Interventions for Struggling Learners in Mathematics

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Sources and Resources

- RtI Practice Guide
- National Mathematics Panel Report
- NCTM Curriculum Focal Points

Foundations for Success

National Mathematics Advisory Panel

FINAL REPORT • SPRING 2008

Panelists
RtI Practice Guide

- Russell Gersten (Chair)
- Sybilla Beckman
- Ben Clarke
- Anne Foegen
- Laurel Marsh
- Jon R. Star
- Bradley Witzel

What is "the problem"?

1. Too many students not learning mathematics well enough
   - For citizenship, continued mathematics study, global competitiveness
   - Social acceptance of not being good at math
2. Pervasive inequality
   - Unequal distribution of mathematical success by race, social class
3. Weak capacity for improvement
   - Public understanding, support, investment
   - Teacher shortages, weak interventions, thin professional knowledge base
   - Teacher educator development and resources

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Charge of the Panels

1. Define what it takes for students to succeed in algebra
2. Identify instructional practices likely to succeed
3. Approach problems in a proactive, preventative fashion
4. Guidance on how to screen students likely to experience problems so that we can intervene “early”

Unique Issues in Mathematics

1. Most of the RtI research has been in reading
2. So many students fail algebra!!!!!!
3. Huge teacher shortages in mathematics
4. The mathematics wars… are they irrelevant?

Key Principles of RtI (Response to Intervention)

- Incorporate prevention and early intervention rather than waiting
- Include universal screening to identify student needs
- Effective practices implemented class-wide in general education mathematics (primary intervention or Tier 1)
- Successive levels of support increasing in intensity and specificity provided to students as needed (secondary/tertiary intervention)

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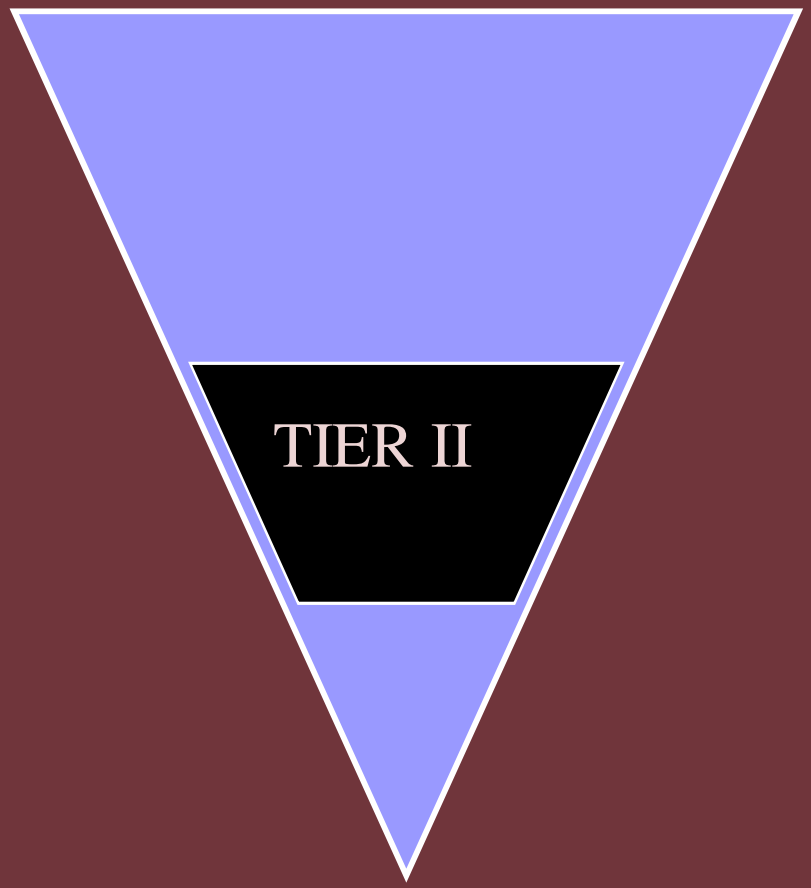
… Challenges for the Panels (and you)

1. Paucity of rigorous research on mathematics instruction
2. Professional communities that do not share a common language (mathematics education, special education and school psychology, research mathematicians, school personnel)
3. Confusion of goals (raising standards for all vs. teaching mathematics to struggling learners at all)

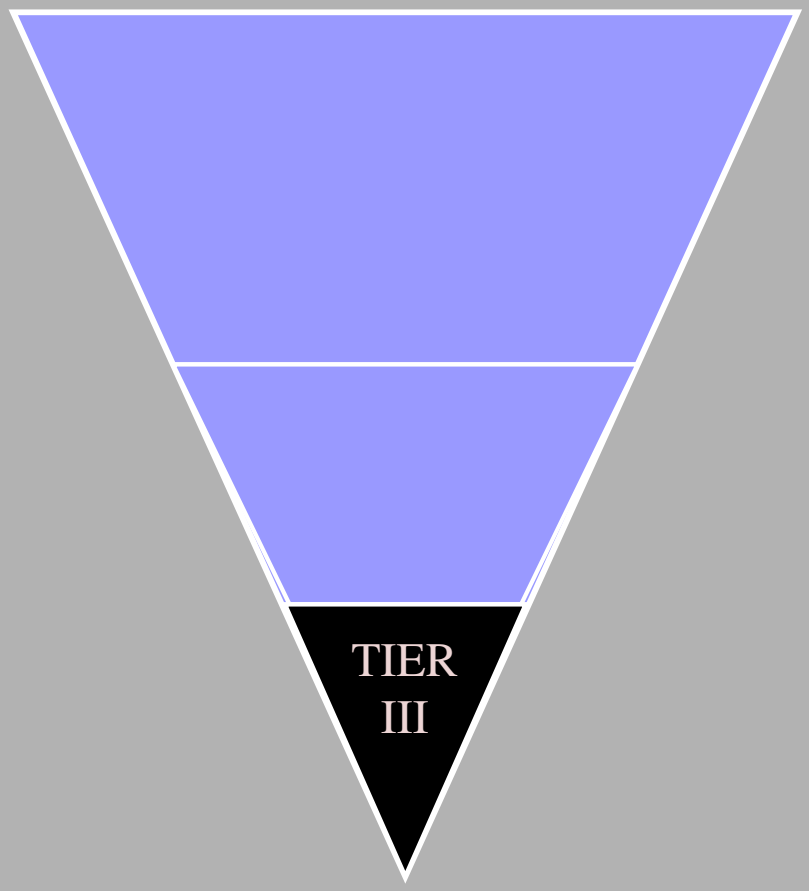
Key Principles of RtI (Response to Intervention)

1. Incorporate prevention and early intervention rather than waiting
2. Include universal screening to identify student needs
3. Effective practices implemented class-wide in general education mathematics (primary intervention or Tier 1)
4. Successive levels of support increasing in intensity and specificity provided to students as needed (Tier 2, 3, special education)

TIER II: SMALL GROUP INTERVENTION



TIER III: INTENSIVE INTERVENTION



- Tier III is specifically designed and customized individual or small-group mathematics instruction that is extended beyond the time allocated for Tier I and Tier II.

NOTE: Some states/districts use 3 tiers and other states use 4 tiers.

What Research Says about RtI in Mathematics & How to Help Struggling Students

- Tier 1
  - Universal Screening****
- Tier 2 and Tier 3
  - Focus instruction on whole number for grades k-5 and rational number for grades 6-8.
  - Systematic instruction*****
  - Solving word problems by learning underlying structure*****
  - Use of Visual Representations***
  - Building fluency with basic arithmetic facts***
  - Progress monitoring
  - Use of motivational strategies

Where We Stand with Universal Screening in Mathematics

Moderate Level of Evidence

Content of Screening Measures

- Single aspect of number sense for K-2

For grades 2 and up: Probably measures state standards, voluntary national standards (?) National Mathematics Panel Benchmarks

- For grades 4 and up: Use state assessment as first screen

What is Number Sense?

Indicators of number sense:

Which number is bigger?:

- 14 or 8? (Kindergarten)
- 802 or 97?
- 3/5 or 19/99?

Show me two ways to solve this problem:

(Knowledge of estimation)

81 – 39

Focus of Interventions: K-5

Instructional materials for students receiving interventions in K-5 should focus intensely on in-depth coverage of

- not only knowing how to compute
- BUT developing a working knowledge of number properties

- Level of Evidence: **Low**

...What Does Conceptual Understanding Mean?)

What are Number Properties?

Commutative property

3 plus 8 is the same as 8 plus 3

And other thrillers such as associative property, distributive property: place value/composition and decomposition

E.g. 18 plus 5 is the same as 20-2 plus 5 etc. etc. etc.

Focus of Interventions

Instructional materials for students receiving interventions should focus intensely on in-depth coverage of

- rational numbers in grades 4-8

Note: Rational number means fractions, decimals, percents

- Level of Evidence: **Low**

What we Know about Effective Practice

Instruction during the intervention should be systematic. This includes providing

models of proficient problem-solving, verbalization of though processes, guided practice/scaffolding

corrective feedback, and

frequent cumulative review.

- Level of Evidence: **Strong**

Take Home Message

- Curricula for interventions must
  - Show students models of both easy and difficult problems
  - Ask students to provide teachers with reasons for the decisions they make
  - Provide a good deal of practice and review….. Move at a deliberate pace

Suggestions from Practice Guide

- Ensure that intervention materials are systematic and explicit and include numerous models of easy and difficult problems with accompanying teacher think-alouds.
- Provide students with opportunities to solve problems in a group and communicate problem- solving strategies.
- Ensure that instructional materials include cumulative review in each session.

Recommendation 2

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

- Level of Evidence: **Strong**

Suggestions

- Teach students about the structure of various problem types, how to categorize problems, and how to determine appropriate solutions.
- Teach students to recognize the common underlying structure between familiar and unfamiliar problems and to transfer known solution methods from familiar to unfamiliar problems.

3. Visual Representations to Promote Understanding

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

- If necessary consider expeditious use of concrete manipulatives before visual representations.
- The number line is critical (think graphs!!!!)
- Moderate Evidence

Reminder: Mathematics entails going from the concrete to the abstract….. Again and again and again…….

Recommendation 5

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

Suggestions

- Provide 10 minutes per session of instruction to build quick retrieval of basic facts. Consider the use of technology, flash cards, and other materials to support extensive practice to facilitate automatic retrieval.
- For student in K-2 grade explicitly teach strategies for efficient counting to improve the retrieval of math facts.
- Teach students in grades 2-8 how to use their knowledge of math properties to derive facts in their heads.

6. Extrinsic Motivation

Mathematics is abstract

Struggling learners often have a hard time

- ✓ Remembering abstract information
- ✓ Juggling abstract information

Whenever people are vulnerable, support and tangible encouragement can work wonders…

(but only would good instructional program)

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.