NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

# Testimony

## Committee on Labor and Education

**on**

## "Foundations for Success"

## The National Mathematics Advisory Panel Report

**Francis (Skip) Fennell**

**McDaniel College**

**Past President, National Council of Teachers of Mathematics**

May 21, 2008

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Good morning, Chairman Miller and Congressman McKeon. My name is Francis (Skip) Fennell. I am a professor of education at McDaniel College in Westminster, Maryland. I am also past president of the National Council of Teachers of Mathematics (NCTM). From my appointment in April 2006 until last month, I also served as a member of the National Mathematics Advisory Panel.

First, thank you for the opportunity to speak with you about the work of the National Mathematics Advisory Panel and its report, "Foundations for Success," which was released on March 13. The National Math Panel was appointed in 2006 by President Bush to advise the President and the Secretary of Education on the best use of scientifically based research to advance the teaching and learning of mathematics. The Panel was charged with making recommendations on improving mathematics achievement for all students, with a focus on preparing students for success in algebra.

I won't belabor what you've already heard about the growing concern about our nation's standing in a global marketplace and the importance of the education in the STEM fields—that's science, technology, engineering and mathematics—to that standing. The concerns about how our students compare with those of other countries are well documented and one of the reasons

the National Math Panel was formed. And the importance of mathematics, specifically algebra, as a foundation for success of all kinds is almost universally acknowledged.

My comments will focus on a few major themes from the report. But I will state that there is a great deal more in the report's 45 recommendations and related findings, which can guide mathematics education in the future.

**Curriculum Focus and Coherence**

One of the most significant challenges in mathematics education today is the need for curricular focus and coherence. Teachers today are guided by state curriculum standards that sometimes more than 100 learning expectations per grade level. Consequently, to get through all of these expectations, teachers address topics superficially rather than in depth, and learning suffers. The Math Panel's report acknowledges the need for a more focused, coherent curriculum in grades pre-K–8 that is streamlined and emphasizes a well-defined set of the most critical topics in the early grades.

By *focused*, the Panel means that curriculum must include (and engage with adequate depth) the most important topics prerequisite for success in school algebra. These are the Panel's Critical Foundations for Algebra and accompanying benchmarks. By the term *coherent*, the Panel means that the curriculum is marked by effective, logical progressions from earlier, less sophisticated topics into later, more sophisticated ones. Improvements like those suggested in the report promise immediate positive results with minimal additional cost.

The National Council of Teachers of Mathematics (NCTM) advocates for a broad vision of the mathematics for all students at these levels; it also recognizes the necessity for focus and coherence within a prekindergarten through grade 8 mathematics program. NCTM's *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics: A Quest for Coherence* describes the need for a coherent set of mathematics topics that are important for all students to acquire at particular grade levels in order to prepare for the study of algebra as well as other important mathematics. It presents the most important mathematical topics for each grade level. The Panel's Critical Foundations and accompanying benchmarks are consistent with NCTM's Curriculum Focal Points and are connected as prerequisites for algebra.

**Fractions**

Some would argue that fractions may be the most critical of the Panel's Critical Foundations for algebra. Fractions are defined here as fractions, decimals, and percent, leading to work with ratio and proportion. Several of the Panel's task groups, as well as the Panel's teacher survey, substantiated that difficulty with fractions is pervasive and an obstacle for far too many students to success in algebra.

A nationally representative sample of over 700 teachers of Algebra I who were surveyed for the Panel rated students as having very poor preparation in "rational numbers and operations involving fractions and decimals." As with learning whole numbers, a conceptual understanding of fractions, decimals, and percent, proficiency with their use, and the opportunity to solve problems with fractions is mutually reinforcing.

**Effort Matters**

Another important message from the Panel report addresses a cultural issue that seems to have gained more prominence in the United States, and that's the fallacy that there is some "math gene" that endows some students with an affinity to learn mathematics. There is no such math gene. Rather, research shows that students in other countries devote more effort to mathematics learning, and learn more as a result. One of the most important findings in the Math Panel's report is that effort matters. Grappling with challenging math problems, even if they are not "solved," leads to greater understanding and more learning, on the part of all students. So, once and for all, we need to stop the parent conference that begins with the phrase, "Well, you know I was never good in math either." Math is important—for our children and for our country.

**Conceptual Understanding**

One of the issues at the core of what has become known in education circles as the "Math Wars" is the debate over conceptual understanding and basic skills. In the highly charged lexicon of the two sides on the math wars, it is not an either/or proposition. The National Math Panel has stated very clearly that understanding mathematics conceptually, becoming proficient in the use of procedures, and extending this understanding and proficiency to solving problems must be developed simultaneously. In short, as students learn mathematics they need to have the mutually reinforcing benefits of conceptual understanding, procedural fluency, and the opportunity to solve problems applying and extending the mathematics learned. Students—all students—need need to make sense of the mathematics they are learning and become proficient in that mathematics, and how better to do that than solving problems that involve mathematics—

whether that's deciding the impact of that 5 percent finance charge or the, seemingly daily increase in gasoline prices.

**Early Learning**

Another finding from the Panel's work is that there are significant advantages for children to have a strong start in engaging with and learning mathematics very early. A high-quality, challenging, and accessible mathematics education provides early childhood learners with a critically important, vital foundation for future understanding of mathematics. Young children in every setting should experience effective, research-based curricula and teaching practices. Teachers should connect ideas within mathematics as well as with other subjects, and they should encourage children to communicate, explaining their thinking as they interact with important mathematics in deep and sustained ways. Early childhood educators should actively introduce mathematical concepts, methods, and language through a range of appropriate experiences and teaching strategies.

**Algebra as Gateway**

One of the reasons for the focus on algebra in the Panel's charge from the President is that Algebra is clearly a passport or a demonstrable gateway to higher level mathematics. Moreover, research shows that completion of Algebra II correlates significantly with success in college and future employment earnings. In fact, students who complete Algebra II are more than twice as likely to graduate from college compared to students with less mathematical preparation. Among African-American and Hispanic students with mathematics preparation at least through Algebra II, the differences in college graduation rates versus the student population in general

are half as large as the differences for students who do not complete Algebra II. As one panelist suggested at the release of the Panel report, the content (the mathematics) is king here. We need a more focused, coherent curriculum for *all* students—with particular emphasis on points of focus that are foundational for success in algebra.

Excellence in mathematics education rests on equity—high expectations, respect, understanding, and strong support for all students. Policies, practices, attitudes, and beliefs related to mathematics teaching and learning must be assessed continually to ensure that all students have equal access to the resources with the greatest potential to promote learning. A culture of equity maximizes the learning potential of all students.

**Teachers**

We have known for some time that the single most important factor in mathematics learning is teacher quality. Unfortunately, little is known from existing high-quality research about what effective mathematics teachers do to generate greater gains in student achievement. This is one of several fields in which the Panel found that further research is needed. Regarding teaching, research is needed to identify and more clearly define the skills and practices underlying these differences in teachers' effectiveness, and how to develop them in teacher preparation programs. We must be able to tell what works in teacher education and frankly what's needed to prepare and retain our best teachers. This, to me, represents a clarion call for teacher education—at every level.

**Math Specialists**

In an attempt to improve mathematics learning especially at the elementary level, a number of school districts around the country are using mathematics specialists. While the terms math specialist and math coach are not always clearly or consistently defined, there is potential in this movement. The Panel's recommendation for mathematics specialist teachers is based on the success of this particular model. The Panel identified three different types—math coaches (lead teachers), full-time elementary mathematics teachers, and pull-out teachers. Some of these show promise and should be examined more closely to determine how they can be increased in scale.

The Panel recommends that research be conducted on the use of full-time mathematics teachers in elementary schools. These would be teachers with strong knowledge of mathematics who would teach mathematics full-time to several classrooms of students, rather than teaching many subjects to one class, as is typical in most elementary classrooms. This recommendation for research is based on the Panel's findings about the importance of teachers' mathematical knowledge. The use of teachers who have specialized in elementary mathematics teaching could be a practical alternative to increasing all elementary teachers' content knowledge (a problem of huge scale) by focusing the need for expertise on fewer teachers. However, I would add that at a time of teacher surplus at the elementary school level, it is perhaps time to scrap the model of elementary teacher as generalist. Why not have specifically trained elementary mathematics specialists starting from day one of their career? Our country can't wait until such specialists are graduate students.

**Research**

In conformity with its charge from the President, the National Math Panel's work was very directed by research. In short, it found that much more educational research of almost all kinds is needed. This includes research relative to the impact of technology on the teaching and learning of mathematics. This means all technology—software, the use of graphing calculators, and the role of the Web. Technology continues to expand and infiltrate our lives, often without any documentation of its impact. How do we both acknowledge and harness the promise of technology as a tool for teaching and learning?

Support should be provided to encourage the creation of cross-disciplinary research teams, including expertise in educational psychology, sociology, economics, cognitive development, mathematics, and mathematics education. In short, we need more expertise at the table. Most important, in an NCLB world with AYP looming each year, Pre-K–12 schools should be provided with incentives and resources to provide venues for, and encourage collaboration in, educational research.

New funding should be provided to establish support mechanisms for career shifts (K, or career development, awards from the National Institutes of Health represent one example). Many accomplished researchers who study the basic components of mathematics learning are not directly engaged in relevant educational research. While this more basic kind of research is important both in its own right and as a crucial foundation for designing classroom-level learning projects, at least some of these investigators have the potential to make more directly relevant contributions to educational research. Consequently, providing incentives for them to change the

emphasis of their research programs could enhance research capacity in the field.

We strongly encourage capitalizing on the work that is currently being accomplished on learning and educational practices by the National Science Foundation. This work can augment and improve current instructional practice and student learning.

As you know, Congress last year showed strong bipartisan support for increased investments in strengthening and improving STEM education programs through enactment of the America COMPETES Act. That bill authorized Math Now, which embodies a number of the Math Panel's recommendations, and also recommends an increased investment in programs at the National Science Foundation. Programs under the Foundation's Education and Human Resources Directorate—the division of the NSF that administers the Math and Science Partnerships program, the Noyce Scholarship Program and other important education initiatives—would receive $995 million if appropriators followed the recommendations of the authors of that bill. I encourage Congress to do just that.

There are programs at other federal agencies that also yield benefits for the field of mathematics education, math educators, and students. The Department of Energy is engaged in creating opportunities for students and educators to participate in the nation's research enterprise as a means to improving the competitiveness of U.S. industry and overall scientific literacy through programs at the Office of Science's Workforce Development for Teachers and Scientists. Those efforts, which include exciting opportunities for K–12 math and science teachers, warrant federal support and investment as well.

**Math Now**

The America COMPETES legislation calls for funding a Math Now initiative for $95 million to improve math instruction in the elementary and middle grades and to provide targeted help to struggling students so that all students can reach grade-level mathematics standards. Math Now will give teachers research-based tools and professional development to improve elementary and middle school students' achievement in mathematics and help mathematics teachers to teach students who are the hardest to reach. These innovations are sorely needed. The early years of mathematics education are foundational to success in algebra, that critical gateway not only to future learning and educational success in every STEM field, but for a better, stronger workforce, and a stable, well-informed citizenry. I strongly encourage Congress to fund this initiative, which would support the end result of much what we're here to talk about today—student learning of mathematics.

Thank you again for your invitation to address the committee and for this opportunity. I would be glad to answer any questions you might have relative to the work of the Panel, the work of the National Council of Teachers of Mathematics, or my own work as a mathematics educator with more than 40 years of experiences as a classroom teacher, principal, supervisor of instruction, and teacher educator.