



Best Practices for Implementing HSTW and MMGW

SREB

MAKING
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WORK

Schools' Actions Add Up to Success in Raising Students' Mathematics Achievement

Quality instruction and student engagement in mathematics are strategies that are becoming more vital as the new century unfolds. To prepare for living and working in a technically intensive world, high school students need a culture of high expectations, quality college-preparatory-level courses and numeracy across the curriculum. The following actions are being taken by *High Schools That Work* (HSTW) sites in efforts to raise students' mathematics achievement:

Have all students to complete four years of mathematics, including Algebra I and higher.

The HSTW-recommended curriculum calls for all students to complete four courses in mathematics, including Algebra I, geometry, Algebra II and either a higher-level mathematics course or a specially-developed mathematics course such as a senior year catch-up course. Students who complete Algebra I in the eighth grade should take four additional years of mathematics. All students should take a mathematics course in senior year.

Ivy Alford, director of state services for school improvement for the Southern Regional Education Board (SREB), believes mathematics is a gateway to high-salary, high-demand jobs. However, she warned that many students may be unable to complete four mathematics courses in high school if

teachers rely exclusively on textbooks. To help students reach the proficiency level on state mathematics assessments, teachers need to focus on standards-based lesson designs that include real-world, open-ended problems.

Some students will need extra help to pursue a more rigorous mathematics curriculum. To determine which students may need extra help, schools can use ACT's Explore (for eighth- and ninth-graders) and ASSET tests or state assessments. (Schools can also use these tools to identify high school students who are prepared to take college-credit, honors and/or Advanced Placement classes.) Students whose test scores indicate the need for extra help or who make Cs and Ds in Algebra II are probably not ready for college-credit mathematics courses and are prime candidates for a senior year catch-up course, Alford pointed out.

Does the four-year mathematics requirement improve student achievement? Seventy-seven percent of students at the top 50 HSTW sites (as determined by their mean scores on the mathematics portion of the 2004 HSTW Assessment), compared with 42 percent at all HSTW sites, reported taking four mathematics courses at the level of Algebra I or higher.

Mathematics achievement improves when students complete the entire HSTW-recommended curriculum of challenging

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English, mathematics and science courses. The mean mathematics score on the 2004 *HSTW* Assessment for students who completed the recommended academic core was 319, compared with 301 for students completing only one or two subjects and 284 for those completing none. The *HSTW* mathematics goal is 297. Sixty-six percent of students at the top 50 schools, compared with 21 percent at all *HSTW* sites, completed all three parts of the recommended curriculum.

Alford stressed the importance of choosing and completing a concentration in mathematics and science, humanities or a career/technical field. The mathematics and science concentration consists of four courses in each subject, including at least one course at the Advanced Placement (AP) level. Participation in Project Lead The Way, a pre-engineering program of study, is a good option for students choosing the mathematics and science concentration.

The following actions are designed to raise mathematics achievement:

- Have students solve problems outside the textbook.
- Explain processes orally.
- Have students work with others on assignments.
- Have students brainstorm to solve problems in groups.
- Have students solve open-ended problems.
- Have students use graphing calculators.
- Create common unit assessments.
- Create mathematics study teams.

Alford listed 10 questions that schools can use to assess and improve the quality of mathematics instruction:

- How many students complete four years of college-preparatory mathematics courses?
- Which courses support a policy of requiring four rigorous mathematics courses for all students?
- What steps can your school take to reduce the number of low-level courses by 25 percent annually until all low-level courses are eliminated?
- What are the current efforts between high and middle grades schools either to provide Algebra I in the eighth grade or to identify students requiring extra help before reaching high school?
- What steps can be taken to strengthen efforts between high school and middle grades teachers?
- What extra help opportunities are available to your students?

- How do you measure the success of these opportunities? Are they really working?
- How can extra-help opportunities be improved?
- What additional courses, such as AP courses or dual and joint credit opportunities, will be needed to support improved extra-help policies?
- What additional data will you need in order to gain support from the district, the administration and the teachers to implement a policy requiring all students take four rigorous mathematics courses in high school?

(Contact Ivy Alford at ivy.alford@sreb.org.)

Teach Algebra I to all students in the middle grades.

Mathematics achievement is a good predictor of earned income by age 25. Many schools are giving students a head start on success by teaching Algebra I prior to high school. At the very least, schools are using the middle grades to prepare students to complete Algebra I successfully in grade nine.

The **DeKalb County School System** in Decatur, Georgia, the second largest in the state, enrolls more than 100,000 students, including 90 percent minority students. Beginning in the 2004-2005 school year, the system began requiring all eighth-graders to take Algebra I and all seniors to take a mathematics course.

Project Algebra is part of a comprehensive pre-K through 12th grade mathematics reform effort adopted by the DeKalb school board in 2003. **Wanda Gilliard**, senior executive director for curriculum and instruction for the school system, listed these components:

- Algebra I for all eighth-graders;
- an algebra-rich curriculum for all grade levels;
- consistent pacing throughout grade and subject areas;
- instruction beyond the textbook in all mathematics courses across the curriculum;
- formal pre-algebra in the seventh grade;
- a mathematics program, supported by a reading improvement effort, in pre-K through grade six;
- a requirement of four mathematics credits for all high school students; and
- a focus on increasing the number of students taking higher-level and AP courses.

One School's Journey to High Mathematics Achievement

Springdale High School in Springdale, Arkansas, has succeeded in raising mathematics achievement — but it took a rude awakening to get the improvement process under way. Roughly 10 years ago, all juniors at the school took ACT's ASSET test in mathematics. School leaders and mathematics teachers were surprised and chagrined to find that 80 percent of the students taking the test likely would require remediation when they entered college.

The school reacted with the following constructive actions:

- Administrators, counselors and mathematics teachers acknowledged that Springdale had a mathematics problem and began working together to resolve it. They approached the task in a positive manner without placing blame.
- Several members of the group traveled to Glendale, Arizona, to learn how schools in that city had raised mathematics achievement.
- The school worked with other high schools to improve mathematics achievement.

As Springdale High School was coming to grips with the mathematics problem, the Arkansas Department of Education adopted a policy requiring all students take four years of mathematics in high school, including senior year. The school grappled with how to get students and parents to accept the new requirement and how to get teachers to implement it without increasing the dropout rate.

To ensure success, the school:

- began to eliminate low-level courses while adopting Algebra I as the first credit-bearing mathematics course in high school;
- established a teacher-adviser program;
- worked with the local community college to certify Springdale mathematics teachers to teach college-level mathematics courses in a dual-enrollment program at the high school;
- established mastery algebra to give students more than one opportunity to pass;
- quickly mainstreamed non-English speaking students; and
- offered extra-help opportunities for students needing additional support.

The 2004 *HSTW* Assessment showed that Springdale High School had achieved good results from its efforts to upgrade mathematics achievement. The mean score in mathematics for students participating in the *HSTW* Assessment rose from 316 in 2002 to 327 in 2004. The 2004 score exceeded the *HSTW* mathematics achievement goal of 297. Almost half of the students at Springdale High School, compared with only 15 percent at all *HSTW* sites, are performing at the proficient level in mathematics. (*Contact Jan Struebing at jstruebing@sdale.org.*)

The DeKalb system is providing professional development to prepare teachers for the instructional challenges of the new mathematics initiative. The system is offering train-the-trainer programs in which master teachers from each school receive professional development that they deliver to teachers at their schools. Teachers of eighth-graders received professional development on content, best practices and technology integration during the summer of 2005. They also will attend seven days of training during the 2005-2006 school year. Four middle grades mathematics coaches will be assigned to Title I schools in the system. (*Contact Wanda Gilliard at wanda_s_gilliard@fc.dekalb.k12.ga.us.*)

Preparing middle grades mathematics teachers through distance learning

SREB has developed a Middle Grades Mathematics (MGM) series to increase the mathematics content and instructional skills of current middle grades mathematics teachers as well as individuals who want to become

certified or approved to teach middle grades mathematics. The series consists of seven courses developed by three postsecondary institutions. Details are available at www.electroniccampus.org/TeacherCenter/ExperiencedTeacher/MGM/course_information.asp.

Use mathematics to advance achievement in other subjects.

Schools that do a better job of implementing the *HSTW* design are more likely to promote numeracy across the curriculum. At these schools, mathematics concepts are woven into English, science and social studies classes to advance the ability of students to solve problems, acquire knowledge and learn independently.

Problem solving and independent learning are key skills for career/technical students. *HSTW* school improvement consultant **Heather Sass** offers a series of steps for integrating mathematics into career/technical courses:

- Get mathematics and career/technical teachers together to develop proficient-level mathematics problems.
- Review standards for both career/technical and mathematics courses.
- Develop a common language for talking about mathematics in mathematics and career/technical classrooms.
- For each career/technical unit of study, generate a set of career-focused, mathematics-based scenarios.
- Provide staff development for career/technical teachers in how to get students to use mathematics to solve problems in their career areas.
- Develop a system for assigning mathematics problems in career/technical classes.
- Ask students to work together to solve mathematics problems and explain their answers.
- Ask students to do mathematics-related homework problems. Include scenario-type problems and skills practice.
- Include mathematics problems on unit assessments and end-of-course assessments and/or require students to pass a mathematics exam to complete the course.
- Collect data on the effectiveness of mathematics instruction in career/technical classes.
- After each unit, identify strengths and weaknesses in students' mathematics reasoning and skills. Help students to work at the proficient level.
- Review end-of-course exams and/or career/technical mathematics exams to find students' strengths and weaknesses in mathematics.
- Survey students each semester to determine if they perceive an intensive emphasis on mathematics in their career/technical courses.
- Review standardized test data annually to determine gains in students' career/technical mathematics test scores.

(Contact Heather Sass at heather.sass@sreb.org.)

Teaching Algebra I Well: Using a Mastery Approach

Fort Mill High School in Fort Mill, South Carolina, uses Mastery Algebra I to raise mathematics achievement. The six components are:

- The lowest grade accepted on a unit test is 77. (There are 12 unit tests.) Students scoring below that level must retake the test and attend tutoring.
- Unit test grades (cumulative) are weighted as 75 percent of each six-week grade; homework, quizzes, group work, etc. account for another 5 percent. The mandatory South Carolina end-of-course exam counts as the remaining 20 percent of the final grade for the 18-week course.
- Students receive credit for the course only when they master all test units.
- Tutoring and retesting are required.
- Parental involvement is high.
- The entire mathematics department was involved in implementation.

Students and parents receive information about the program. Counselors explain the requirements and assist middle grades and high school students in selecting courses. Students and parents attend a Mastery Algebra I information session as part of freshman orientation. A packet of information given to students at registration contains a course outline, expectations for students and parents, and pre-course homework, which is due the first day of class.

The percentage of Fort Mill students failing Algebra I dropped from 39 percent six years ago to none in the 2004-2005 school year. Ninety-five percent passed the South Carolina end-of-course exam with a grade of C or better.

Mathematics teacher **Anne Ledford** says the system works because everyone has bought into it. "Schools need a strong commitment from teachers, students and parents to address the needs of ninth-graders," she said.

(Contact Anne Ledford at ledforda@fort-mill.k12.sc.us.)

Benjamin E. Mays High School in Atlanta, Georgia, has made an intensive effort to bring real-world mathematics to its 1,836 students. Ninety-nine percent of these students are African-Americans, and 54 percent are eligible for free or reduced-price lunches. The school is the mathematics and science magnet for the Atlanta school system.

John Chandler, *HSTW* coordinator at the school, says the mathematics program is built on four pillars: high expectations, engaging students in learning, continuous improvement and outside opportunities. The school has made the following advances:

- All ninth-graders take Algebra I or higher.
- Twenty-five percent of ninth-graders take geometry or Algebra II.
- Eighty percent of seniors complete calculus.
- The school offers three AP mathematics courses.

Numeracy skills are incorporated into challenging programs of study such as the academy of mathematics and science, JROTC, health care science technology, drafting and graphic design, broadcast and video production, and the ninth-grade academy.

Teachers use a number of strategies to engage students in learning mathematics: differentiated instruction, student-centered classrooms, inquiry learning, problem- and project-based learning, team teaching, hands-on activities, and calculator- and computer-based labs.

Fifty-nine percent of students participating in the 2004 *HSTW* Assessment at Mays High School reported that they experienced an intensive emphasis on numeracy across the curriculum. This compares with 26 percent of students at other high-achieving *HSTW* sites with similar demographics. Sixty-one percent of students, compared with 55 percent at schools with similar students, said they wrote weekly or up to several times a week in mathematics classes. Forty-four percent of students, compared with 7 percent at comparable schools, reported writing a major research paper on a chosen subject in mathematics once a semester.

Students can obtain extra help from the Advancement Via Individual Determination (AVID) program and/or from teachers, college students and peers.

(Contact John Chandler at jdchandler@atlanta.k12.ga.us.)

Use research-based instructional strategies to raise mathematics achievement.

How mathematics is taught matters just as much as what is taught. The right instructional strategies make a big difference in whether students move ahead or are left behind.

William Hadley, chief academic officer for **Carnegie Learning Inc.** in Pittsburgh, Pennsylvania, offered recommendations for improving students' mathematics achievement. First, he cited an article titled "Back to the Future in Mathematics" in the April 7, 2004, issue of *Education Week* reporting that only two out of three students who graduate from high school have completed three years of mathematics, and only two out of three students manage to graduate at all. According to Hadley, these figures are essentially unchanged from 20 years ago, when the *A Nation at Risk* report on the decline of American education was published.

As further evidence, Hadley said 67 percent of African-American students and 77 percent of Hispanic students fail their states' mathematics assessments. In a typical urban high school, a high percentage of ninth-graders fail mathematics.

Hadley listed several factors contributing to the sad state of affairs in mathematics. One is dependence on outmoded mathematics texts that use the same three-step process used for decades: state the rule, give an example, and practice. This type of instructional strategy is unlikely to help students develop into independent learners.

Other factors affecting mathematics performance are curriculums that fail to address real-world needs and instruction that is inappropriate for students today. Instruction should be standards-based, student-centered, differentiated and research-based, Hadley said.

Students should be permitted to struggle with mathematics concepts as they improve their independent learning skills and should receive extra help as needed. They should have opportunities to present their solutions during class, work in teams to solve problems and write answers to mathematics problems in complete sentences.

To improve their instructional techniques, teachers need time to work together, professional development that focuses on raising student achievement, and strong administrative and community support.

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