RtI: Response to Instruction and Intervention and Mathematics

The Potential for Mathematics Education

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Instructional Research Group

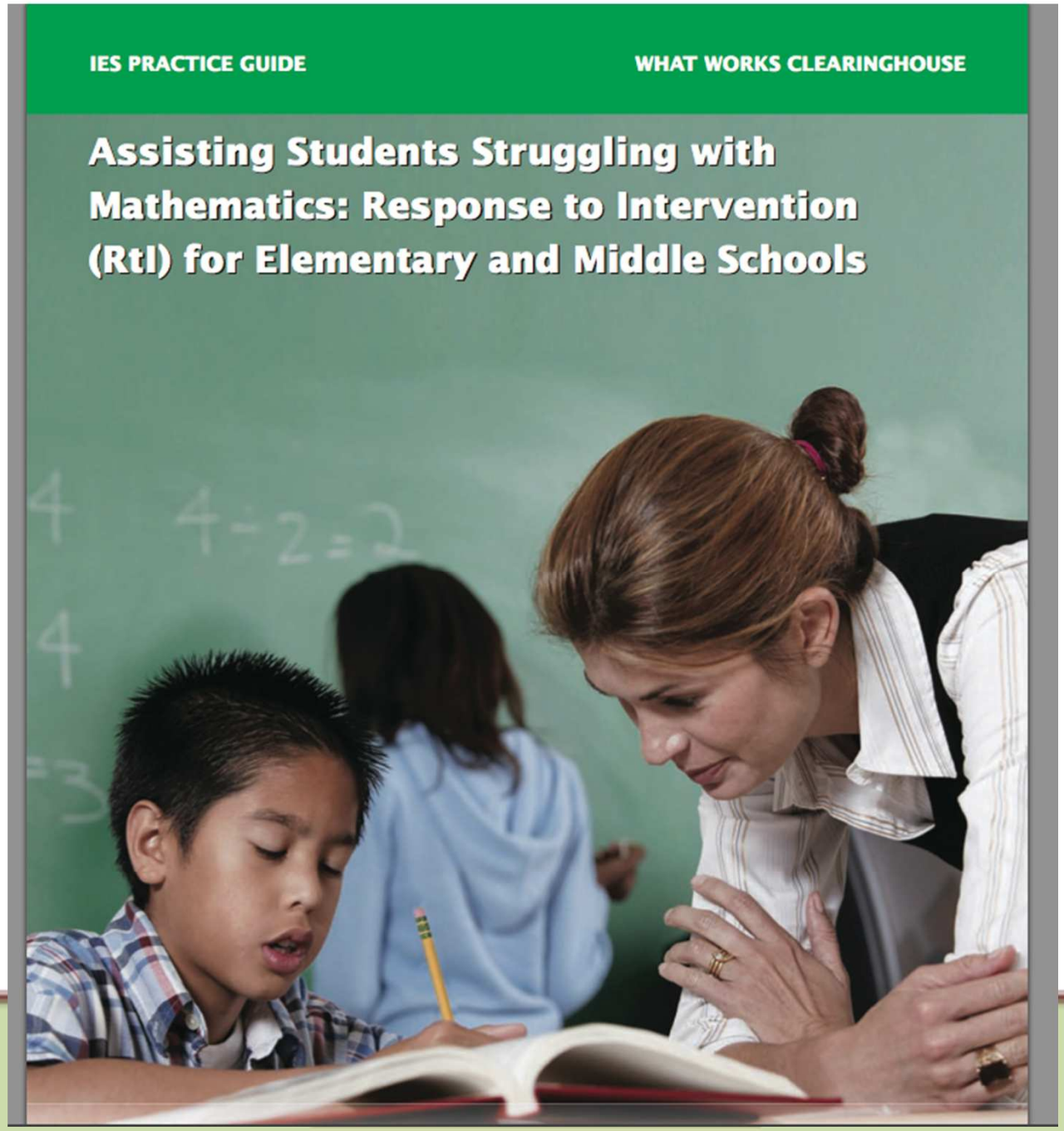
Inattention to RtI in Mathematics

- Forty years ago the ratio of reading disability studies to mathematics disabilities studies was 100:1 (401 studies to 4 studies)
- Collective education research from 1996- 2005 – 14:1 (622 reading disability studies to 43 mathematics disability studies)
- If looking at disability studies in medical-related journals 18:1 (1736 reading to 95 math)
- Where's the research?

Source: Gersten, Clarke, Mazzocco (2007)

Never the Twain Shall Meet?

- Annual TED conferences show
  - 3 out of 150 sessions in 2009 (2.0%)
  - 6 out of 348 sessions in 2010 (1.7%)
- Annual AMTE conferences show:
  - 0 out of 146 sessions in 2008 (0.0%)
  - 2 out of 141 sessions in 2009 (1.4%)
  - 2 out of 158 sessions in 2010 (1.2%)
- Annual NCTM conferences show:
  - 15 out of 753 sessions in 2010 (1.9%)
  - 7 out of 768 sessions in 2011 (0.9%)
- Annual NCTM Research presession 2010:
  - 0 out of 126 sessions (0.0%)


IES PRACTICE GUIDE
WHAT WORKS CLEARINGHOUSE
Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools

Structure of the Practice Guide

- Recommendations
- How to carry out the recommendations
- Levels of evidence
- Potential roadblocks & suggestions

- This report is available on the IES web site at http://ies.ed.gov/ncee/wwc/publications/practiceguides/

Adjust the difficulty of the problems on the basis of the students' success.

Consequences: If misbehavior occurs, take Michael aside and remind him of behavior expectations during whole-group lessons. Describe how the observed behavior affects students' learning. If behavior persists, give Michael a choice of participating in the lesson or relocating to a designated area to work on problems independently until he is ready to return to the whole group.

As demonstrated in the example, teachers' attention to the antecedents and consequences of reoccurring behavior problems can inform the development of more effective and efficient behavioral support strategies to prevent or reduce behaviors that interfere with successful classroom learning.

Potential roadblocks and solutions

Roadblock 1.1. *"I don't know how to collect all this information about behavior problems when I'm trying to teach a room full of students."* General education teachers in public schools must attend to, on average, more than 20 students in their classroom,[15] so to add data collection responsibilities to their tasks can seem impractical or impossible.

Suggested Approach. We recommend keeping methods of information gathering very simple. For example, if the problem behavior occurs several times a day, we recommend that teachers record occurrences over just a few days. If the problem behavior occurs infrequently (such as a few times a week), we recommend that teachers gather data over one or two weeks to be sure to include enough instances of the behavior to inform a plan for intervention. For daily observations teachers can use a chart of their daily classroom schedule and make a simple tally under the time of day and lesson activity when the target behavior occurs (see table 3).[16] Over time patterns should become apparent, showing when the behavior is more likely and less likely to occur. For a behavior of low frequency teachers can make a very brief entry in a notebook or journal during transition periods (for example, at recess or between lessons) or at the end of the day about the immediate antecedents and consequences of the target behavior (see table 4).[17] After recording and reviewing a number of these observations, teachers should be able to denote patterns in the frequency and triggers of the misbehavior.

Roadblock 1.2. *"This classroom so many behavior problems I don't know where to start."* Student problem behaviors can be a source of great frustration and confusion to teachers, especially when they are persistent and appear to be inexplicable.

Suggested Approach. Multiple problem behaviors, such as disruption, inattention, and noncompliance, often originate from similar student needs, so by concentrating on one behavior in one setting, teachers may have a positive impact on others. We suggest that the teacher identify one priority behavior problem—not necessarily the most troublesome or disruptive—on which to focus initial efforts. By assessing the antecedents and consequences that prompt and reinforce the problem behavior and developing strategies that specifically link to the underlying function of the student's

15. U.S. Department of Education (2004).

16. The example data collection tool was adapted from O'Neill et al. (1997), p. 29. In table 3, each tally mark represents an occurrence of the high-frequency target behavior.

17. The example data collection tool was adapted from O'Neill et al. (1997), p. 33. Using table 4, teachers can enter information about low-frequency problem behaviors by describing the behavior in concrete terms and its antecedent(s) and consequence(s).

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The Research Evidence

- The panel considered:
  - High quality experimental and quasi-experimental studies.
  - Also examined studies of screening and progress monitoring measures for recommendations relating to assessment.

Evidence Rating

- Each recommendation receives a rating based on the strength of the research evidence.
  - Strong
  - Moderate
  - Minimal

Panelists

- Russell Gersten (Chair), *Instructional Research Group (IRG), Professor Emeritus University of Oregon*
- Sybilla Beckmann, *University of Georgia*
- Ben Clarke, *Pacific Institute for Research/Instructional Research Group*
- Anne Foegen, *Iowa State University*
- Laurel Marsh, *Howard Count Maryland School District*
- Jon R. Star, *Harvard University*
- Bradley Witzel, *Winthrop University*

Search for Coherence

Panel works to develop 5 to 10 assertions that are:

- Forceful and useful
- And COHERENT
- Do not encompass all things for all people
- Do not read like a book chapter or article
- Cover grades K-8

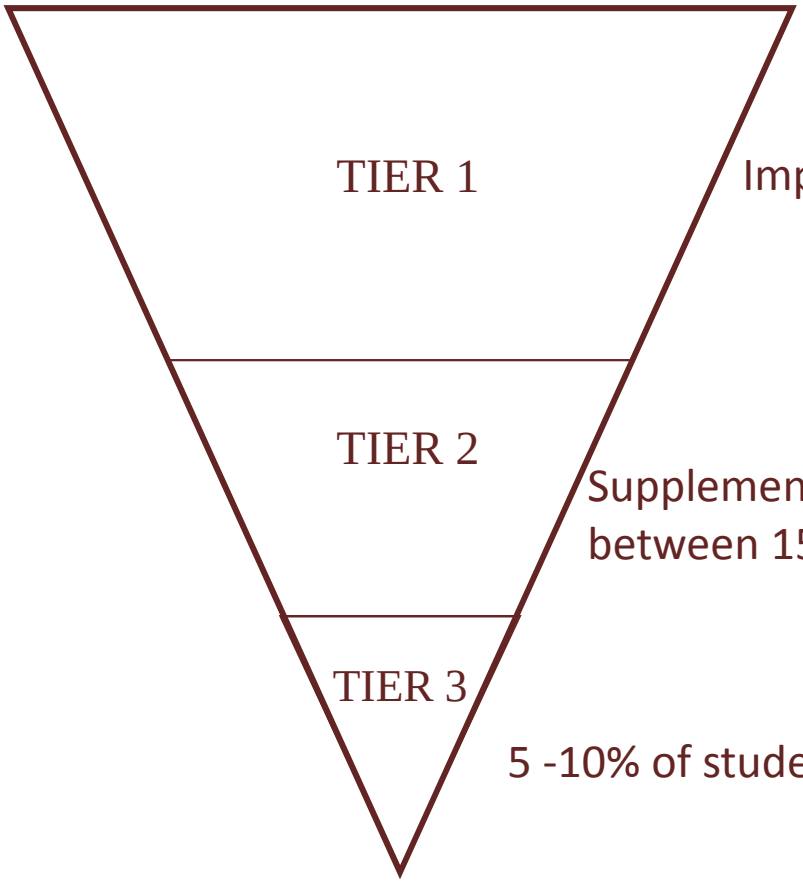
Challenges for the panel:

- State of math research
- Paucity of rigorous research on mathematics instruction

Jump start the process by using individuals with topical expertise and complementary views

Consciously infuse math education thinking

RTI Model



Improve classroom instruction for all students.

Supplemental small group instruction. Typically between 15-25% of students.

5 -10% of students receive the most intensive instruction.

Instructional Research Group

Think (Pair Share) #1

Which 2 recommendations do you focus on the most?

Which Recommendation would you like to learn more about ?

Recommendation
1. Universal screening (Tier 1)
2. Focus instruction on whole number for grades k-5 and rational number for grades 4-8
3. Systematic instruction
4. Solving word problems
5. Visual representations
6. Building fluency with basic arithmetic facts
7. Progress monitoring
8. Use of motivational strategies

Recommendation	Level of Scientific Evidence
1. Universal screening (Tier 1)	Moderate
2. Focus instruction on whole number for grades k-5 and rational number for grades 4-8	Minimal
3. Systematic instruction	Strong
4. Solving word problems	Strong
5. Visual representations	Moderate
6. Building fluency with basic arithmetic facts	Moderate
7. Progress monitoring	Minimal
8. Use of motivational strategies	Minimal

Think Pair Share #2

Which level of evidence is the biggest surprise for you?

Why?

Which do you focus on that have minimal evidence?

Recommendation 1

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

Level of Evidence: **Moderate**

Evidence

- Technical evidence for *validity and reliability* of assessments:
  - K-2: **Strong**
  - Grades 3 and up: **Minimal**

Features

- Short duration measures (1 minute fluency measures)
  - Note many measures that are short duration also used in progress monitoring.
- Longer duration measures (untimed up to 20 minutes) often examine multiple aspects of number sense
  - Issue of purpose is critical to examine
- Most research examines predictive validity from Fall to Spring.

Magnitude Comparison

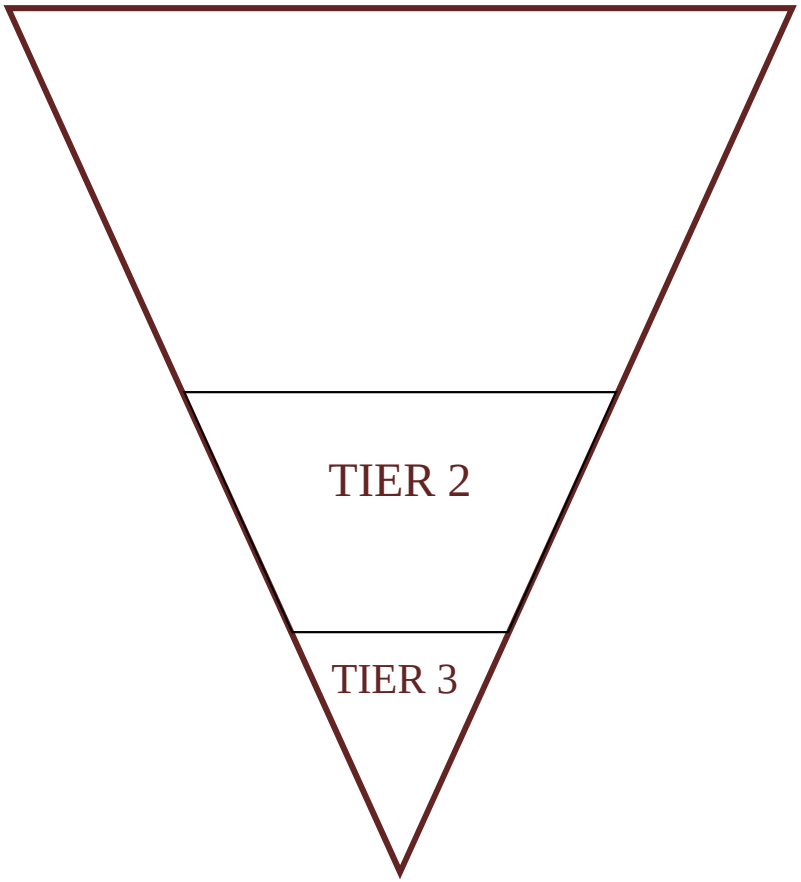
Which is bigger?

- 11 or 9?
- 79 or 95?
- 19 or 23?

Other Possible Constructs

1. Strategic counting
2. Basic Facts (start in grade 1)
3. Word Problems
4. Attentiveness (Morgan, Farkas, Hillemeier, & Maczuga, 2009)

TIER 2 & TIER 3



- **Tier 2**
  - Is individual or small-group intervention *in addition to the time allotted for core mathematics instruction.*
  - Includes curriculum, strategies, and procedures designed to *supplement, enhance, and support* core classroom instruction.
  - Can backtrack and/or elaborate/reinforce classroom curriculum.
- **Tier 3**
  - Includes some one-to-one work and more intense methods.

Recommendation 2
What to Teach in Intervention

Instructional materials for students receiving interventions should focus in-depth on:

- Whole numbers in kindergarten through grade 6
- Rational numbers in grades 4 through 8
- Applications to geometry and measurement

– Level of Evidence: **Minimal**

Evidence

- Consensus across mathematicians, professional organizations, and research panels
  - National Council Teachers of Mathematics (NCTM) and National Mathematics Advisory Panel (NMAP)
  - International comparisons
  - *We made the leap to nature of intervention curricula…*

What to Teach in Intervention (continued)

- Instruction should include:
  - procedures
  - AND concepts
  - AND word problems
- Whole number work consistently links operations to number properties

Recommendation 3

Instruction during the intervention should be **systematic and explicit**. This includes providing models of proficient problem-solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.

– Level of Evidence: **Strong**

Evidence

- Six randomized controlled trials met standards
- Key themes
  1. *Extensive practice with feedback*
  2. *Let students provide rationale for their decisions*
  3. *Instructors and fellow students model approaches to problem solving*

Recommendation 4

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

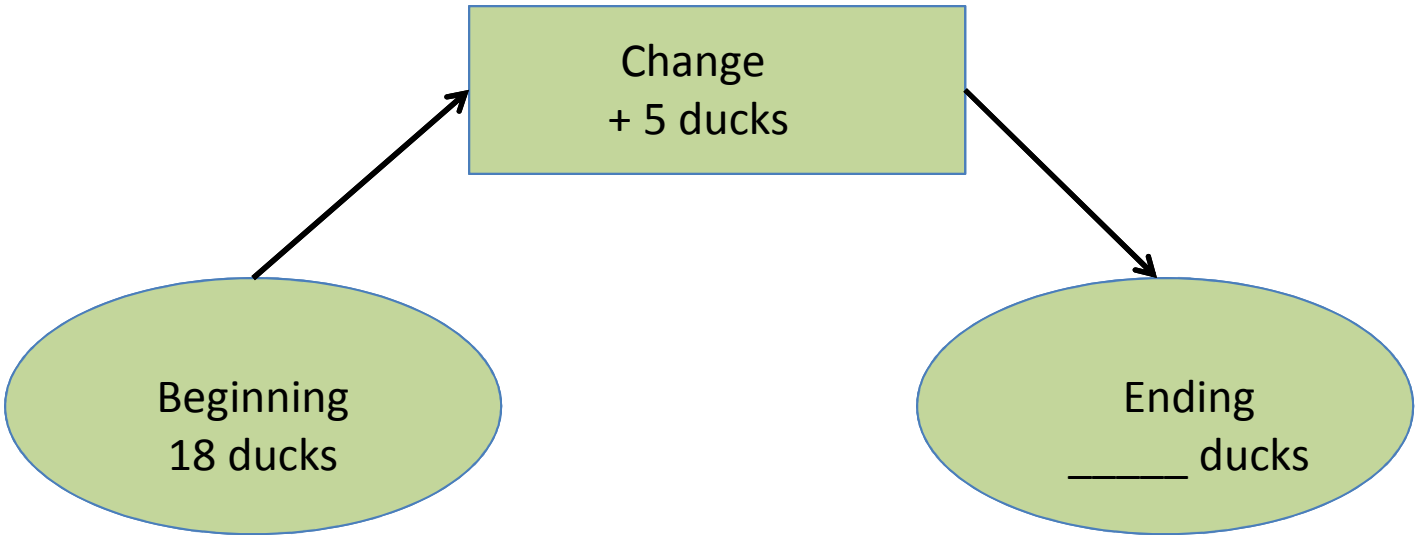
- Level of Evidence: **Strong**

Explicitly Teach the Underlying Structure

- Addition and Subtraction Story Problems
  - Change Problems
    - A quantity is increased or decreased
  - Group Problems
    - Two groups are combined to form a large group
  - Compare Problems
    - Two things are compared to find the difference

Visual Representation for Change Problems

- There are 18 ducks. Then 5 more swim over. How many ducks are there now?

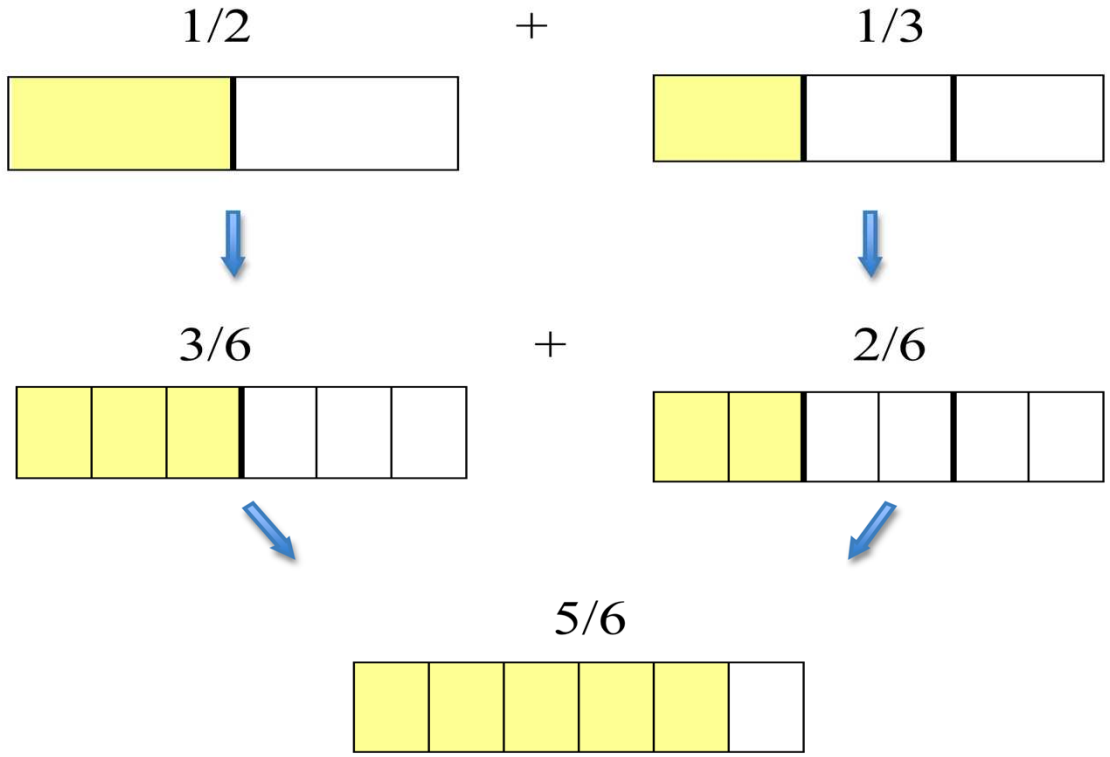


Recommendation 5

Intervention materials should include opportunities for the student to work with visual representations of mathematical ideas, and interventionists should be proficient in the use of visual representations of mathematical ideas.

- Level of Evidence: **Moderate**

Explicit instruction helps with understanding of fractions



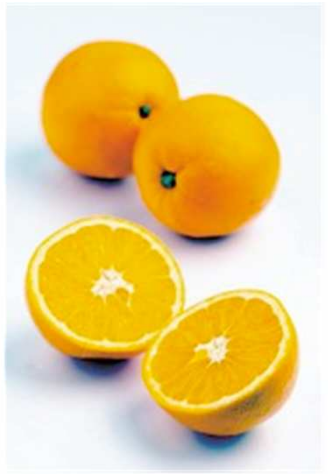
Suggestions

- Use visual representations such as number lines, arrays, and strip diagrams.

- If necessary consider use of concrete manipulatives before visual representations. The goal should be to move toward abstract understanding.

Developing Understanding of Fractions

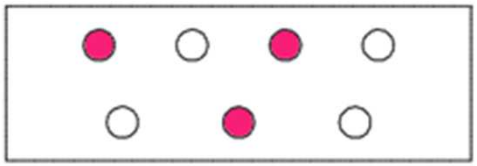
- Concrete



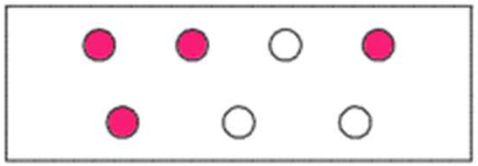
- Visual

Area model for 3/7

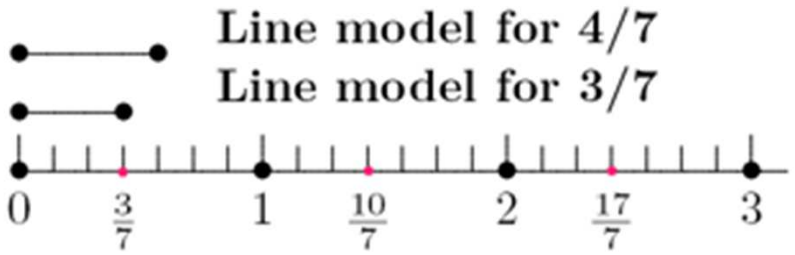
Area model for 4/7



Partitive model for 3/7



Partitive model for 4/7



Recommendation 6

Interventions at all grades should devote about 10 minutes in each session to building fluent retrieval of basic arithmetic facts.

– Level of Evidence: **Moderate**

Recommendation 7

Monitor the progress of students receiving supplemental instruction and other students who are at risk.

- Level of evidence: **Minimal**

  (Note: **Moderate** for Tier 1)

Progress Monitoring Assessment

- Purpose: Frequent, timely measures to determine whether students are learning enough of critical skills.
- When: Weekly or Monthly
- Who: At-risk students
- Relation to Instruction: Indicates student response to instruction.

Magnitude Comparison

Which is bigger?

- 11 or 9?
- 79 or 95?
- 19 or 23?

Suggestions

- Monitor the progress of Tier 2, Tier 3 and borderline Tier 1 students at least once a month using **valid progress monitoring measures of equivalent difficulty**.

- Use formative assessment procedures with evidence of validity.

Recommendation 8

Include motivational strategies in Tier 2 and Tier 3 interventions.

- Level of Evidence: **Minimal**

Roadblocks

- Rewards can reduce genuine interest in mathematics by directing student attention to gathering rewards rather than learning math.

- Suggested Approach: Rewards have not shown to reduce intrinsic interest. As students become more successful, rewards can be faded so student success becomes an intrinsic reward.

Resources

- Fennell, F. (Ed.) (2011). *Achieving fluency: Special education and mathematics*. NCTM.
- Gersten, R., Clarke, B., & Mazzocco, M. (2007). Chapter 1: Historical and contemporary perspectives on mathematical learning disabilities. In D. B. Berch & M. M. M. Mazzocco (Eds.), *Why is math so hard for some children? The nature and origins of mathematical learning difficulties and disabilities* (pp. 7-29). Baltimore, MD: Brookes.
- Gersten, R. & Newman-Gonchar, R. (Eds.) (August, 2011). *Response to Intervention in mathematics*. Baltimore, MD: Brookes.
- Center on Instruction (COI) http://www.centeroninstruction.org
- National Center for Learning Disabilities (NCLD) RTI Action Network http://www.rtinetwork.org/
- National Center on Response to Intervention http://www.rti4success.org
- WWC Practice Guide http://ies.ed.gov/ncee/wwc/publications/practiceguides

Next Steps

~~Beginning Substantive Collaboration~~ between Mathematics Education and Special Education: Teaching Mathematics to Students with Disabilities

- Project goals:
- To build a core community of researchers interested in research related to RtI
- To promote rigorous research on this topic, involving innovative concepts from mathematics education and cognitive psychology
- To promote dissemination of research to relevant practitioners
- To create professional development resources

Questions?

Thank you

Contact Information:

http://www.inresg.org/