Mathematics Curriculum Revision

Executive Summary

Performance Standards

The most noticeable difference between the former and the new curriculum in mathematics for Georgia schools is the use of *performance standards*. A performance standard has four components: a content standard, illustrative tasks, examples of student work, and a commentary for teachers. Together, these components will be the teacher's guide as to what to teach, how thoroughly to treat a topic, and what some instances of student work that meet the content standard might look like.

The Georgia performance standards for mathematics have been designed to achieve a balance among concepts, skills, and problem solving. The curriculum stresses rigorous concept development, presents realistic and relevant tasks, and keeps a strong emphasis on computational skills. At all grades, the curriculum encourages students to reason mathematically, to evaluate mathematical arguments both formally and informally, to use the language of mathematics to communicate ideas and information precisely, and to make connections among mathematical topics and to other disciplines.

Although extensive reteaching and review were common in the previous curriculum and were well meant, they resulted in minimal learning for too many students. Eliminating extensive repetition, the new performance standards address fewer topics at each grade level. Each concept is to be taught and learned with both rigor and depth, building on previous concepts and skills and employing them in the service of new ideas. When students are using mathematics to solve challenging problems, they have natural opportunities to review the mathematics they have learned, and their teachers can assess their grasp of that mathematics. Fewer topics, together with sample tasks, student work, and commentary, provide clear expectations for student performance, guide instruction, and allow for a careful alignment of instruction and assessment.

Rationale for Change

In September 2001, the Georgia State Board of Education requested an audit of Georgia's Quality Core Curriculum. Phi Delta Kappa conducted the audit and found that in several areas the curriculum lacked rigor and was inadequate to guide teaching and to ensure common expectations for all students. It not only lacked depth and could not be covered in a reasonable amount of time; it did not even meet national standards. The audit found that it would take 23 years—not 12—to cover the topics included at anywhere near the level of depth necessary for real learning to take place. Shallow standards forced our teachers to guess what they should teach and to hope that what they were teaching was what would be tested. Inevitably, teachers used the curriculum document not as a guide for quality instruction but as a reference to mention in lesson plans and then put back on the shelf.

The Georgia Department of Education was asked by the State Board to develop a plan for strengthening the Georgia curriculum. The Department was specifically asked to address the following concerns:

1. The curriculum needs to be rigorous—more than "a half an inch deep."
2. The curriculum needs to be more focused—less than a "mile wide."
3. The curriculum needs to be clearly understandable by teachers so they can effectively guide instruction. The curriculum standards need to specifically describe what the students are expected to know and be able to do.
4. Instruction needs to be student-centered rather than teacher-centered. Educators should focus on what students are learning.

Student performance on the Georgia Criterion-Reference Competence Tests (CRCT), the Georgia High School Graduation Test (GHSGT), the National Assessment of Educational Progress (NAEP), and the SAT provide data clearly indicating that, although as a state we may be improving in some ways, we are not improving fast enough, nor are we closing the achievement gap between student groups. Furthermore, Georgia students are still below the national average on NAEP mathematics. Despite prolonged efforts to improve students' performance, mathematical proficiency in Georgia schools remains alarmingly low. The federal No Child Left Behind Act requires a curriculum that will meet the needs of all students. A curriculum revised to meet those needs will ensure Georgians that all our students will be doing mathematics at grade level.

Essential Changes

The new Georgia K–12 performance standards in mathematics support a strong, cohesive, and coherent curriculum that provides a clear path to higher mathematics and intelligent citizenship. They draw on the strengths of the Japanese school mathematics curriculum: coherence, leanness, and rigor. They are presented in a format adapted from the North Carolina standards. For grades K–8, the Georgia standards are presented grade by grade, and there is a description of what a student should be able to do at the beginning of each grade level. For grades 9–12, the standards are presented course by course. Consistent with the curricula of the top-performing nations in the world, all the high school courses weave together different mathematics content areas, thus requiring course names other than those used at present such as Algebra I and Geometry. The mathematics curriculum is organized into five content strands: number and operations, measurement, geometry, algebra, and data analysis and probability. At each grade, there are process standards that emphasize problem solving, reasoning, representation, connections, and communication.

Grades K–8

At grades K–2, there are four content strands: number and operations, measurement, geometry, and data analysis. At grade 3, the algebra strand is added. Throughout the curriculum, students are expected to be actively engaged in developing their mathematical understanding by using manipulatives, technology, and a variety of representations, working independently and cooperatively to solve problems, estimating and computing efficiently, and conducting investigations and recording findings.

Students are expected to apply mathematical concepts and skills in the context of realistic problems and to understand concepts rather than merely following a sequence of procedures. In their mathematics classroom, students learn to think critically in a mathematical way, understanding that there are many different paths to a solution and that sometimes there is more than one right answer.

In grade 6, the curriculum begins to address traditional topics from algebra and geometry, and from grade 7 on, the curriculum has four content strands: number and operations, geometry, algebra, and data analysis and probability. In the past, very little new content was introduced in middle grades, making it easy for students to skip a course. In the new curriculum, new content topics are introduced in every grade in middle school, making it impossible to justify skipping any course. Acceleration of students with exceptional mathematical talent should be achieved by increasing the rigor and depth of the existing standards at each grade level as opposed to skipping or compressing courses. The rigor of the middle school curriculum allows all students to take in high school the courses they need to enter college. By the end of grade 8, the student will have completed the equivalent of traditional first-year algebra and much of the traditional geometry course.

Grades 9–12

The high school curriculum provides three paths: the Core Mathematics sequence prepares students to enter college, the regular Mathematics sequence allows students to enter college at the calculus level, and the Accelerated Mathematics sequence allows students to leave high school having completed Advanced Placement (AP) Calculus. Because common standards are addressed in all three sequences, movement from one sequence to another is possible at various points in the curriculum, and a variety of paths are available regardless of which course a student takes in the ninth grade. In addition, a new course in discrete mathematics and the AP Statistics course will be offered as options.

The high school mathematics content standards address four strands: number and operations, algebra, geometry, and data analysis and probability. Courses are carefully designed to develop the natural connections that exist among these strands, between mathematical topics and to other disciplines. These connections allow students to see and use mathematics as a tool for solving complex problems.

The implementation of this curriculum will require that mathematics classrooms at every grade be student-focused rather than teacher-focused. Working individually or collaboratively, students should be actively engaged in inquiry and discovery related to real phenomena. Knowledge and procedural skills should be developed in this context. Multiple representations of mathematics, alternative approaches to problem solving, and the appropriate use of technology are all fundamental to achieving the specified goals of the curriculum.

Reading Across the Curriculum

A standard for reading across the curriculum is included in the mathematics standards. This standard addresses the requirement that, across all subjects, every student should

read 25 books or one million words a year. Teachers of mathematics should emphasize reading mathematics.

Implementation

The new performance standards make heavy demands on teachers of mathematics, and extensive professional development will be needed. Training for sixth-grade teachers began in fall 2004. Beginning at grade 6 in fall 2005, the standards for grades 6–12 are to be implemented in the classroom a grade at a time. Initial training for grades K–2 teachers begins in fall 2005, with implementation in these grades in fall 2006. Initial training for grades 3–5 teachers begins in fall 2006, with implementation in these grades in fall 2007.

Textbooks

Most current elementary and middle school mathematics textbooks will need to be supplemented if the new standards are to be met. In 2006, a new state adoption will recommend books that are more closely aligned with the standards. The biggest changes in mathematics textbooks will need to be at the high school level. Some books exist now that are close to what is needed, and by the time the high school mathematics standards are implemented, there will be appropriate books.