Vidya Thirumurthy and James D. Kiryl

A Response: Highlighting Key Elements of the National Mathematics Advisory Panel's Blueprint

Bradley S. Witzel

Bradley S. Witzel is Assistant Professor, Special Education, Winthrop University, Rock Hill, South Carolina.

Several studies have reported on the poor achievement scores of U.S. students in mathematics. In 2003, the U.S. Department of Education's National Center for Education Statistics (NCES) announced that approximately one-fourth of 4th-grade students and one-third of 8th-grade students in the United States scored below the "basic" level in mathematics. In 2005, the National Assessment of Educational Progress (NAEP) reported that only two percent of U.S. students attained advanced levels of mathematics achievement by their senior year (NCES, 2006). Moreover, in 2006, the Program for International Student Assessment (PISA) concluded that the average 15-year-old student in the United States scored below the average student from 57 other nations in mathematics literacy (Baldi, Jin, Skemer, Green, & Herget, 2007). Finally, when comparing the highest performing mathematics students internationally (90th percentile and above), U.S. students again scored below average (Baldi et al., 2007). Furthermore, fewer students in the United States pursue careers requiring advanced degrees in mathematics and science, such as engineering (National Science Board, 2008).

In an attempt to reverse this trend, President Bush appointed a 19-member National Mathematics Advisory Panel (NMP) in 2006 to create a blueprint for advancing mathematics education in the United States. After reviewing over 16,000 research publications and reports and receiving testimonials from 110 individuals, the panel made its report public in March 2008 (to review the entire report, see *www.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf).*

The NMP report provides over 50 recommendations about learning processes, curricular content, instructional practices and materials, teachers and teacher education, assessment of mathematics learning, and research policies and mechanisms, all aimed at improving the proficiency of the K-8 students in mathematics. While many aspects of the report are worthy of discussion, for the purposes of this article I will discuss six key elements: 1) Learning Processes: Success in Algebra, 2) Curricular Content, 3) Instructional Practice and Materials, 4) Teachers and Teacher Education, 5) State Assessments, and 6) Future Research.

1. Learning Processes: Success in Algebra

Algebra is considered a gateway course to future employability because of its abstract quantitative nature. It is a known fact that algebra forms the foundation for pre-calculus. Unfortunately, U.S. students, taken as a group, are lagging behind in algebra. Therefore, NMP emphasizes achieving success in algebra as a major goal of mathematics education in elementary and middle schools. Furthermore, current analyses reveal that students struggle with whole number computation, fractions, geometrical properties, and measurement, concepts considered predictors of success in algebra. Finally, "Few curricula in the United States provide sufficient practice to ensure fast and efficient solving of basic fact combinations and execution of the standard algorithms" (National Mathematics Advisory Panel, 2008, p. 26). To that end, NMP recommends that the current state standards in mathematics be changed such that students become fluent with basic facts in mathematics, and that students be taught the skills to effortlessly retrieve facts. If students can develop automaticity with computation as well as procedural and conceptual knowledge of fractions and geometry, they will be able to direct more attention to complex tasks when studying secondary level algebra and other advanced mathematics coursework.

2. Curricular Content

In line with recommendations from *Curriculum Focal Points* (National Council of Teachers of Mathematics, 2006), NMP argues that curriculum should "avoid the need to revisit essentially the same material over several years, often referred to as 'spiraling' " (NMP, 2008, p. 22). Currently, many mathematics textbooks follow Bruner's (1996) spiraled approach to learning, where one revisits an idea on multiple occasions. For example, the concept of signed numbers (e.g., 5 on a number line) may be introduced in a lesson one year, but actual practice in computing signed numbers (e.g., (5)×(+2))

may not occur until the next year. Because spiraling of concepts does not clearly lead to mastery of the concept, many experienced teachers spend extensive periods in sequencing lessons more effectively than what the textbooks suggest. They also have to spend additional time so the students have opportunities for mastery learning. In short, the spiraling curriculum does not provide opportunities for students to learn concepts more fully.

A word of caution here: Although NMP suggests avoiding spiraling, it should not be completely avoided. It can be valuable, especially as mathematics topics become compressed at the secondary level and content strands become one course, such as with geometry and algebra. Moreover, spiraling can be useful for teachers with respect to assessing students' background knowledge. This type of assessment allows the teacher to monitor students' retention of mathematical knowledge.

3. Instructional Practice and Materials

One of the panel's most controversial decisions concerned not wanting to engage the public and professional community in a debate on explicit versus implicit instruction. In fact, several education organizations and parent groups have expressed disagreement with the panel's apparently neutral stance. Yet, the panel does not ignore the importance of planning differentiated instruction so that math lessons are tailored to the needs of struggling students. For example, when teaching computation and word-problem solving, the teacher may differentiate her instructional practice by utilizing such basic strategies as modeling and think-alouds.

4. Teachers and Teacher Education

While differences certainly may exist in how effectively mathematics can be taught, it is obviously important that all teachers have command of the subject matter. Somewhat in concert with the underpinnings of No Child Left Behind (NCLB), NMP rightly argues that all teachers of mathematics be "highly qualified." However, NMP (2008) points out that "existing research does not provide definitive evidence for the specific mathematical knowledge and skills that are needed for teaching" (p. 37). Thus, teacher education programs must be clear regarding the exact content needed to teach math. This requires a comprehensive evaluation of math education programs at teacher education institutions.

5. State Assessments

Knowing the influence that the NAEP has on state assessments, NMP suggests a reorganization of the NAEP content strands. With the interest in improving algebraic knowledge, the NMP blueprint calls for an increased emphasis on fractions and decimals in both 4th- and 8th-grade testing, as well as a decreased emphasis on probability in the 4th grade. Additionally, NMP calls for a change in how students are tested, stating, "There are too many flawed items on the NAEP and state tests, often related to the wording of an item" (2008, p. 60). Thus, the potential negative implications for such errors are enormous with respect to accurate student assessment scores. Stated another way, students, parents, and educators clearly deserve valid assessment tools that report accurate outcomes.

6. Future Research

It is evident that rigorous research in mathematics education is lacking in the United States. The NMP report (2008) includes many statements to this effect, such as "research is needed," "a paucity of high-quality studies," and "no peer-reviewed studies could be found." To that end, teachers and researchers must work collaboratively on investigative studies, which ultimately can lead to better instruction, textbooks, interventions, manipulatives, and assessments. Financial and credit incentives are needed not only for teachers, but also for students, who already endure a great number of tests throughout the academic year.

Conclusion

These recommendations provide a glimpse into positive changes possible for mathematics education in the United States. I highly recommend that you read the report in its entirety to gain a sense of how implementing the recommendations could be an excellent initial step to the United States regaining its international standing in mathematics education.

References

Baldi, S., Jin, Y., Skemer, M., Green., P. J., & Herget, D. (2007). *Highlights from PISA 2006: Performance of U.S. 15-year-old students in science and mathematics literacy in an international context* (NCES 2008-016). Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Bruner, J. (1996). *The culture of education*. Cambridge, MA: Harvard University Press.

National Center for Education Statistics. (2003). *Highlights from the trends in international mathematics and science study (TIMSS) (2003)*. Washington, DC: U.S. Government Printing Office.

National Center for Education Statistics. (2006). *Highlights from the trends in International mathematics and science study (TIMSS) (2005)*. Washington, DC: U.S. Government Printing Office.

National Council of Teachers of Mathematics. (2006). *Curriculum focal points*. Reston, VA: Author. Retrieved from www.nctm.org/standards/default.aspx?id=58.

National Mathematics Advisory Panel. (2008). *Foundations for success: The final report of the national mathematics advisory report*. Washington, DC: U.S. Department of Education. Retrieved from www.ed.gov/MathPanel.

National Science Board. (2008). *Science and engineering indicators 2008*. Arlington, VA: National Science Foundation (volume 1, NSB 08-01; volume 2, NSB 08-01A).