

Archived Information

Objective 2.3: Every eighth-grader masters challenging mathematics, including the foundations of algebra and geometry.

National Need

National Concerns. To be prepared for postsecondary study and promising careers, students need to master advanced skills in mathematics, science, and technology. Mathematics also teaches ways of thinking that apply in the workplace and are essential for informed civic participation. Yet far too many students finish high school without mastering the mathematics necessary for success in either higher education or our competitive knowledge-based economy. U.S. fourth-graders perform above the international average, but mathematical performance begins to decline in the middle grades, and U.S. students perform significantly below the international average by the end of secondary school (Third International Mathematics and Science Study (TIMSS), 1997, 1998). Moreover, although the curriculum in the United States is broader than in higher performing countries, it lacks their depth.

Increasing the number of highly qualified teachers across the Nation is critical to improving student achievement in mathematics. Unfortunately, many mathematics teachers today lack the appropriate credentials and licensure for the subjects they teach, and many of those who are appropriately certified are under-prepared in their disciplines. U.S. teachers also have less time for planning, reflecting on their teaching strategies, and using other teachers as resources. Future teacher shortages—especially in mathematics—and student population growth are likely to exacerbate these problems.

Our Role. The Department of Education's Federal resources are used to help states, local school districts, and schools improve teaching, upgrade curriculum, integrate technology and high-quality instructional materials into the classroom, and motivate students to help them understand how mathematical concepts are applied in today's global workplace. This is accomplished through *America Counts*, a Department-wide mathematics initiative, and a variety of programs, including the Elementary and Secondary Education Act (ESEA) Title I and Title II and the Higher Education Act (HEA) Title II, among others, which give a blend of formula and competitive grants to

- Equip teachers to teach challenging mathematics content in effective ways, with high expectations for their students;
- Provide personal attention and additional learning time for students;
- Support high-quality research to inform best practices of mathematics teaching and learning;
- Build public understanding of the mathematics today's students must master;
- Encourage a challenging and engaging curriculum for all students; and
- Promote the coordinated and effective use of Federal, state, and local resources.

Synergy with other Federal agencies guides the work of the Department to strengthen the impact of Federal resources on mathematics education nationwide.

Our Performance

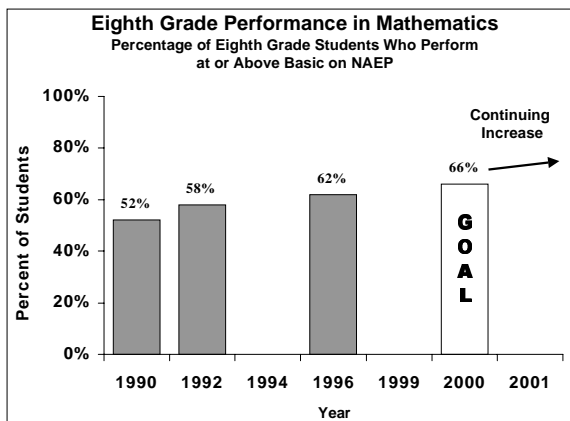
How We Measure. The Department is assessing progress toward this objective by monitoring national trends in student achievement in mathematics, teacher preparation and ongoing professional development, and schools' access to and use of information on best practices for mathematics instruction.

Indicator 2.3.a. Increasing percentages of eighth-graders reaching the basic, proficient, and advanced levels in math on the National Assessment of Educational Progress. On international assessments, at least 50 percent will score at the international average by 1999.

Assessment of Progress. 1999 data from the main data sources are not available, but other sources show a positive trend toward the 2000 targets. U.S. students have shown progress in their mathematics achievement on the National Assessment of Educational Progress (NAEP) since 1990, yet many still fail to achieve the high standards needed for future success in both education and work. The last data from NAEP, in 1996, show that 62 percent of students scored at or above the basic level on NAEP compared with 52 percent in 1990. Much smaller percentages of students perform at the proficient or advanced levels. By 2000, if current trends continue, we expect that 66 percent of eighth-graders will perform at or above basic on NAEP, and we expect a continuing increase in 2001, although no data are being collected for that year.

Since NAEP data are only available every four years, we are also reporting state assessment data, which are available annually, as another measure of student progress in mathematics. These data show moderate student progress in mathematics. On state assessments, eighth graders in 8 of 11 states (that had comparable assessments for 2 years for grade eight and reported by performance level) made varying levels of forward progress in mathematics between 1996 and 1998.

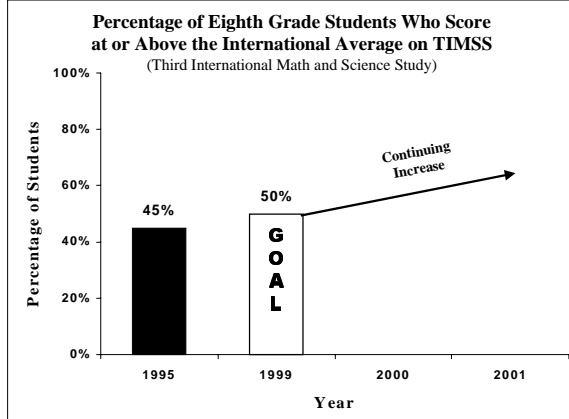
Figure 2.3.a.1



Source: NAEP, 1990, 1992, 1996 Mathematics Assessment. *Frequency:* Every 4 years for NAEP. *Next Update:* The NAEP assessment will be given again in 2000 and the data will be available in 2001. **Validation procedure:** Data validated by NCES review procedures and *NCES Statistical Standards*. **Limitations of data and planned improvements:** The TIMSS international average will vary depending on which nations participate in the study. Therefore, a special average will be computed for those nations that participated in both the 1995 and 1999 assessments.

Assessment of Progress. Although U.S. fourth graders performed above the international average in math, our eighth-graders and twelve-graders scored below the international average. Our 1999 goal is for 50 percent of eighth graders to score at or above the international average on TIMSS. We expect improvement in U.S. students' test scores because there has been an increased effort to improve the mathematics curriculum in the middle grades throughout the country. The next update in 2001 will show U.S. performance compared with a core set of countries in both 1995 and 1999.

Figure 2.3.a.2

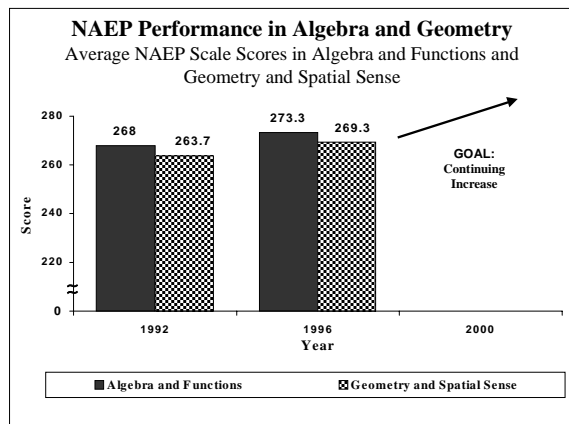


Source: The Third International Mathematics and Science Study (TIMSS), 1995 eighth-grade Assessment. **Frequency:** TIMSS does not have a regular assessment cycle. **Next Update:** The TIMSS replication took place in the spring of 1999 and the results will be available in early 2001. **Validation procedure:** Data validated by NCES review procedures and *NCES Statistical Standards*. **Limitations of data and planned improvements:** The TIMSS international average will vary depending on which nations participate in the study. Therefore, a special average will be computed for those nations that participated in both the 1995 and 1999 assessments.

Indicator 2.3.b. Each year more students will have a solid foundation in algebra and geometry by the end of eighth grade.

Assessment of Progress. 1999 data are not yet available, but there is a positive trend toward the target. Understanding basic concepts in algebra and geometry is a prerequisite for most higher-level mathematics courses. Many states and districts have realized the importance of early exposure to these topics and have increased their mathematics requirements for middle and high school students. An increasing number of students are taking algebra, geometry, or other courses that include a focus on the fundamentals of algebra and geometry. For instance, NAEP data show that 25 percent of eighth graders in 1996 took an algebra course, compared with 20 percent in 1992.

Figure 2.3.b.1

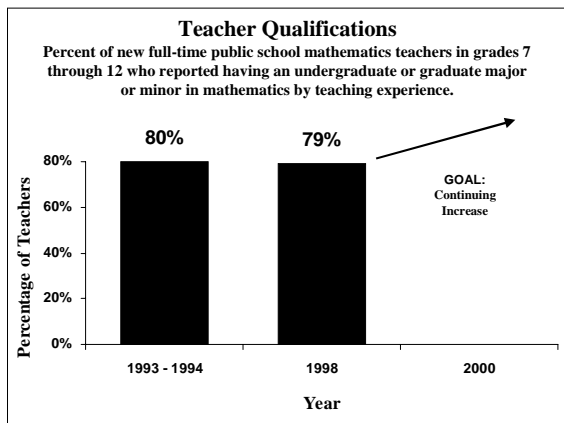


Source: National Assessment of Educational Progress (NAEP), 1990, 1992, 1996 Mathematics Assessment. **Frequency:** Every 4 years. **Next Update:** The NAEP assessment will be given again in 2000, and the data will be available in 2001. **Validation procedure:** Data validated by NCES review procedures and *NCES Statistical Standards*. **Limitations of data and planned improvements:** These data represent performance on NAEP's subset of questions in algebra and geometry and may not represent what other sources consider to be the fundamental principles of algebra and geometry.

Indicator 2.3.c. Each year, more new teachers will enter the workforce with adequate preparation to teach challenging mathematics to students in kindergarten through 12th grade.

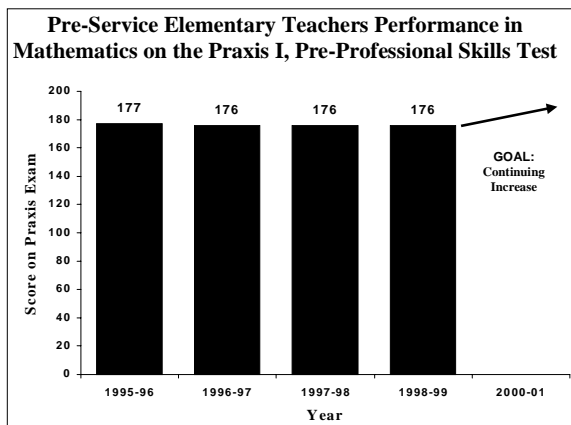
Assessment of Progress. No 1999 data are available, but data from earlier years suggest no change. It is not surprising that there has been little change in this indicator, as few states and districts have attempted to seriously upgrade the mathematics content or pedagogical knowledge of their new teachers. One hypothesis is that it is difficult for states and districts to increase requirements for new teachers at a time when many face teacher shortages. Still, there is reason for guarded optimism that these data measures may improve, because more national and state policies are starting to focus on increasing requirements for new teachers (e.g., more stringent degree requirements, higher scores on standardized tests). See Figure 2.3.c.1.

Figure 2.3.c.1



Source: *Schools and Staffing Survey (SASS)*, 1993-94; *Teacher Quality: A Report on Teacher Preparation and Qualifications of Public School Teachers*, 1999. *Frequency:* Biennial. *Next Update:* 2000, reported February 2001. **Validation procedures:** Data validated by NCES review procedures and *NCES Statistical Standards*. **Limitations of data and planned improvements:** The SASS data are only for current teachers of grades 7-12 and are only one measure of teachers' content knowledge. There are no SASS data on kindergarten-sixth grade teachers or on teachers' pedagogical knowledge.

Figure 2.3.c.2

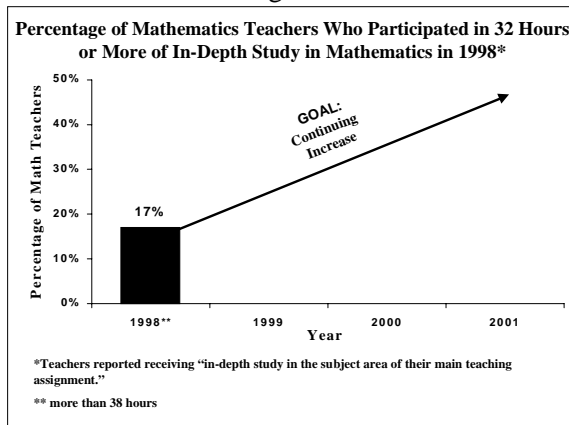


Source: Educational Testing Service (ETS), 1999, *Praxis I Pre Professional Skills Test (PPST)* *Frequency:* Annual. *Next Update:* Fall 2000. **Validation procedures:** Data validated by ETS quality control procedures. **Limitations of data and planned improvements:** Based on data from those 29 states that require the PPST. The PPST measures knowledge in mathematics content and pedagogy for prospective elementary school teachers in states that require this exam. The data are only for those two-thirds of preservice teachers who took the paper and pencil test and do not represent teachers who took the computer test.

Indicator 2.3.d. Each year, more teachers of mathematics will complete intensive professional development to enable them to teach challenging mathematics.

Assessment of Progress. Unable to judge increase because only one year of data is available. Only 17 percent of mathematics teachers participated in more than 32 hours of in-depth study in their main assignment field in 1998. Future data will report on elementary school teachers' participation in professional development and will report more specifically on the content of professional development.

Figure 2.3.d.1

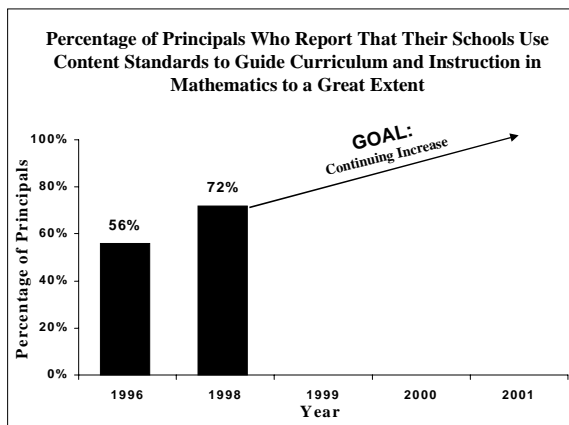


Source: *Teacher Quality: A Report on the Preparation and Qualifications of Public School Teachers, 1999.* Frequency: Every 2 years. Next Update: 2000, reported February 2001. **Validation procedures:** Data validated by NCES review procedures and *NCES Statistical Standards*. **Limitations of data and planned improvements:** This is the first year for which the Schools and Staffing Survey (SASS) data are available, and therefore there is no trend. Data are only available for teachers whose main assignment is math, which includes few elementary school teachers. In addition, although length of professional development experience often correlates with quality, it does not measure change in teacher practice nor subsequent impact on student achievement. The next NCES Teacher Quality survey will collect data about mathematics professional development from all elementary school teachers.

Indicator 2.3.e. Each year, increasing numbers of schools will have access to, and use, information on best practices for math content and instruction.

Assessment of Progress. There are no 1999 data, but significant progress was made between 1996 and 1998, making further progress in 1999 and 2000 likely. A key component of educational reform in states, districts, and schools is the implementation of challenging standards in the content areas. It is expected that as challenging mathematics content standards are implemented in schools, instruction and achievement will improve. This indicator shows improvement in the number of principals reporting the use of standards, a prerequisite for the effective implementation of standards at the classroom level.

Figure 2.3.e.1



Source: 1996 data: Status of Education Reform in Public Elementary and Secondary Schools, Principals' Perspective, NCES 1998 data: School-Level Implementation of Standards-Based Reform: Findings from the Followup Public School Survey on Education Reform. Frequency: No regular schedule. Next Update: Spring 2000. **Validation procedures:** Data validated by NCES review procedures and *NCES Statistical Standards*. **Limitations of data and planned improvements:** This indicator relies on self-reported data, which may not be a completely accurate measure of teacher practice. It is also an incomplete measure of schools' use of best practices.

How We Plan to Achieve Our Objective

How ED's Activities Support the Achievement of This Objective. America Counts, the Department's mathematics initiative, is a multifaceted initiative that coordinates the Department's programs and its own projects to improve student achievement in mathematics. The initiative is guided by the six strategic goals outlined below. Activities are under way in each area to promote achievement of these goals.

- **Equip teachers to teach challenging mathematics through high-quality preparation and ongoing professional growth opportunities.** The Department recently created the National Commission on Mathematics and Science Teaching for the 21st Century, chaired by former Senator and astronaut John Glenn. The Glenn Commission is made up of 32 of our Nation's finest business and education leaders; public officials at the Federal, state, and local levels; and teachers of mathematics and science. The Glenn Commission will submit to Secretary of Education Richard Riley in the fall of 2000 a final report with recommendations and a corresponding action strategy for different stakeholders to improve the quality of math and science teaching in our Nation's classrooms. In addition, the Department has developed a number of professional development products and toolkits that help teachers teach challenging mathematics. A \$2 million program to help implement the recommendations of the Glenn Commission has been proposed in the National Activities for the Improvement of Teaching and School Leadership FY 2001 budget request (formerly the Eisenhower Professional Development Federal Activities).

The Department also provides funding for teacher preparation and professional development through several programs. The Administration's proposed State Grants program and the Eisenhower Regional Consortia help provide sustained, intensive, high-quality professional development for mathematics and science teachers. The Department also supports partnership programs that improve teacher preparation in mathematics and science through the Title II funds of the Higher Education Act (HEA).

- **Provide personal attention and additional learning time for students.** To encourage postsecondary institutions to support mathematics tutoring, effective July 1, 1999, the Federal government is paying 100 percent of the wages of Work Study students who serve as mathematics tutors to elementary through ninth-grade students. The Federal Work Study efforts began this past fall, and close to 300 postsecondary school campuses have currently signed on. An online roadmap is available to help campuses initiate and sustain high-quality tutoring programs. The Department has extended mathematics learning opportunities in its 21st Century Community Learning Centers and Gaining Early Awareness and Readiness for Undergraduate Programs (GEAR UP) programs as well. Finally, the Department has developed both *Helping Your Child Learn Math* (including a Spanish version) and *Early Childhood: Where Learning Begins--Mathematics*, two booklets that help families participate in their children's mathematical learning.
- **Support high-quality research to inform best practices of mathematics teaching and learning.** The Department and the NSF have funded the National Academy of Sciences (NAS) to conduct a Mathematics Learning Study and a Study on calculus, biology, chemistry, and physics Advanced Placement (AP) Programs. The Mathematics Learning Study is scheduled for completion in the spring of 2000, and will examine the factors that lead to successful mathematics learning and provide research-based recommendations for the improvement of mathematics teaching and learning. The AP study is scheduled for completion in 2001 and will explore whether U.S. secondary mathematics and science instruction and assessment programs help students develop world-class advanced competencies. The Department is also cofunding with NSF the Interagency Education Research

Initiative, a \$30-million effort supporting research directed toward understanding how to make substantial improvements in early learning in mathematics and other areas. Moreover, the Department promoted the 1999 replication of the TIMSS assessment to interested states and districts that wanted to benchmark their efforts in mathematics and science against international standards.

- **Build public understanding of the mathematics that today’s students must master.** The Department and NSF recently launched (December 1999) a \$3-million, three-year national public engagement campaign. The campaign is distributing “math challenges” targeted to middle schools that give families an opportunity to explore mathematical ideas together and demonstrate the relevance of mathematics to daily life. The Department also continues to develop and widely disseminate clear, research-based information on the importance of challenging mathematics. For instance, the Department has recently distributed several articles on Federal Work Study and Glenn Commission activities. Recently, the Department developed and widely disseminated *The Formula for Success: A Business Leader’s Guide*, which encourages business leaders to actively participate in improving mathematics and science achievement in schools.
- **Encourage a challenging and engaging curriculum for all students based on rigorous standards.** As mandated by Congress, an expert panel released in the fall of 1999 a list of mathematics programs and instructional materials identified as promising or exemplary to help teachers and administrators select and implement high-quality curricula. The expert panel will release results from reviews of science materials in 2000.
- **Promote the coordinated and effective use of Federal, state, and local resources.** The Department has been working to infuse high-quality mathematics into existing Federal programs, especially Title I and the proposed State Grants program, Title II. In partnership with NSF, the Department held regional conferences with state- and district-level teams on how to better use Federal, state, and local resources to improve mathematics achievement. Two reports have been developed from those conferences, including one with case studies of districts that are demonstration projects for the coordinated use of resources, and will be used as the basis for continued technical assistance with Title I and Title II coordinators.

How We Coordinate with Other Federal Agencies

- **The Department of Education (ED) worked with other Federal agencies to create the National Commission on Mathematics and Science Teaching for the 21st Century, chaired by former senator John Glenn.** There is ongoing collaboration with ex-officio members and their staff, including several Federal agencies (NASA and the Departments of Energy, Transportation, and Defense) and major math and science organizations (NSF, National Academy of Sciences, and the White House’s Office of Science Technology and Policy).
- **ED worked together with the NSF to release *An Action Strategy for Improving Achievement in Mathematics and Science*** in response to a Presidential directive that targeted mathematics in middle grades as a leverage point and laid out many of the strategies that America Counts is currently pursuing. The Department continues to collaborate with NSF and other Federal agencies as we implement many of the strategies highlighted above.

Challenges to Achieving Our Objective

Public understanding of the mathematics education that all students today need is often based on recollections of personal mathematical experiences. Many of these recollections are negative and are characterized by a belief that mathematics excellence is only for a talented few. “What are we going to use this for?” is not merely a student’s common lament. Many adults willingly admit their own mathematical ineptitude and demand little more from, or for their children. Coupled with this pervasive malaise is an inadequate understanding of the time needed to make real change in classrooms. Some parents understandably do not want experimentation in their children’s classrooms and are concerned about new teaching methods and high-stakes test scores that do not quickly show growth. The public engagement campaign and the high profile of the Glenn Commission will focus new attention on these issues.