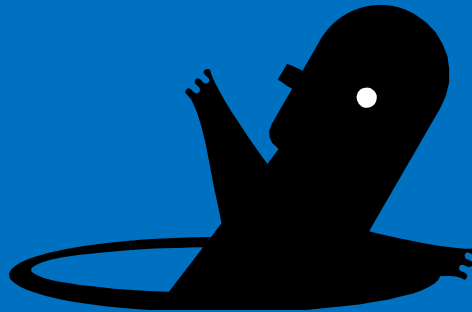


The National Mathematics Panel
Report: Policy Implications,
Gaping Holes
& Unresolved Issues



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$$\begin{array}{r} 4 \overline{)2581} \\ 796 \\ + 58 \\ \hline 854 \end{array}$$



$$3s + 1 = 4 + s$$
$$y \leq 10 - 2x$$



$$67 > 12/3$$

Foundations for Success

$$-\frac{2}{5} \div \frac{1}{4}$$

$$f(x) = x^2 + x - 1$$



$$y \geq 7x + 15$$



$$3/8 = 37.5\%$$

$$x^2 - y^2 = (x - y)(x + y)$$

$$3x - 1 = 4 + x$$



$$x^2 = \frac{5}{2}$$
$$c = \sqrt{37}$$

$$61 - 24 = 37$$

$$42 \times 13 = 546$$

National Mathematics Advisory Panel
FINAL REPORT • SPRING 2008

Topics

1. State Standards: Implications for
 - Instructional Materials
 - State assessments
2. Instructional Practices
3. Teachers and Teacher Education

Purpose

- ✓ Clarify evidence base for Recommendations
- ✓ Identify issues for state action

Charge of the Panel

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

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

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

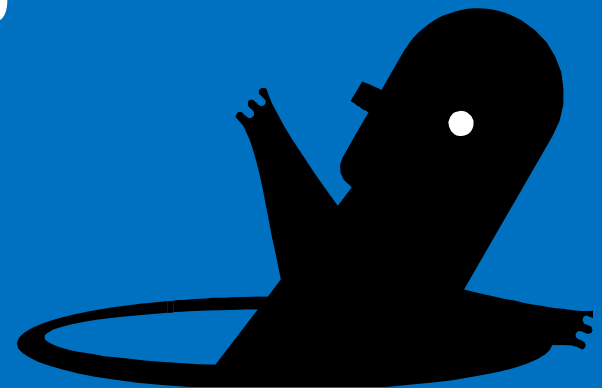
State Standards:

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



Curricular Content

The benchmarks should guide:

Classroom Curricula

Mathematics Instruction

Textbook Development

State Assessment

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.

Key Messages on Content

- Adequate time on fractions and whole number
- This means:
 - Cut out some topics that are not Critical
 - E.g. pattern recognition not critical
 - Do not tolerate texts that flit around/immerse
 - Focus state assessments on Benchmarks
 - Develop a major strand on fractions and ratio

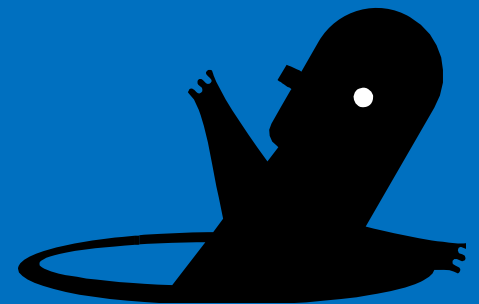
Algebra Teachers Talked About Critical Foundations

1. Fractions and ratio
- 2. Word problems**
3. Task persistence

Word problems also deemed critical by
community college personnel...

Instructional Practices:

- No particular theoretical framework was used to generate this list.
- Panelists selected topics that were perceived as:
 - High interest to policymakers
 - Charge into the hot button issues



Instructional Practices Topics

1. Teacher directed vs. Student centered
2. Real world problem solving
3. Use of formative assessment
4. Special populations:
 - Mathematically precocious
 - Learning disabilities (relevant to RtI)
 - Low achieving (relevant to RtI)

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.

Findings and Recommendations

1. No evidence that child centered or teacher-directed instruction is better than the other

- Few studies did head on comparisons
- These terms remain murky

Recommendation: Don't mandate 100% one or the other

Findings and Recommendations (continued)

2. Use of complex multi-step problems helps students solve them but does not help general mathematics achievement

Recommendation: Use them sparingly (not weekly) and make sure students know the underlying mathematics

3. Formative Assessment can raise mathematics achievement by approximately 8 percentile points

Recommendation: Use valid and reliable measures

If teachers have tools to help them, effects double

**Note: these are not clinical, diagnostic assessments
(no research on these)**

Explicit Systematic Instruction Works for Low Achieving Students

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.

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

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 Materials

- U.S. mathematics textbooks are far too long – often 700 to 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
- 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





Teachers and Teacher Education

Adapted from (with permission):
Deborah Loewenberg Ball

University of Michigan

October 6, 2008

National Mathematics Panel Forum • Washington, D.C.

1. Which are myths? Which are true?

Mark M (myth) or T (true).

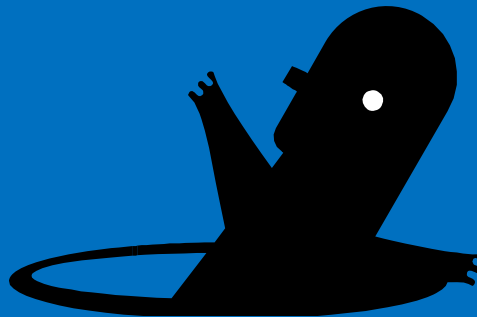
- a. The number of mathematics courses that a teacher has taken is a good predictor of how effective he or she will be.
- b. Most high-performing countries use math specialist teachers in the upper primary grades.
- c. Creating professional learning communities is at the heart of effective professional development.
- d. Individual teachers can have a significant impact on students' learning.

What is also the problem?

- Repeated efforts to “solve” the problem that fail (alone) to improve mathematics learning
- Thin understanding of teaching and learning in schools (e.g., overemphasis on materials)
- Underestimation of the power of and skill required for effective instruction

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



Headlines related to teachers

1. Teachers' mathematical knowledge matters; strongest signal with content measured close to its use in practice.
2. Lack of evidence to identify effective practices in teacher education or professional development.
3. Preparing some K-5 teachers to teach mathematics only (i.e., "math specialists") may be one way to manage the scale of the need
4. Teacher pay may be a possible lever to distribute teachers better and to provide incentives for the hard work it takes to help pupils learn

Teachers

- Persistent evidence that a large proportion of the variability in student achievement gains is due to who the teacher is
- Less clear from the evidence exactly what it is about particular teachers that makes them more effective
- Need to know how more effective teachers differ from less effective ones and how to measure this

Teachers' mathematical knowledge

- Overall signal: teachers' content knowledge is a positive factor in students' achievement.
- Number of courses, degree, or certification in math do not predict student achievement gains at K-8 and very inconsistently at high school level
- Closer measures (tests of relevant knowledge) show stronger signal

Teacher education

Lack of evidence overall about:

- Features of teacher preparation or professional development produce changes in teachers' knowledge or their students' learning
- What features of teacher preparation or professional development produce changes in teachers' knowledge or their students' learning

Teacher pay

- Salary differential between teaching and other technical fields is large.
- Location-based pay can keep experienced teachers in high-need schools.
- Performance pay for teachers can enhance students' achievement.
- Lack of evidence overall on:
 - How to best design teacher pay schemes to enhance student achievement (e.g., individual or school; competitive or not; levels of compensation)
 - Whether and how location-based pay helps to attract teachers to high-need areas

“Mathematics specialists”

- Different models of “math specialists”: lead teacher, elementary math teachers, math coaches
- Promising to explore the use of full-time mathematics teachers in elementary schools.
- Lack of evidence overall on whether math specialists (any model) lead to greater gains in student achievement

Next steps: Using the NMP

1. Focus on areas of progress and substantial agreement; build on and extend those
2. Strengthen teachers' opportunities to learn mathematics for teaching practice
3. Develop measures of that knowledge that can be related to instruction and student learning
4. Use strong research designs to study alternatives in professional training (preservice, early career support, professional education) for their impact on teachers' effectiveness

Where should we place our bets, given what we know (and what we don't)?

- Build a usable knowledge base for instruction
- Provide much more detailed instructional guidance
- Provide systematic professional training for successful practice
- Learn how other professions prepare practitioners (e.g., Grossman) and consider similarities
- Install sustained professional opportunities for continuous improvement, connected to the actual tasks of practice in settings
- Coordinate policy signals, curriculum, assessment, professional education

The post-test: Checking your answers

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1. Which are myths? Which are true?

Mark M (myth) or T (true).

- M** The number of mathematics courses that a teacher has taken is a good predictor of how effective he or she will be.
- M** Most high-performing countries use math specialist teachers in the upper primary grades.
- M** Creating professional learning communities is at the heart of effective professional development.
- T** Individual teachers can have a significant impact on students' learning.

Next Steps

1. Examination of state standards in terms of benchmarks
2. Ensuring teachers know the mathematics they teach (includes underlying mathematics)
3. Ensuring texts adhere to benchmarks
4. Ensuring assessments adhere to benchmarks
5. Ignore ideologues in terms of how to teach
6. Provide appropriate interventions to struggling students that covers core content for success in algebra