the courses they have just taught; by comparing notes with one another they can share successful approaches. For districts that have the ability to do so, the final AR test student responses can be resorted and rescored so that the Algebra teachers receiving these students the following year can see profiles of the strengths and weaknesses of their students both individually and collectively.

### MDTP Written Response Materials

While MDTP's diagnostic tests do probe for conceptual understanding, they cannot provide as complete indications of students' reasoning and problem solving as written work. Another MDTP resource to consider is the Written Response Materials notebook that has been developed to assess and improve students' ability to think and communicate effectively about mathematics. The notebook contains seven AR problems with detailed rubrics that require students to demonstrate their mathematical reasoning and problem-solving strategies and enable teachers to identify students' incomplete or erroneous mathematical understandings. These problems also provide exemplars of the kinds of assessment items and scoring rubrics that teachers might develop based on their own curricula.

For more information about using MDTP tests or the Written Response Materials in support of an Algebra Readiness Program, please contact your regional MDTP Site, which you can identify and contact through MDTP's web site **mdtp.ucsd.edu**. To place an order for test booklets and other test materials, use the link on MDTP's web site. All MDTP test booklets and other test materials and scoring services are provided at no charge to mathematics teachers in California precollegiate schools.

## Who Should Take Algebra in 8th Grade? Using Standardized Test Data to Guide Placement Policies

*by Shelley Kriegler and Theresa Lee, UCLA Department of Mathematics*

In an effort to raise academic standards and close the achievement gap in mathematics, the 1998 *California Mathematics Framework* established Algebra 1 as the grade level content for 8th grade students. This caused many school districts to reevaluate their achievement expectations for all 8th grade students and to institute more aggressive local policies about placement of 8th graders into algebra. In the past two years, at least 50% of California's 8th graders took Algebra 1 annually, and about 40% of those students scored proficient or advanced on the Algebra California Standards Test (CST). While it is encouraging that an average of 20% of California's 8th graders scored proficient or higher in Algebra each year, it is also troubling that nearly 80% of them each year did not. Thus, an algebra readiness course option was included in the 2006 *California Mathematics Framework* as a realistic response to teaching students who are not yet ready for algebra.

Currently, the decision to place 8th grade students into an algebra class or into a pre-algebra class is typically made at the school level and guided by district policy. Two pertinent questions arise:

- ✔ What level of mathematics achievement is needed in 7th grade for success in algebra in the 8th grade?
- ✔ How can a school assess whether its placement decisions lead to mathematical growth for students?

Two types of data published on the California Department of Education web site were used to explore these questions: school results from the CST and school rankings. For the

years 2005 and 2006, school reports included the number of students who took various standards-based mathematics tests and the percentage of students who met one of five different proficiency levels—advanced (A), proficient (P), basic (B), below basic (BB) and far below basic (FBB). All 7th graders took a 7th grade standards test. Eighth grade students who were on track to complete algebra took the Algebra 1 standards test. (About 3% of California's 8th grade students took the Geometry CST in 2007. For purposes of this study, geometry scores were combined with algebra scores.) The other 8th grade students took a general mathematics standards test, which consisted primarily of 7th grade mathematics standards. In addition, every school received a rank on a scale of 1 to 10, where 1 represented an overall school performance in the bottom 10% of all schools, and 10 represented an overall performance in the top 10%.

For this study, the CST achievement scores of 7th grade students in 2005 were compared to their 8th grade achievement scores in 2006 for 112 randomly selected middle schools in the greater Los Angeles area (about 1/3 of all schools). The schools represented a range of placement policies, and the performance rankings were proportional to the rankings of all the schools in the area (See *Table 1* and *Table 2*).

| Overall performance ranking | Percent of schools ($n$ = 112) |
|---|---|
| Low performing (Rank: 1–3) | 38 |
| Middle performing (Rank: 4–7) | 32 |
| High performing (Rank: 8–10) | 29 |

*Table 1: Performance Ranking of Schools*

| Minimum 7th grade CST score for students taking algebra | Percent of schools ($n$ = 112) |
|---|---|
| Far Below Basic (FBB) | 23 |
| Below Basic (BB) | 10 |
| Basic (B) | 29 |
| Proficient or Advanced (PA) | 35 |

*Table 2: Algebra Placement Policies of Schools*

Assumptions and unknowns are worth noting. First, although we recognize that schools do not place students into algebra based on 7th grade CST scores (in fact, these scores are not even available for this purpose), we will assume that the more proficient students in 7th grade took the Algebra CST while the less proficient students took the General Mathematics CST. Furthermore, we acknowledge that CST data provides no information about the curriculum provided to the students, which varies greatly from school to school. However, a reasonable assumption is that students who took the Algebra CST were on track to complete a full one-year algebra course, while students who took the General Mathematics CST were in some variation of a general mathematics or pre-algebra program.

## Using Stacked Bar Graphs to Display Data

For each school, four stacked bar graphs were created, similar to the example for XYZ Middle School, shown in *Figure 1*. The top (first) bar presents achievement data for the 7th grade, showing the percentage of students who met various proficiency levels in 2005. At XYZ Middle School, the black bar shows that about 20% of the 7th graders scored advanced on the 7th Grade CST. In 8th grade, students took either the Algebra or Geometry CST (represented by the third bar) or the General Mathematics CST (represented by the fourth bar). The layout of the third and fourth bars is consistent with the assumption that more proficient 7th graders took the Algebra/Geometry CSTs, while the less proficient 7th graders took the General Mathematics CST, because a portion of each bar is blank, and the sum of the two bars is 100%. From the third bar we see that about 60% of the students took the Algebra CST, and about 8% of the entire 8th grade class scored advanced on this test. From the fourth bar, we see that about 40% of the 8th grade class took the General Mathematics CST, and about 4% of all students scored advanced on this test. The second bar represented the aggregated achievement levels for all 8th graders. At XYZ School, about 12% of all students scored advanced on the mathematics CST they took in 8th grade.

*Continued on page 42* ⇒⇒

XYZ Middle School: Rank = 3

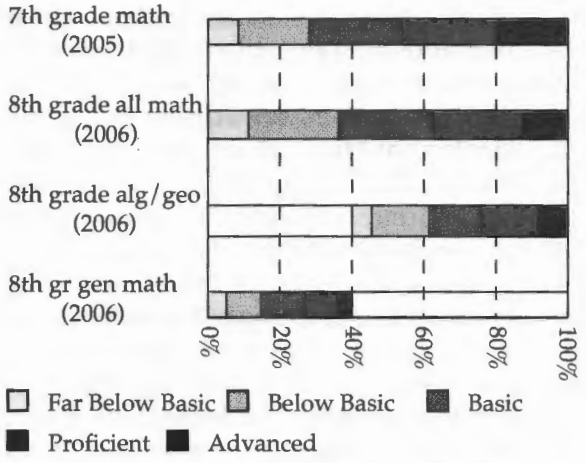


*Figure 1: Sample Stacked Bar Graph Profile*

To analyze placement patterns, some definitions were needed. We defined a *high-ranked school* as one with a ranking of 8, 9, or 10; a *middle-ranked school* as one with a ranking of 4, 5, 6, or 7; and a *low-ranked school* as one with a ranking of 1, 2, or 3. We also defined an *aggressive placement strategy* as one where students who performed at below basic or far below basic levels of mathematics achievement in 7th grade took the algebra CST, a *typical placement strategy* as one where students who performed at a basic level took algebra, and a *conservative placement strategy* as one where students who performed at the proficient or advanced level of mathematics achievement took the algebra CST. As an example, XYZ School was classified as a low-ranked school with a typical algebra placement policy.

## Patterns in Algebra Placement

To better understand the patterns and implications of aggressive, typical, and conservative placement strategies, the 112 school profiles were divided by school rank, and the minimum 7th grade achievement level of students taking algebra was noted. *Figure 2* shows that about 75% of the high-ranked schools took a conservative approach to algebra placement while only 22% of the middle- and low-ranked schools took this approach. *Figure 2* also shows that about 40% of the middle- and low-ranked schools and 12% of high-ranked schools used aggressive strategies for algebra placement. *In other words, high-ranked schools were three times more likely to use conservative placement strategies and low-ranked schools were three times more likely to use aggressive placement strategies when placing students into 8th grade algebra.*

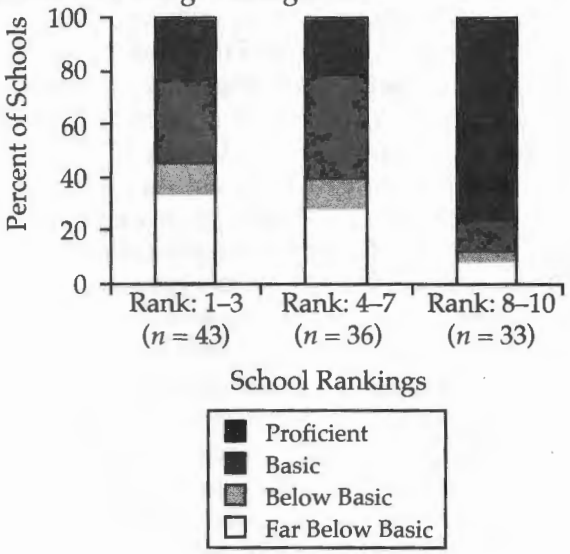


*Figure 2: Minimum Student Achievement Level of 7th Graders who Take 8th Grade Algebra*

## Patterns in Student Achievement

To explore relationships between placement decisions and student achievement, the 112 school profiles were sorted based on the minimum 7th grade CST score for students taking the Algebra CST. Column 4 of *Figure 3* shows that 65% of the schools who chose a conservative placement strategy for algebra students increased the number of students scoring proficient or higher in 8th grade, and decreased in the number of students scoring below basic or lower. It also shows that 90% of the schools using a conservative placement strategy improved in at least one of these ranges. Columns 1 and 2 of *Figure 3* also show that less than 20% of the schools using an aggressive placement policy showed growth in at least one of the two ranges.

The 3rd column of *Figure 3* shows that schools who enrolled basic students in algebra had mixed results in achievement. About one-third of those schools saw growth on both factors, about one-third saw growth on just one factor, and about one-third saw no overall growth. *In other words, 90% of the schools that used a conservative algebra placement policy saw an increase in the number of proficient students or a decrease in the number of non-proficient students, while only 20% of the schools using an*

*aggressive algebra placement strategy saw improvement in at least one of these ranges.*

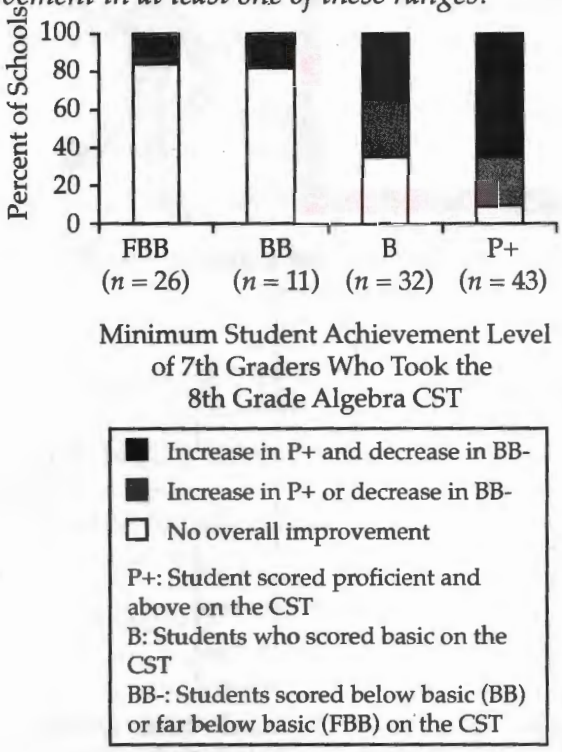


*Figure 3: Improved Proficiency in CST Scores from 7th Grade to 8th Grade*

## Conclusions and Comments

We are now able to answer the questions we set out to explore.

- *What level of mathematics achievement is needed in 7th grade for success in algebra in the 8th grade?*

The data strongly suggest that proficiency in 7th grade mathematics is an important indicator of success in 8th grade algebra, and that enrolling 7th grade students who are below basic or far below basic in mathematical proficiency is ineffective. The results are inconclusive about whether students at the basic level are ready for algebra, indicating that this decision probably needs to be made on a case-by-case basis.

- *How can a school assess if its placement decisions lead to mathematical growth for students?*

Schools where students are growing mathematically reduce the number of students from year-to-year who score below basic and far below basic, and increase the number of students who score at the proficient or advanced levels. Creating stacked bar graph displays using CST data, like the example included here, gives school decision-makers a visual tool for assessing the effectiveness of mathematics programs and enrollment policies. A template for creating these graphs is available on the web at **www.introtoalg.org/resources**.

We believe that this study offers compelling evidence about who should take algebra in the 8th grade. While tests should not be the only indicator, it seems clear that schools should consider enrolling proficient and advanced students in 8th grade algebra, and that the others should take some kind of pre-algebra course aimed at increasing proficiency on general mathematics and algebra readiness topics. Furthermore, the study shows that this approach would likely benefit all schools regardless of school rank.

*While tests should not be the only indicator, it seems clear that schools should consider enrolling proficient and advanced students in 8th grade algebra, and that the others should take some kind of pre-algebra course aimed at increasing proficiency on general mathematics and algebra readiness topics.*

We also applaud the writers of the 2006 *California Mathematics Framework*, who included a blueprint for an algebra readiness curriculum in the document. We believe that the availability of this new program will give school decision-makers an 8th grade mathematics option that is likely to lead to greater growth for struggling students. We believe that the next step will be to align high stakes tests and policies so that schools are not penalized on state and national performance indicators when placement decisions are made in the interest of promoting mathematical growth for all students.