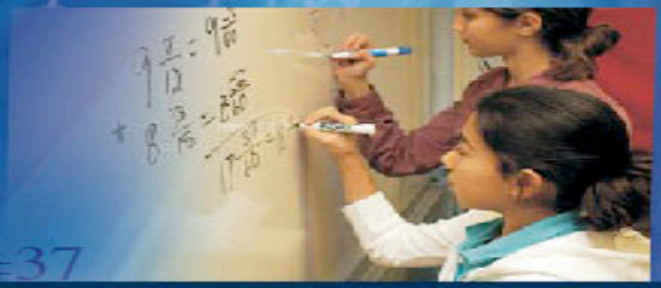

Foundations for Success

National Mathematics Advisory Panel

FINAL REPORT • SPRING 2008

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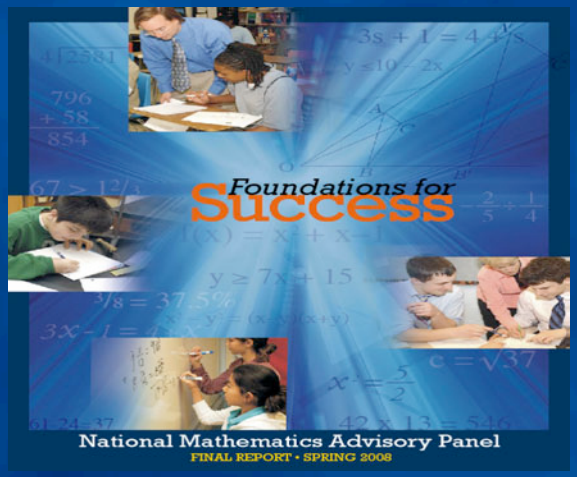
For more information

Please access information online at:

http://www.ed.gov/MathPanel



The National Mathematics Advisory Panel Report:

Major Themes and Implications for Special Education

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Deborah Loewenberg Ball, University of Michigan

April 5, 2008 • Council for Exceptional Children • Boston, MA

Overview of session

- Panel charge and process
- Summary of report results
- Implications for special education
- Extensions:
  - Instructional practices
  - Mathematical knowledge for teaching
- Questions

Starting point:
Weak proficiency of U.S. students

- International comparisons
- Uneven student achievement; achievement "gaps"
- Falling proficiency at higher grades
- Heavy remedial demand upon entry into college

Algebra as a gateway

Overview of report structure

- Task Groups:
  - Conceptual knowledge and skills
  - Learning processes
  - Instructional practices
  - Teachers
  - Assessment
- Subcommittees:
  - Standards of evidence
  - Survey of algebra teachers
  - Instructional materials

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

Curricular Content

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

Curricular Content

Benchmarks should guide:

- Classroom curricula
- Mathematics Instruction
- Textbook development
- State assessment

They should be interpreted flexibly to allow for the needs of students and teachers.

Learning Processes

- Most children develop considerable knowledge of mathematics before they begin kindergarten.
- Children living in poverty often have less mathematical knowledge when they begin school than do children from more advantaged backgrounds. This tends to hinder their learning for years to come.
- There are promising interventions to improve the mathematical knowledge of these young children before they enter kindergarten.

Learning Processes

- To prepare students for Algebra, the curriculum must simultaneously develop conceptual understanding, computational fluency, factual knowledge and problem solving skills.
- Conceptual understanding promotes transfer of learning to new problems and better long-term retention.

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.

Instructional Practices: Selection of Topics

- No particular theoretical framework was used to generate this list. Panelists selected topics that were perceived as:
  - areas requiring additional attention in terms of implementation of recent federal policies (NCLB and IDEA).
  - topics deemed critical by organizations such as NCTM.
  - high interest to the teachers and policymakers

Selection of Topics

1) Real-world problem solving
2) Relative effectiveness of explicit or teacher-centered instruction vs. student-centered and/or inquiry based instruction.
3) Formative assessment
4) Cooperative, collaborative learning and peer-assisted instruction.
5) Instructional strategies for students with learning disabilities
6) Instructional strategies for low-performing students.
7) Instructional strategies for mathematically precocious students
8) Technology with a particular focus on use of graphing calculators and single function calculators.

- ✓. Many widely used instructional practices were omitted because of time limitations

- 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 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.

Instructional Practices Finding 1

- No evidence to support an all-encompassing recommendations that instruction should be student-centered or teacher-directed
- These terms remain murky
- For purposes of this analysis, child centered included students working together in highly structured fashion
- Positive effects for cooperative learning (TAI) &peer assisted learning

Instructional Practices Findings

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

Finding: Students with LD should receive

- ✓ *explicit instruction*

  on a regular basis that

  1. Covers critical foundation topics in depth
  2. Integrates concepts, procedures, story problems
  3. Uses visual representations such as number line.

No reason to assume this is 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. Clear model of steps involved in solving a problem
2. Carefully orchestrated examples/ sequences of examples.
3. Concrete objects to understand abstract representations and notation.
4. Teachers should encourage students to think aloud and talk about decisions made

Instructional Practices Findings

Use of technology shows promise when:

- Computer-assisted instruction supports drill and practice
- Well designed tutorials are delivered through computer-assisted instruction
- Learning is supported by the careful, targeted application of computer programming

More research is needed
Note: did not address graphing calculators

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.

Teachers and Teacher Education

- Evidence shows that a substantial part of the variability in student achievement gains is due to the teacher.
- Less clear from the evidence is exactly what it is about particular teachers—what they know and do –that makes them more effective.
- The mathematics preparation of elementary and middle school teachers must be strengthened as one means for improving teacher effectiveness in the classroom

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.

Teachers and Teacher Education

The Math Panel recommends policy initiatives that put in place and carefully evaluate the effects of:

- Raising base salaries for teachers of mathematics to attract more mathematically qualified teachers into the workforce;
- Salary incentives for teachers of mathematics for working in locations that are difficult to staff; and
- Opportunities for teachers of mathematics to increase their base salaries substantially by demonstrable effectiveness in raising student achievement.