Response to Instruction and Intervention for Math:

Assessment~Collaboration~Instruction

Making a Difference: Educational Practice that Work!

January 12, 2011

Pennsylvania Department of Education
Annual Conference 2011

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Overview

- RTII Overview
- Instructional Foundations
  - NMAP 2008 Final Report
  - IES RtI Math Practice Guide
- Tier I and II Instructional Supports
  - Scaffolding Problem Solving
  - Facilitating Thinking aloud
  - Spaced Learning Overtime
  - Interleave Worked out Solutions
- Conclusion

U.S. Math Performance

The 2005 & 2007 National Assessment of Educational Progress (NAEP) reported:

- 15% of Grade 4 students scored below the basic level
- 25% of Grade 8 students scored below the basic level
- 36% of Grade 12 students scored below the basic level

U.S. Math Performance

The 2005 & 2007 National Assessment of Educational Progress (NAEP) reported:

- 40% of Grade 4 students with disabilities scored below the basic level
- 66% of Grade 8 students with disabilities scored below the basic level
- 83% of Grade 12 students with disabilities scored below the basic level

U.S. Math Performance

- International comparisons
- Low fractions of proficiency on NAEP
- Falling proficiency at higher grades
- Heavy remedial demand upon entry into college
- Achievement gap

NMAP, 2008

Mathematics Performance

Translated to Real World Performance

- 78% of adults cannot explain how to compute interest paid on a loan
- 71% cannot calculate miles per gallon
- 58% cannot calculate a 10% tip
- 27% of 8th graders could not correctly shade 1/3 of a rectangle
- 45% could not solve a word problem that required dividing fractions

Mathematics Advisory Panel Final Report, 2008

RTII Components

1. Belief System***
2. Universal Screening
3. Progress Monitoring
4. Instructional Tiers
5. Research-Based Instruction and Interventions
6. Educational Decisions
7. Ongoing Evaluation and Refinement Procedures

RTII Belief System

- **Four Core Beliefs**

1. All Students can be Mathematically Proficient

2. All Students need a High-Quality Mathematics Program

RTII Belief System

- **Four Core Beliefs**

3. Effective Mathematics Programs must teach *conceptual understanding*, *computational fluency*, *factual knowledge*, and *problem solving skills*

4. Effective ***Instruction Matters*** and Significantly Impacts Student learning

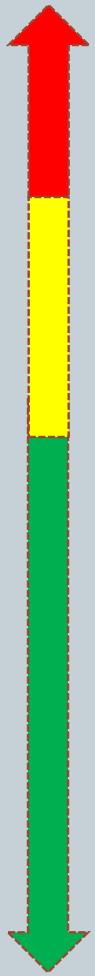
RTII Universal Screening

- Assessment used to measure all students' progress at least 3 to 4 times a year
- Used to identify those students in need of more intensive instruction
- The screening measures are relatively short and simple to administer and score (10 minutes)
- Both general and special education teachers are vested in the use of assessment data for instructional decisions.

RTII Progress Monitoring

- Assessment similar (or the same) as universal screening measures
- More frequent progress monitoring of those students in need of more intervention (weekly to bi-weekly)
- Student data is used to determine effectiveness of instructional programs and interventions

RTII Instructional Tiers



- **Tier 3 –** additional instruction should be given to students who do not benefit from tier 2. Interventions should be delivered 1:1 or in small groups and should include specialized personnel.
- **Tier 2 –** additional instruction should be given to students who demonstrate weak progress. Interventions typically take 20-40 minutes per day, 4-5 times per week.
- **Tier 1 –** high quality instruction and universal screening. High quality has a broad meaning. However, it means that at least 80% of your students are achieving on grade level.

RTII Educational Decisions

- Since the RtI process is based on the collection of scientific data, districts are afforded the opportunity to make decisions pertaining to various educational procedures:
  - effectiveness of instructional program-Core curriculum and instruction,
  - effectiveness of interventions in all Tiers
  - determination of when an intervention is required and/or no longer required,
  - progress towards end of year learning goals, and
  - eligibility for special education.

RTII Research-Based Instruction & Intervention

- Research based instruction and interventions become the foundation of the core mathematics program
- Selection of curricular materials and interventions is guided by high quality research evidence and "philosophy"
- Decisions based on student instructional needs, learning characteristics, and content

Guidelines for RTII implementation

- General education drives Tier 1 instruction, thus general education must use ***research-validated instructional practices , interventions, and curriculum***
  - NMAP 2008 Recommendations
  - IES RTI Math Practice Guide (k-8)
- Progress monitoring is used to monitor the academic performance of ***everyone*** in school
- Require ***collaboration and consultation*** between stakeholders and services
- A ***student performance data*** must be collected for each student who progresses through tiers

Foundations for Success

National Mathematics Advisory Panel

FINAL REPORT, MARCH 2008

Select Slides taken from the NMAP-Final Report
Presentation available at: http://www.ed.gov/MathPanel

Learning Processes

- To prepare students for Algebra, the curriculum must ***simultaneously*** develop ***conceptual understanding***, ***computational fluency***, ***factual knowledge*** and ***problem solving skills***.

- Limitations in the ability to keep many things in mind (***working-memory***) can hinder mathematics performance.
  - ***Practice*** can offset this through automatic recall, which results in less information to keep in mind and frees attention for new aspects of material at hand.
  - Learning is most effective when ***practice is combined with instruction*** on related concepts.
  - Conceptual understanding ***promotes transfer*** of learning to new problems and better long-term retention.

NMAP 2008; HO #1

Instructional Practices

Instructional practice *should be informed by high quality research,* when available, and by the best professional judgment and experience of accomplished classroom teachers.

- All-encompassing recommendations that instruction should be *student-centered* or *teacher-directed* ***are not supported by research.***

NMAP 2008; HO #1

Instructional Practices

Research on students who are *low achievers, have difficulties in mathematics, or have learning disabilities* related to mathematics tells us that the effective practice includes:

- ✓ ***Explicit methods of instruction available on a regular basis***
- ✓ ***Clear problem solving models***
- ✓ ***Carefully orchestrated examples/ sequences of examples.***
- ✓ ***Concrete objects to understand abstract representations and notation.***
- ✓ ***Participatory thinking aloud by students and teachers.***

NMAP 2008; HO #1

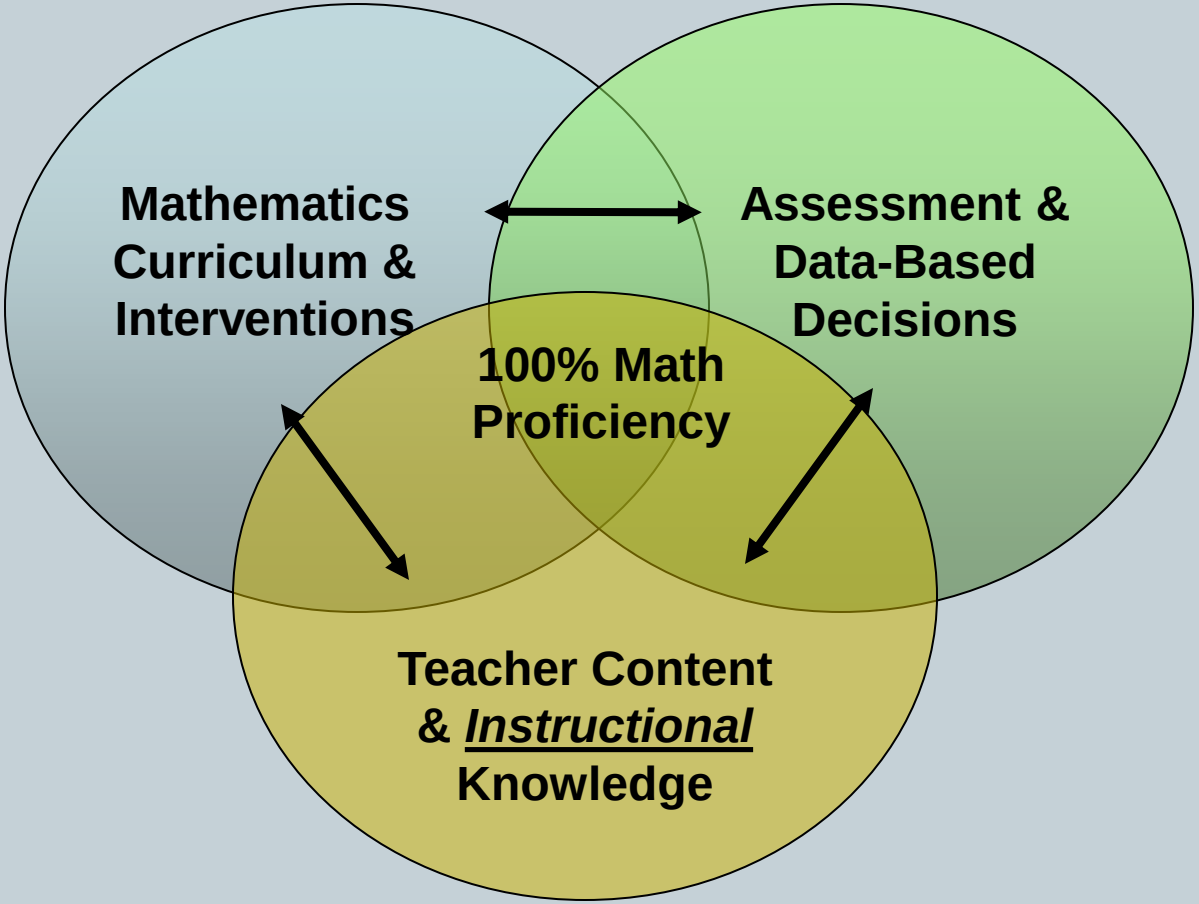
IES RtI Math Practice Guide

Focus on 1 of 8 Recommendations

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

Gersten et al., 2009; HO #2

Components of Effective RTII Mathematics Programs



General Components: Form the Basis of Effective RTII Model

1. Engaged Time
2. Student Success Rate
3. Content Coverage & Opportunity to Learn
4. Grouping for Instruction
5. Scaffolded Instruction
6. Addressing Forms of Knowledge
7. Activating & Organizing Knowledge
8. Teaching Strategically
9. Making Instruction Explicit
10. Making Connections

Basic Facts and Fluency

- Why should students learn math facts?
- Roadblocks to learning math facts
- Fact Fluency Instruction
  - Relationship
  - Understanding
  - Fluency/Automaticity

5 Reasons to Learn Basic Facts

1. Knowledge of simple facts is needed for proper use of calculators.
2. Ability to estimate implies mastery of single digit facts.
3. Students slow at facts are less likely to learn more complex math problem types.
4. Students must know multiplication facts quickly to be able to master fractions.
5. Algebra is not open to those who haven't mastered fractions.

Crawford, 2002

Basic Facts to Automaticity

Activities for Mastery (Fluency)

Requires

1. Specific criterion for introducing new facts
2. Intensive practice on newly introduced facts (more than 1x)
3. Systematic practice on previously introduced facts
4. Adequate allotted time (10min/day)
5. Record keeping
6. Motivational procedures

Fact Fluency Practice

- Peer-mediated activities
  - Are activities that include a set of instructional procedures where by students are taught by peers
  - Students work together through a series of structured activities to practice important skills during peer-mediated instructional time

Fact Fluency Instruction

- Fluency of facts is vital, but instruction for conceptual understanding must occur first
- Fluency activities must be cumulative
  - Newly introduced facts receive intensive practice, while previously introduced facts receive less intensive, but still SYSTEMATICALLY PLANNED.
- Fluency building activities should ***NOT*** use up all of the allocated math time.
- Fact ***fluency instruction*** is often ***overlooked*** by most math programs

5. Scaffolded Instruction

Instructional scaffolding is a process in which a teacher adds supports for students to enhance learning and aid in the mastery of tasks.

5. Scaffolded Instruction

Characteristics of Effective Scaffolding

- temporary and adjustable support
- reduce task to fewest steps
- initial explicit demonstration
- promote student elaboration
- promoting cueing and fading of cues
- scaffolding and explicit instruction

5. Instructional Scaffolding

- **3 Levels of Instructional Scaffolding**
  - Content
  - Task
  - Material

3 Levels Instructional Scaffolding

- **Content Scaffolding**
  - the teacher selects content that is ***not distracting*** (i.e., too difficult or unfamiliar) for students when learning a new skill.
  - allows students to ***focus on the skill being taught***, without getting stuck or bogged down in the content
- 3 Techniques for Content Scaffolding
  - Use Familiar or Highly Interesting Content
  - Use Easy Content
  - Start With the Easy Steps

Instructional Scaffolding

- **Task Scaffolding**
  - **Specify the steps** in a task or instructional strategy
  - **Teacher models the steps** in the task, verbalizing his or her thought processes for the students.
  - the **teacher thinks aloud and talks** through each of the steps he or she is completing
  - Even though students have watched a teacher demonstrate a task, it does not mean that they actually understand how to perform it independently

Approaching Word Problems

- ***Explicit modeling of cognitive and metacognitive strategies***
- Steps
  - Read for understanding
  - Paraphrase in your own words
  - Visualize a picture or diagram
  - Hypothesize a plan to solve the problem
  - Estimate or predict the answer
  - Compute or do the arithmetic
  - Check to make sure everything is correct

Example of Content Scaffolding

- **Math Word Problems Strategy Instruction**
  - Remove irrelevant information
  - Include answer in the problem (i.e., no question)
  - Allows students to focus in process of strategy

- **For example:**

  - Robert planted an oak seedling. It grew 10 inches the first year. Every year after it grew 1 ¼ inches. How tall was the oak tree after 9 years?

  - An oak seedling grew 10 inches in the first year. Every year after it grew 1 inch. After 9 years the oak tree was 18 inches tall.

Instructional Scaffolding

- **Material Scaffolding**
  - Material scaffolding involves the use of written prompts and cues to help the students perform a task or use a strategy.
  - This may take the form of ***cue sheets*** or ***guided examples*** that list the steps necessary to perform a task.
  - ***Students can use these as a reference, to reduce confusion and frustration.***
  - The ***prompts and cues should be phased*** out over time as students master the steps of the task or strategy.

Example of Material Scaffolding

- Concepts Maps—better to use a few rather than 50 different concepts maps

- Posters and bulletin boards are other examples. Remember they must be ***faded over time***

Scaffolding

- How much scaffolding is necessary?

- BOTTOM LINE:

As much as the students require to learn and be successful!

9. Making Instruction Explicit

a. Make goals, objectives, and expectations explicit

b. Make instructional content explicit

c. Make the structure of the lesson explicit

Instructional Practices

Research on students who are *low achievers, have difficulties in mathematics, or have learning disabilities* related to mathematics tells us that the effective practice includes:

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Explicit Instruction

- **Six Critical Features of Explicit Instruction**
  1. Daily Reviews
  2. Presentation of New Content
  3. Guided Practice
  4. Explicit feedback and Correctives
  5. Independent Practice
  6. Weekly and Monthly Reviews

Weekly and Monthly Reviews

- Much of teaching is about helping students master new knowledge and skills and then helping students ***NOT*** to forget what they have learned.
- Facilitate learning and remembering information
- Work Smarter NOT Harder!

Two Tier 1 Recommendations

1. Space learning over time
2. Interleave worked example solutions and problem-solving exercises

Pashler et al., 2007

Recommendation #1: Space learning over time

- Arrange for students to have ***S***paced ***I***nstructional ***R***eview (*SIR*) of key course concepts (Big Ideas)
  - At least 2 times
  - Separated by several weeks to several months
- Why:
  - Helps student remember key facts, concepts, and knowledge

Pashler et al., 2007

Recommendation #1 (con't)

- Caution: some important content is automatically reviewed as the learner progresses through the standard curriculum
  - For example: Students use single digit addition nearly every day in second grade

- This recommendation applies to important knowledge and skills that are not automatically reviewed

Pashler et al., 2007

Recommendation #1 (con't)

- Make sure important and essential curriculum content is reviewed at least 3-4 weeks after it was initially taught.

- Benefits of a delayed review is much greater than the same amount of time spent reviewing shortly after initial instruction (Rohrer & Taylor, 2006).

Pashler et al., 2007

Recommendation #1 (con't)

1. Use class time to review important curriculum content
   - For example, every other week a 4th grade teacher spends half the class reviewing an important math skill taught in the pervious 3-4 weeks (i.e., estimation, LCD, fractions)

2. Use homework assignments as opportunities for students to have spaced practice of key skills and content
   - For example, in every homework assignment a math teacher intentionally includes a few problems covering material presented in class 1 or 2 months ago

3. Give cumulative midterm and final exams
   - Provides student incentives to study all course material at widely separated points in time.

Pashler et al., 2007

Recommendation #2: Interleave Worked Example

- Interleave worked example solutions and problem-solving exercise
- Literally, alternate between worked examples demonstrating one possible solution path and problems that the student is asked to solve independently
- This can markedly enhances student learning

Pashler et al., 2007

Recommendation #2: Interleave Worked Example

- Typical Math Homework assignment
  - Pg. 155 #1-21 odd
- Students are required to solve all problems.

Solve $5 + 3x = 20$ for x

Pashler et al., 2007

Recommendation #2: Interleave Worked Example

- Interleaved Homework assignment
  - Pg 155 1-10 (all)
  - Odd problems

Below is an example solution to the problem:

"Solve $12 + 2x = 15$ for x"

Study each step in this solution, so that you can better solve the next problem on your own:

$$12 + 2x = 15$$

$$2x = 15\text{-}12$$

$$2x = 3$$

$$x = 3/2$$

$$x = 1.5$$

Pashler et al., 2007

Recommendation #2: Interleave Worked Example

- **Other considerations:**
  1. The amount of guidance an annotation accompanying the worked out examples varies depending on the situation
  2. Gradually fade examples into problems by giving early steps in a problem and requiring students to solve more of the later steps
  3. Use examples and problems that involve greater variability from one example or problem to the next
     - Changing both values included in the problem and the problem formats.

Pashler et al., 2007

Recommendation #2: Interleave Worked Example

- During Whole Class instruction
  1. Start off discussion around an already solved problem
     - Pointing out critical features of the problem solution
  2. After discussion have students pair off in small groups or work individually to solve a problem (JUST ONE!) on their own
  3. Then back to studying an example, maybe one students present their solutions and have others attempt to explain
  4. Then after studying the solved example, students are given another problem to try on their own.

Pashler et al., 2007

Organizing Instruction and Study Time

- **Remember it's always easier to work smarter NOT harder**

Summary

- Foundation of Tier I and II Instructional supports
  - Explicit and systematic
  - Scaffolding Supports
    - Content
    - Task
    - Material
  - Space Learning Overtime
  - Interleave Worked Out Solutions

Remember…..

Instruction Matters!