The National Mathematics Panel Report: The Evidence Base, The Gaping Holes and Implications for Policy and Practice

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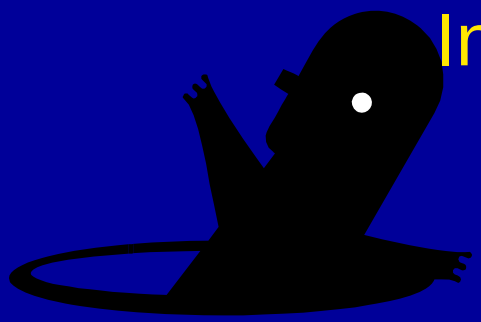


Foundations for Success

National Mathematics Advisory Panel

FINAL REPORT • SPRING 2008

Purpose

- Clarify evidence base for Recommendations
- Bring some coherence to the report
- Discuss implications for Response to Intervention (RtI)in mathematics

Charge of the Panel:

1. Focus on what it takes to succeed in algebra
2. Interdisciplinary (research mathematicians, policy, cognitive psych as well as educational researchers)
3. Charge was to use best available evidence

Task Groups

- Conceptual knowledge and skills
- Learning processes
- Instructional practices**
- Teachers**
- Assessment, Curriculum

* Most rigorous contemporary standards of evidence used

What is Missing from NMP

1. **Coherence**
   - Because the scope of the report was so large, there was no way to integrate the pieces conceptually.
2. **Specificity**

Inputs

- Reviewed 16,000 research studies and related documents
- Gathered public testimony from 110 individuals
- Reviewed written commentary from 160 organizations and individuals
- Held 12 public meetings around the country
- Analyzed survey results from 743 Algebra I teachers

Streamline the Mathematics Curriculum in Grades PreK-8:

- Follow a coherent progression, with emphasis on mastery of key topics
- Focus on the critical foundations for algebra

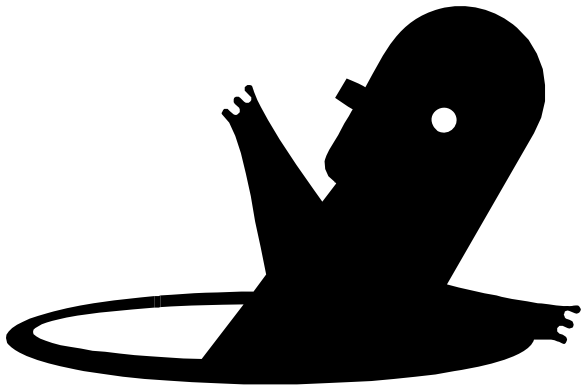
  -Proficiency with whole numbers

  -Proficiency with fractions

  - Particular aspects of geometry and measurement (similar triangles as pinnacle)

Evidential Base

- Expert opinion
- Based on knowledge of mathematics and/or logical basis
- No evidence that success with fractions linked to success in algebra
- Informally, perceptions of TIMSS entered into group thinking

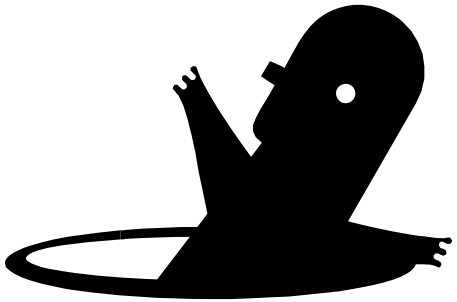


Fractions/ Rational Number (an example of Benchmarks)

1. By the end of Grade 4, students should be able to identify and represent fractions and decimals, and compare them on a number line or with other common representations of fractions and decimals.
2. By the end of Grade 5, students should be proficient with comparing fractions and decimals and common percents, and with the addition and subtraction of fractions and decimals.
3. By the end of Grade 6, students should be proficient with multiplication and division of fractions and decimals.

Instructional Practices: Selection of Topics

- No particular theoretical framework was used to generate this list. Panelists selected topics that were perceived as:
  - High interest to the teachers and policymakers
  - Areas requiring additional attention in terms of implementation of recent federal policies (NCLB and IDEA).



Instructional Practices Topics

- Teacher directed vs.. Student centered mathematics instruction
- Real world problem solving
- Teacher use of formative assessment
- Special populations:
  - Mathematically precocious
  - Learning disabilities (relevant to RtI)
  - Low achieving (relevant to RtI)

Many widely used instructional practices were omitted

Chose to focus on hot button issues

Methodology : Task Group Research Reviews

Committed to assembling the most rigorous scientific research addressing questions of effectiveness about the types of interactions occurring in mathematics classrooms relative to student performance.

- Experimental and quasi-experimental studies that meet or meet with reservations the What Works Clearinghouse (WWC) Standards: lead to causal inference, as the primary goal.

Procedures:
Literature Search and Study Inclusion

- Study was published between 1976 and 2007.
- Study involved K-12 students studying mathematics through algebra.

➢ **A total of 1,733 studies were identified based on these search terms.**

Finding: Students with LD Should Receive

Explicit Instruction

- on a regular basis that:
  - Covers critical foundation topics in depth
  - Integrates concepts, procedures, and story problems
  - Uses visual representations such as number line.

No reason to assume this is the only type of instruction students should receive.

Explicit Systematic Instruction

- entails . . .

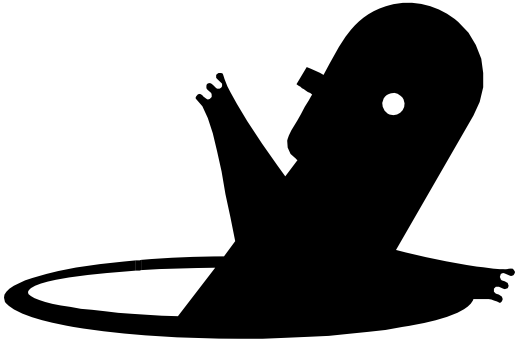
- Teachers explaining and demonstrating specific strategies, and
- Allowing students many opportunities to ask and answer questions, and
- To think aloud about the decisions they make while solving problems
- Careful sequencing of problems by the teacher or through instructional materials to highlight critical features.

Other Instructional Variables

1. Concrete objects to understand abstract representations and notation
2. Teachers should encourage students to think aloud and talk about decisions made
3. Ample practice with feedback

Instructional Practices Finding 2

- No evidence to support the all-encompassing recommendations that instruction should be student-centered or teacher-directed
- These terms remain murky
  GAPING HOLE:
  LACK OF CONCRETENESS…..



- For purposes of this analysis, child centered included students working together in highly structured fashion
- Positive effects for cooperative learning (TAI) & peer assisted learning

Finding 3

Formative assessment significantly enhances mathematics achievement, particularly when:

- Teachers are given tools for use of these data
- Based on only one type of formative assessment

Instructional Practices Findings

Mathematically precocious students with sufficient motivation appear to be able to learn mathematics successfully at a much higher rate than normally-paced students, with no harm to their learning.

- Supportive evidence weak

Instructional Practices

The use of "real-world" contexts to introduce mathematical ideas has been advocated, with the term "real-world" being used in varied ways.

- If mathematical ideas are taught using "real-world" contexts, then students' performance on assessments involving similar problems is improved.

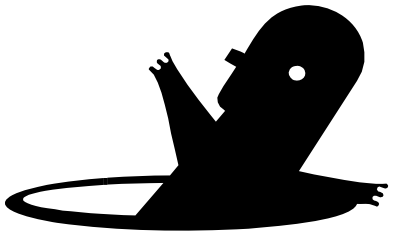
Instructional Materials

- U. S. mathematics textbooks are far too long -- often 700-1000 pages. Mathematics textbooks are much smaller in many nations with higher mathematics achievement than the U.S. Excessive length makes our books unnecessarily expensive and tends to undermine coherence and focus.

- Publishers must ensure the mathematical accuracy of their materials.

Key Messages: Learning Processes

- Stress on both algorithmic proficiency and conceptual understanding
- Growth in procedures and conceptual growth are reciprocal
- Conceptual understanding promotes transfer of learning to new problems and better long-term retention
- Gaping hole: Based on small number of short term studies

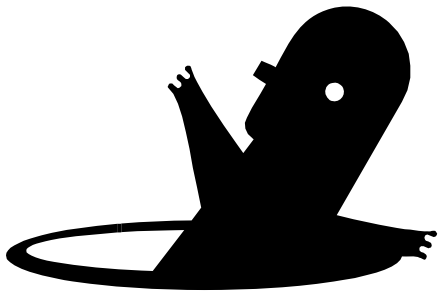


- Statement is so general that it is hard to use to guide concrete answer

Learning Processes

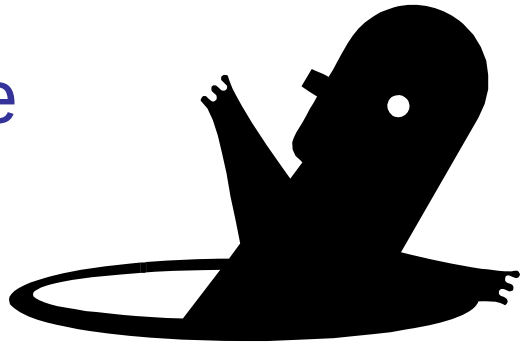
Children's goals and beliefs about learning are related to their mathematics performance.

- Children's beliefs about the relative importance of effort and ability can be changed.
- Experimental studies have demonstrated that changing children's beliefs from a focus on ability to a focus on effort increases their engagement in mathematics learning, which in turn improves mathematics outcomes.
- Gaping hole: Tiny body of research



Teachers & Teacher Development

- Evidence shows that a substantial part of the variability in student achievement gains is due to the teacher.
    - Includes evidence from gold standard randomized controlled trials.
- Less clear from the evidence is **exactly what it is about particular teachers—what they know and do** –that makes them more effective.
- Gaping hole



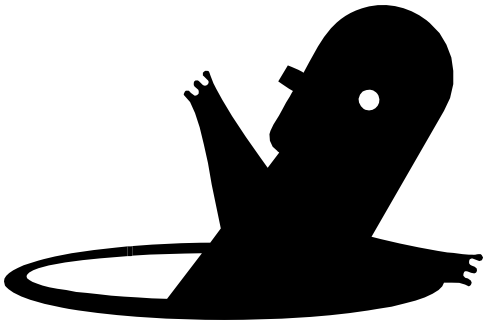
Teachers and Teacher Education

- Currently there are multiple pathways into teaching.
  - Research indicates that differences in teachers' knowledge and effectiveness between these pathways are small or non-significant compared to very large differences among the performance of teachers within each pathway.

- The Panel recommends that research be conducted on the use of full-time mathematics teachers in elementary schools, often called elementary math specialist teachers.

Wrap-Up

What are the gaping holes?



Next Steps

- Collate information on interventions for struggling students
- Seriously examine professional development that works for helping teachers with interventions (RtI)
- Continue to refine the concept of specialized knowledge of mathematics for teaching
- Serious experiments with whether content knowledge in mathematics can help teachers in grades 4-6