For the Success of Each Learner

Educational Leadership

February 2004 | Volume **61** | Number **5**

Improving Achievement in Math and Science Pages 68-71

Math Acceleration for All

Carol Corbett Burris, Jay P. Heubert and Henry M. Levin

A middle school in New York eliminated tracked math classes, adopted a universal accelerated math program, and instituted heterogeneous grouping, with dramatic results.

February 2004

Imagine that one school's organizational change resulted in more students taking advanced math courses in middle and high school and that these students demonstrated substantial gains in overall math achievement, including higher scores on Advanced Placement exams in calculus. Imagine further that the program produced these improvements for all groups of students—initial low achievers, initial high achievers, and students of different socioeconomic levels and racial backgrounds.

South Side Middle School, a diverse suburban school in the Rockville Centre School District in New York State, implemented such an organizational change in 1995 when it began to provide accelerated math instruction for all students. An analysis of six years of longitudinal data on what math courses these students subsequently took and their level of achievement in math has documented the program's extraordinary benefits (Burris, 2003). It also reveals how a community and a faculty committed to high standards for all can make that goal a reality.

The Importance of Advanced Math

Studying advanced math in high school has an enormous influence on whether or not a student subsequently enrolls in a four-year college and earns a bachelor's degree. Horn and Nunez (2000) report that students whose parents never attended college more than doubled their chances of enrolling in four-year colleges if they took high school math courses beyond Algebra 2. Similarly, a U.S. Department of Education study (Adelman, 1999) found that taking advanced math in high school was more strongly associated with successful completion of college than any other factor, including high school grade point average and socioeconomic status.

Successful completion of college, in turn, correlates strongly with subsequent educational and employment opportunities (Murnane & Levy, 1996). In other words, studying advanced math in high school strongly correlates with future success.

Traditional Grouping Practices

If studying advanced math in high school produces such large benefits, why don't all students do it? Two inhibiting factors are tracking and the attitudes often associated with tracking. In the United States, the most proficient math students at lower grades usually advance to algebra in the 8th grade. These students usually continue taking other high-level math courses in high school, culminating with calculus in the 12th grade. For students who leave elementary school as low achievers in math, however, a two-year algebra course in high school is usually the end of math study, concluding a secondary sequence that typically begins with remedial pre-algebra courses.

Research suggests that such low-level instruction is not the best way to help all students—including initial low achievers—develop a deep understanding of mathematics. According to the National Research Council, low-track classes are “typically characterized by an exclusive focus on basic skills, low expectations, and the least-qualified teachers” (Heubert & Hauser, 1999, p. 282). Low-achieving students assigned to low-level courses fall further behind rather than acquiring increasingly high-level knowledge and skills. Tracking thus contributes to low math performance rather than addressing it (Kifer, 1993; McKnight, 1987; Oakes, Ormseth, Bell, & Camp, 1990). Low-track placements also reflect certain assumptions: that many students cannot learn beyond low levels, that good teachers are wasted on low achievers, and that high expectations will harm the self-esteem of low-achieving students.

But there is another way. Indeed, the current standards movement rests on the premise that virtually all students can reach high levels of achievement if they receive high-quality curriculum and instruction. Research on accelerating instruction supports the premise that an enriched, accelerated curriculum does more than a low-track, remedial curriculum to enhance the performance of low achievers and students who are at risk of failure (Bloom, Ham, Melton, & O'Brien, 2001; Levin, 1988; Peterson, 1989).

Accelerated Math and Heterogeneous Grouping

New York State requires that middle schools provide an unspecified percentage of students with accelerated math instruction and that these students take the algebra-based New York State Regents exam, Sequential I Mathematics, in 8th grade. Most middle schools provide this instruction to approximately 20 percent of their students.

Believing that all middle school students would benefit from instruction in high-level, heterogeneously grouped classes, Rockville Centre Superintendent William H. Johnson and South Side Middle School Assistant Principal Delia Garrity developed a multiyear program to eliminate

tracking in middle school math. Before initiating universal acceleration in math, the district had already worked since the late 1980s on dismantling tracking in English and social studies. In preparation for universal math acceleration, the district for several years gradually increased enrollments in accelerated math classes. Despite these increases, median scores on the Sequential I Mathematics Regents exam remained stable, a positive portent for universal acceleration.

Starting in 1995, all students entering 6th grade at South Side Middle School took accelerated math in heterogeneously grouped classes and prepared for taking the Regents exam when they reached 8th grade. Research found positive results for all student groups, even the initial high achievers who had previously studied advanced math in homogeneous, high-track classes.

South Side's middle school math teachers worked together to revise and condense the regular 6th and 7th grade math curriculum to prepare students for the accelerated algebra course usually reserved only for high achievers in 8th grade. Together, the teachers eliminated redundancies and streamlined content. The school supported struggling learners in three ways: It instituted special support classes that met every other day in addition to the regular class meetings; It required teachers, as part of their work contract, to provide after-school help four out of five days a week; and it offered general resource support, such as supplementary materials that teachers requested.

The reform took five years (1994–1998) to plan and implement. Along the way, some math teachers and parents expressed misgivings about universal acceleration and its effects on high achievers. The middle school administrators addressed these concerns by presenting data showing universal acceleration's positive effects, even for high achievers, and by actively promoting the district's strong public commitment to high standards for all. By the year 2000, middle school math teachers confidently told visitors that they had no interest in returning to the previous tracked system. Accelerated math instruction has become an integral part of the culture of the school.

The Study

Evaluation of this reform (Burris, 2003) used longitudinal student achievement data from six student cohorts: the last three 6th grade cohorts at South Side Middle School that did not receive universal math acceleration and the first three 6th grade cohorts that received it. The evaluation used achievement and demographic data to examine the academic consequences of providing all students with a high-level, accelerated math curriculum.

The study first examined whether all students benefited from an accelerated algebra course in 8th grade, defining *benefit* as continued participation in the accelerated math program and enrollment in other advanced math courses in grades 9–12.

The study also looked at the effects of acceleration on specific subgroups: African American and

Latino students; students from a low socioeconomic background; and initial low achievers, average achievers, and high achievers. Students' initial level of achievement was defined according to their 5th grade stanine scores on the Math Concepts subtest of the Iowa Tests of Basic Skills. The study also examined the effects of heterogeneous grouping on the performance of high achievers.

Important Benefits for Each Group

By every measure, students benefited from studying accelerated math in heterogeneously grouped classes. The research documented a statistically significant increase in the percentages of all students who took math courses beyond Algebra 2 in high school. This benefit applied to every subgroup. Among students completing trigonometry before they graduated from high school, the percentage of students from low socioeconomic backgrounds increased from 32 to 67 percent; African American and Latino students increased from 46 to 67 percent; initial low achievers increased from 38 to 53 percent, average achievers from 81 to 91 percent, and even initial high achievers from 89 to 99 percent. The rates at which each group took precalculus and Advanced Placement calculus also increased.

Conversely, universal acceleration did not increase the percentages of students who did not take math courses or who took math courses below their grade levels; indeed, when compared with earlier cohorts, more students took math courses at higher levels. The high standards did not discourage even the initial low achievers.

Universal math acceleration also helped close the achievement gap associated with poverty. For the trigonometry-based course (New York State Sequential III Mathematics), the advantage gained by members of the universal-acceleration cohort nearly wiped out the disadvantage associated with poverty. For example, students from a low socioeconomic background who participated in the accelerated program had approximately the same probability of completing Sequential III math (0.37) as did students of middle or high socioeconomic backgrounds who attended South Side before universal acceleration (0.38).

Likewise, universal acceleration narrowed the achievement gap associated with ethnicity. Being an African American or Latino student had been associated with lower odds of completing advanced math courses, but universal acceleration almost entirely offset these previously lower odds.

Effects on High Achievers

A contentious issue in the tracking debate is whether the inclusion of all learners in heterogeneously grouped math classes diminishes the achievement levels of initial high achievers. Some studies find that high achievers learn less in heterogeneous groups (Kulik, 1992; Loveless, 1998), whereas others report no such achievement effects (Mosteller, Light, & Sachs, 1996).

Even if heterogeneous grouping were generally associated with diminished learning for high achievers, it is unclear whether the effect would be due to the grouping or to a less rigorous curriculum for lower-track classes (Lucas, 1999; Slavin, 1995). Some researchers (Oakes et al., 1990; Slavin & Braddock, 1993; Wheelock, 1992) assert that heterogeneous grouping will not impair the learning of high achievers if the top-track curriculum "becomes accessible to a broader range of students without watering it down" (Slavin & Braddock, 1993, p.15).

What happened, then, to the initial high achievers at South Side Middle School?

In fact, more of them—especially those who were African American or Latino—took trigonometry, precalculus, and Advanced Placement calculus courses in high school. For students of color in the highest initial-achievement categories, universal acceleration was the only factor that significantly contributed to the completion of a high school course in calculus.

Aside from taking more advanced classes, the math achievement of these students remained high. A careful comparison between high achievers in pre-acceleration and post-acceleration cohorts found that their mean scores on the Sequential I Regents Exam taken in 8th grade were statistically indistinguishable, and high achievers' scores of the post-acceleration cohorts on the Advanced Placement calculus exams were significantly higher.

Nor were initial high achievers the only ones whose Advanced Placement calculus scores improved after universal acceleration. The overall percentage of South Side High School students achieving scores of 3 or better on the Advanced Placement calculus exams increased as well, even as the percentage of students studying Advanced Placement calculus increased to more than 50 percent. In other words, high achievers are doing better, and more students have become high achievers. As long as the curriculum is rigorous, heterogeneous math classes can benefit all students.

Implications of the Study

Although nearly all Japanese students study algebra in the 8th grade, fewer than 25 percent of all U.S. 8th graders do so (Horn & Nunez, 2000). The percentages of African American and Latino students studying accelerated math are even lower: 13 percent and 12 percent, respectively (Shakrani, 1996). These low participation rates are troubling.

We can attribute this phenomenon partly to faulty assumptions about what portion of the student population can reach high achievement levels and partly to the questionable assumption that heterogeneous grouping inevitably waters down the curriculum so that high achievers learn less (Oakes et al., 1997).

Recent experience in the Rockville Centre School District challenges these assumptions. The inclusion of all learners did not undermine the performance of the high-achieving students, and all students received clear, long-term benefits. Rockville Centre's success demonstrates that

universal acceleration can succeed in the United States, not just in Japan.

As we strive to educate all students to high standards, who gets what curriculum is a matter of great importance. We must not reserve accelerated courses in math and other subjects only for the most fortunate, but rather make these courses accessible and available to all. The potential long-term benefits for students and for society are enormous.

References

Adelman, C. (1999). *Answers in the tool box: Academic intensity, attendance patterns and bachelor's degree attainment*. Washington, DC: U.S. Department of Education, Office of Educational Research. Available: www.ed.gov/pubs/Toolbox

Bloom, H. S., Ham, S., Melton, L., & O'Brien, J. (2001). *Evaluating the accelerated schools approach*. New York: Manpower Demonstration Research Corporation.

Burris, C. C. (2003). Providing accelerated mathematics to heterogeneously grouped middle school students. *Dissertations Abstracts International, 64*(5), 1570.

Heubert, J. P., & Hauser, R. M. (Eds.). (1999). *High stakes: Testing for tracking, promotion, and graduation*. Washington, DC: National Research Council.

Horn, L., & Nunez, A. M. (2000). *Mapping the road to college: First-generation students' math track, planning strategies and context of support* (NCES 2000-153). Washington, DC: U.S. Department of Education. Available: http://nces.ed.gov/pubs2000/2000153.pdf

Kifer, E. (1993). Opportunities, talents and participation. In L. Burstein (Ed.), *The IEA study of mathematics III: Student growth and classroom processes* (pp. 279–308). Oxford, UK: Pergamon Press.

Kulik, J. A. (1992). *An analysis of the research on ability grouping: Historical and contemporary perspectives*. Storrs, CT: National Research Center on the Gifted and Talented.

Levin, H. M. (1988). *Accelerated schools for at-risk students* (Report No. 142). New Brunswick, NJ: Rutgers University.

Loveless, T. (1998). The tracking and ability grouping debate. *Thomas B. Fordham Foundation, 2*(8). Available: www.edexcellence.net/library/track.html

Lucas, S. R. (1999). *Tracking inequality: Stratification and mobility in American high schools*. New York: Teachers College Press.

McKnight, C. C. (1987). *The under-achieving curriculum: Assessing U.S. school mathematics from an international perspective—A national report on the Second International Mathematics Study*. Champaign, IL: Stipes.

Mosteller, F., Light, R., & Sachs, J. (1996). Sustained inquiry in education: Lessons from skill grouping and class size. *Harvard Educational Review, 66*(4), 797–843.

Murnane, R., & Levy, F. (1996). *Teaching the new basic skills*. New York: The Free Press.

Oakes, J., Ormseth, T., Bell, R., & Camp, P. (1990). *Multiplying inequalities: The effects of race, social class, and tracking on opportunities to learn mathematics and science*. Santa Monica, CA: Rand.

Oakes, J., Wells, A. S., & Jones, M. (1997). Tracking: The social construction of ability, cultural politics, and resistance to reform. *Teachers College Record, 98*, 482–510.

Peterson, J. M. (1989). Remediation is no remedy. *Educational Leadership, 46*(6), 24–25.

Shakrani, S. (1996). Eighth grade algebra course-taking and mathematics proficiency. *NAEPFACTS, 1*(2) (NCES 96815). National Center for Educational Statistics.

Slavin, R. E. (1995). Detracking and its detractors: Flawed evidence, flawed values. *Phi Delta Kappan, 77*, 220–223.

Slavin, R. E., & Braddock, J. H., III. (1993). Ability grouping: On the wrong track. *College Board Review, 168*, 11–17.

Wheelock, A. (1992). The case for untracking. *Educational Leadership, 50*, 6–10.

Carol Corbett Burris is Principal of South Side High School, 140 Shepherd St., Rockville Centre, NY 11570-2297; burriscarol@hotmail.com. **Jay P. Heubert** is Associate Professor of Education, Teachers College, Columbia University, Box 181, 525 W. 120th St., New York, 10027; jay.heubert@columbia.edu. **Henry M. Levin** is William Heard Kilpatrick Professor of Economics and Education at Teachers College, Columbia University, and is the founding director of the Accelerated Schools Project, a school reform approach involving approximately 1,000 schools; hl361@columbia.edu.
