overview of the current evidence base
5. Ultimate goal: Understanding RtI in mathematics

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POLL QUESTION 2: WHICH BEST DESCRIBES YOUR ROLE?

1. RtI specialist or coordinator
2. Mathematics teacher
3. Classroom teacher
4. Special education teacher
5. School psychologist
6. Interventionist
7. Other

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THE COMMON CORE IN A NUTSHELL

1. Students need to understand reasons for procedures
   - ✓ orally,
   - ✓ in writing,
   - ✓ through diagrams/visual representations

This sets the stage for students being ability at mathematical proof and discussions of mathematical ideas.

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THE COMMON CORE IN A NUTSHELL (1)

Link between arithmetic and algebra explicit

1. Algebra is a general case of arithmetic (in the view of many mathematicians)– ongoing work is to develop this insight
2. Much of arithmetic is extension of commutative, associate and distributive properties of addition and multiplication– much of the work is to develop these insights
3. Heavy emphasis on demonstrating understanding
4. Heavy emphasis on visual models and graphic models

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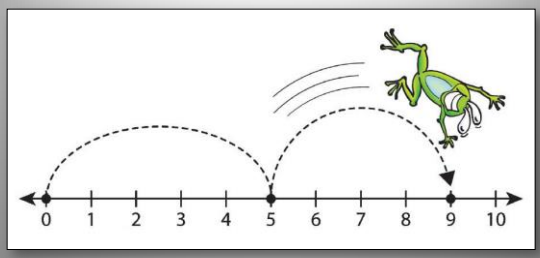
LIFE ON THE NUMBER LINE

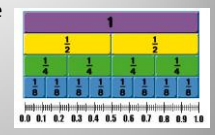


COMMON CORE IN A NUTSHELL (2)

1. Covers fractions more than 1 and less than 1 **concurrently**
2. Word problems integrated with symbols/operations from the start
3. Ideas (concepts) and procedures linked
4. Major stress on number line
5. KEY ISSUE: **how to teach???**

WHY ARE FRACTIONS SO HARD?

1. Numbers of the same magnitude can look different (e.g., ¾ and 9/12)
2. Sometimes, when numerals get bigger, the fraction gets smaller (1/4, 1/6, 1/8)



3. Not always the case, however (2/4 < 6/7)
4. Infinite amount of numbers between 2 fractions.

APPROACH TO FRACTIONS SEEN AS KEY SHIFT IN COMMON STANDARDS

…But in what many experts are calling one of the biggest shifts associated with the Common Core State Standards for mathematics, more teachers are now being asked to emphasize fractions as points on a number line, rather than just parts of a whole, to underscore their relationships to integers.

Source: Heitan, L. (2014).
http://www.edweek.org/ew/articles/2014/11/12/12cc-fractions.h34.html

BARRIERS

1. Most of us are asked to teach mathematics differently than how we learned it.
2. Some teachers lack the knowledge of the mathematical ideas and concepts required by Common Core… especially in fractions and geometry.

HOW TO DEVELOP THESE INSIGHTS AND UNDERSTANDINGS THAT ARE STRESSED IN COMMON CORE?

1. Asking students to explain reasoning

   AND
2. Build proficiency with arithmetic computations
3. Some research to guide us:
   - ✓ Research of Bob Siegler and colleagues: e.g. Rittle-Johnson, B., Siegler, R. S., & Alibali, M. W. (2001).
   - ✓ Research by Ken Koedinger and colleagues

HOW TO DEVELOP THIS LEVEL OF PROFICIENCY

1. Instruction includes:
   - ✓ procedures
   - ✓ AND concepts
   - ✓ AND word problems

   This is a reciprocal relationship.
2. Whole number work consistently links operations to number properties
3. Same true for work with rational number (fractions/decimals)

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BRIEF SET OF INSIGHTS FROM EXPERIMENTAL COGNITIVE PSYCHOLOGY

1. May be good idea to teach procedure/algorithm one day and focus on ideas and visual representations on alternate days (e.g. work of Rittle Johnson and Koedinger on linear equations)
2. May be good idea to expeditiously use manipulatives even in middle school (e.g. research of Brad Witzel and Paul Riccomini)

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POLL ITEM

In which of the following are the three fractions arranged from least to greatest?

A. $\frac{5}{9}, \frac{1}{2}, \frac{2}{7}$ C. $\frac{5}{9}, \frac{2}{7}, \frac{1}{2}$ $\frac{2}{7}, \frac{1}{2}, \frac{5}{9}$

D. $\frac{1}{2}, \frac{2}{7}, \frac{5}{9}$ $\frac{1}{2}, \frac{5}{9}, \frac{2}{7}$ E.

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NAEP

1. Many American students are unable to solve fractions problems in middle or even high school.
   - ✓ Example: NAEP Grade 8 in 2007: Pass rate = 49%
2. Most think that the reason for poor performance on these items is that students never understood the mathematical ideas relating to fractions.

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FROM COMMON CORE

Standard 4.NF.3:

Understand a fraction a/b with $a > 1$ as a sum of fractions $1/b$.

a. Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by **using a visual fraction model**.

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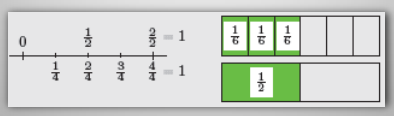
STRIP DIAGRAMS (AKA FRACTION STRIPS, FRACTIONS TILES) CAN BE USED DEMONSTRATES APPROPRIATE MATHEMATICAL MODELS



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EXAMPLE

1. Assignment: Use the lowest common denominator when appropriate

   ½ + ⅓ =

2. Student Response

   ½ + ⅓ = ⅖

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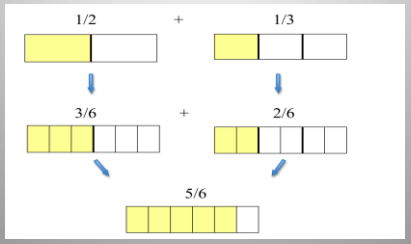
STRIP DIAGRAMS HELPS WITH UNDERSTANDING OF FRACTIONS



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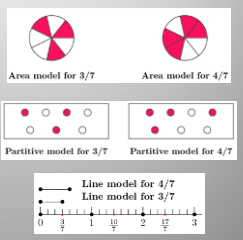
EXPEDITIOUS USE OF CONCRETE OBJECTS TO ENSURE STUDENTS UNDERSTAND VISUAL REPRESENTATIONS

Concrete

Visual Representations



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RECAP: GOALS

Core instruction must allow students to

1. demonstrate understanding
2. use visual models
3. solve problems in more than one way

Goal is, in part, to develop insights into mathematical ideas, the ideas that are foundational to algebra (and geometry and measurement)

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RECAP: HOW TO DO IT (1)

1. Frequent use of visual representations especially number line
2. Strip diagrams are a great tool for helping students transition to number line.
3. Expeditious use of manipulatives also a great tool.
4. Integration of work on mathematical ideas/concepts and procedures (e.g. computation)
5. Integration of word problems

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RECAP: HOW TO DO IT(2)

6. Frequent teacher think alouds
7. Explicit instruction that helps create the links
8. Students given many opportunities to demonstrate understanding/explain

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POLL QUESTION: WHICH IS GREATEST CHALLENGE FOR YOU OR YOUR SCHOOL?

1. Frequent use of visual representations especially number line
2. Strip diagrams are a great tool for helping students transition to number line.
3. Expeditious use of manipulatives also a great tool.
4. Integration of work on mathematical ideas/concepts and procedures (e.g. computation)
5. Integration of word problems
6. Frequent teacher think alouds
7. Explicit instruction that helps create the links
8. Students given many opportunities to demonstrate understanding/explain

VIDEO EXAMPLE OF EXPLICIT INSTRUCTION

1. Links to visual representations and concrete representations
2. Thinking aloud
3. Note how different this is than modeling a procedure

NB: *This is a simulation so there are no students*

CORE MATHEMATICS INSTRUCTION

What does research have to say about effective Tier 1 mathematics instruction?

DIRECT OBSERVATION STUDY

1. A study of direct observation of one day's of mathematics instruction (on average 1 hour 10 minutes) in

   First grade: Almost 4000 students in 364 classrooms

   Second grade: Almost 3000 students in 269 classrooms throughout U.S.

   - ✓ A national sample
   - ✓ Curricula used included a wide range (Saxon, Investigations, Mathematics Expressions, Scott Foresman)
   - ✓ All Title I

Source: Clements, D. H., Agodini, R., & Harris, B. (2013).

WHAT THEY FOUND

For first grade, two practices linked with higher mathematics proficiency:

1. Teachers telling students the strategy to use in response to students' work or answers
2. Higher percentage of math instructional time spent in a large-group instruction

For second grade:

3. Teachers asking the class if it agrees with a student's answer
4. Number of representations that teachers demonstrate
5. Students help one another understand math concepts or procedures

BUT TWO LED to DECREASES:

6. Teachers eliciting multiple strategies or solutions
7. Teachers prompting a student to guide practice or lead the class in a routine

Note: Red means linked to earlier discussion

POLL: WHICH FINDING MOST SURPRISING

1. Frequent use of visual representations especially number line
2. Strip diagrams are a great tool for helping students transition to number line.
3. Expeditious use of manipulatives also a great tool.
4. Integration of work on mathematical ideas/concepts and procedures (e.g. computation)
5. Integration of word problems
6. Frequent teacher think alouds
7. Explicit instruction that helps create the links
8. Students given many opportunities to demonstrate understanding/explain

CAVEATS

This was not a study of **quality** of each teaching practice.

Research looked at quantity of each

Yet, these do provide food for thought.

MORGAN, P. L., FARKAS, G., & MACZUGA, S. (2014). *WHICH INSTRUCTIONAL PRACTICES MOST HELP 1ST GRADE STUDENTS WITH AND WITHOUT MATHEMATICS DIFFICULTIES?*

1. Morgan et al. looked at factors in Tier 1 in first grade that increased achievement of students in the at risk category. These findings have some relevance for RtI.
2. Database was nationally representative.
3. Here, teaching practice was from teacher report **not direct observation.**

FINDINGS

When researchers statistically adjusted for pretest score and demographic factors,

1. These students did better when teacher-directed practices were used.
   - ✓ In particular, when teachers did what they called "routine drill and practice".
   - ✓ As with earlier study, effects were not large (effect size of .05-07) or a few percentile points, on average.
2. Classes with a good deal of use of manipulatives, calculators or music tended to produce more students in the at-risk category.

TAKE AWAY

1. For students not considered at risk, both teacher-directed and student-centered practices were helpful.
2. This suggests:
   - ✓ Neither all inquiry nor all teacher-directed works best for all.
   - ✓ At-risk learners need more explicit instruction and more practice than others.

Source: Morgan, P. L., Farkas, G., & Maczuga, S. (2014).

RECAP WITH RESEARCH INTEGRATED

1. Mix of teacher-directed and student-centered (peer or group activities) instruction seems optimal for average students.
2. Explicit instruction can, and should, include think alouds.
3. Integration of work on mathematical ideas/concepts and procedures (e.g. computation).
4. All instruction (explicit and student activities) should include frequent use of a small set of visual representations especially number line.
5. Strip diagrams are a great tool for helping students transition to number line.
6. Integration of word problems with work on mathematical ideas-can be back to back lessons- think alouds or problems assigned can be the links.
7. Students given many opportunities to demonstrate understanding/explain.
8. Especially for students in at-risk category plenty of practice necessary to ensure fluent and proficient calculation proficiency and to ensure that mathematical ideas are understood.

RELEVANCY

1. Most of this is relevant to intervention

Food for thought: How much to link intervention (Tier 2 especially) to grade level content?

NEXT WEEK

Webinar Title	Date/Time	Agenda
RtI Principles and evidence base (con) Why start early with RtI? Universal Screening	Tuesday, November 25th 4:00-5:15 pm EST	• Key Principles of RtI and Mathematics • Importance of mathematics growth in K and 1 • Importance of fractions for success in algebra • Screening ✓ Tools and measures ✓ Using Screening Data to Determine Who's At-risk • Roadblocks & Suggestions

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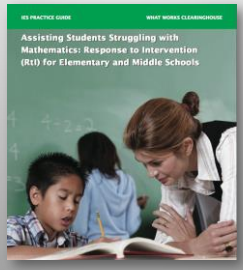
HTTP://IES.ED.GOV/NCEE/WWC/PRACTICEGUIDE.ASPX?SID=2
OR GOOGLE PRACTICE GUIDE



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