Strategies for Improving Tier I and II Mathematics Instruction in a Response to Instruction and Intervention Model

Response to Instruction and Intervention in PA:
An All Education Standards Aligned Initiative

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Overview

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

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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**

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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.

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Instructional Practices (See HO #1)

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:

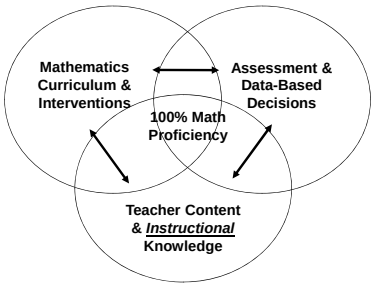
- ***Explicit methods of instruction available on a regular basis***
- ***Clear problem solving models***
- ***Carefully orchestrated examples/ sequences of examples.***
- ***Concrete objects to understand abstract representations and notation.***
- ***Participatory thinking aloud by students and teachers.***

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.

Components of Effective Mathematics Programs



General Components: Form the Basis of Effective Math Instruction

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**

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

- 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

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

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

- **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

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

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

See Handout #13 and 13a

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!

Recommendations

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

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

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

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).

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.

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

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.

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.

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Summary

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

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