# USING STANDARDIZED TEST DATA AS GUIDANCE FOR PLACEMENT INTO 8TH GRADE ALGEBRA

By Shelley Kriegler and Theresa Lee
UCLA Department of Mathematics

## Background

In an effort to raise academic standards and close the achievement gap in mathematics, the 1998 California Mathematics Framework established Algebra 1 as the mathematics grade level content for 8th grade students. This caused many school districts in California to reevaluate its achievement expectations for all 8th grade students and to institute more aggressive local policies about placement of 8th graders into algebra[1].

As shown in *Table 1*, the percentage of 8th graders tested on the Algebra California Standards Test (CST) increased from 34% of 8th graders statewide in 2003 to 50% in 2006.[2] During this four-year period, the percentage of students scoring Proficient or Advanced on the Algebra CST increased slightly (from 41% in 2003 to 43% in 2006). However, far too many students remained unsuccessful (i.e., less than Proficient) in Algebra as 8th graders. As a result, one of the new features of the 2006 California Mathematics Framework is an explicit acknowledgement that all students may not be ready for Algebra as 8th graders, along with a curriculum outline for an algebra readiness program for lower achieving students.

*Table 1:* **Achievement of 8th Grade Students Who Took the Algebra (or higher) CST**

| Year | % of the 8th Grade Class | % who are score proficient or advanced on CST | % who score below basic or far below basic on CST |
|---|---|---|---|
| 2003 | 34% | 41% | 42% |
| 2004 | 41% | 38% | 34% |
| 2005 | 48% | 37% | 35% |
| 2006 | 50% | 43% | 34% |

Currently, the decision as to whether to place 8th grade students into an Algebra class or into a general mathematics class is typically made at the school level and guided by district policy. Two pertinent questions arise related to these school and/or district policies:

[1] About 2-3% of all 8th grade students take geometry. For the purposes of this analysis, achievement of these students is aggregated with the students who take algebra.

[2] California guidelines state that students in 8th grade who are on track to complete Algebra should take an Algebra CST. Students in 8th grade who will not complete a full year of Algebra take a General Mathematics CST, which consists primarily of 7th grade mathematics standards.

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

2. How can a school use CST data as an indicator of mathematical growth for 8th graders who take algebra or general mathematics?

Two types of data published on the California Department of Education website were used for this study: school results from the CST and school rankings. For the years 2005-06, 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. These levels are advanced (A), proficient (P), basic (B), below basic (BB), and far below basic (FBB). All 7th graders took a 7th grade standards test. 8th grade students who were on track to complete algebra took the Algebra 1 standards test. The other 8th grade students took a general mathematics standards test, which consisted primarily of 7th grade mathematics standards. In addition, every school receives a rank on a scale of 1 to 10, where 1 represents an overall school performance in the bottom 10% of all schools, and 10 represents an overall performance is in the top 10%.

For this study, the CST achievement scores of 7th grade students in 2005 were compared to the cohort's 8th grade achievement scores in 2006 for 112 randomly selected middle schools in the greater Los Angeles area (about 1/3 of all schools). Analysis of student cohorts made it possible to compare student progress in mathematics from one year to the next. Comparisons across schools allowed for plausible generalizations about the effects of varied algebra placement policies.

Assumptions and unknowns are worth noting at this point. 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 math CST. Furthermore, we acknowledge that CST data provides no information about the curriculum provided to the students, which is quite varied 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 math CST were in some kind of general mathematics or introductory algebra program.

## Using Stacked Bar Graphs to Display Data

For this study, stacked bar graph profiles were created for 112 randomly selected middle schools in the greater Los Angeles area. Among these schools, the California performance rankings varied, as did the algebra placement policies (See *Table 2* and *Table 3*)

*Table 2:* **Performance Rankings of Schools**

| 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% |

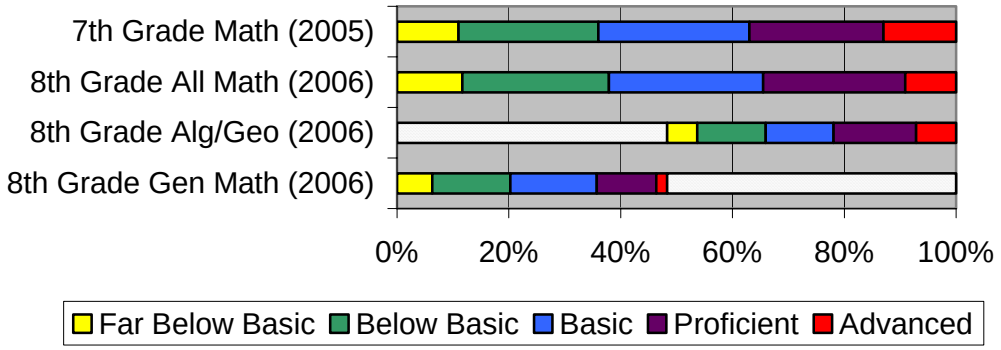
*Table 3*: **Algebra Placement Policies of Schools**

| 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% |

The stacked bar graph in *Figure 1* displays the CST math achievement results of California's 7th graders in 2005 and their achievement results as 8th graders in 2006. We will use this graph to explain some of the information that can be extracted from it, and to get a sense of California schools' typical algebra placement pattern.

*Figure 1* includes four bars. The top (1st ) bar gives achievement data for the 7th grade, showing the percentage of students who met various the proficiency levels in 2005. Here we see that about 37% of all 7th graders scored proficient or advanced on the 2005 CST. In 8th grade, students may take the Algebra CST (represented by the 3rd bar), or they may take a General Mathematics CST (represented by the 4th bar). The assumption that more proficient 7th graders took the Algebra CST, while the less proficient 7th graders took the general mathematics test is evident in the layout of the 3rd and 4th bars: a portion of each bar is blank, and the sum of the two bars is 100%. The 2nd bar represents the aggregated achievement levels for all 8th graders. For example, about 13% of the 8th students were proficient on the Algebra CST (3rd bar) and about 10% of the students were proficient on the General Mathematics CST (4th bar). Therefore the 2nd bar shows that 23% of all 8th grade students demonstrated proficiency on the test that they took.

*Figure 1:* **Mathematics Proficiency Levels of 7th Grade (2005) and 8th Grade (2006) Students in California**




about 470,000 students

Comparing the 1st bar to the 3rd and 4th bars in *Figure 1*, we see that about 50% of all 8th grade students took algebra. This group included about half of the students who scored basic, along with the students who scored proficient or advanced in 7th grade. Note that although State and National policies established strong incentives for schools to make algebra its 8th grade curriculum, still about half of all students in 8th grade took the General Mathematics CST. Furthermore, a comparison of the 1st bar and 2nd bar reveals that the overall percentage of students scoring below basic or far below basic increased while the percentage of students scoring proficient or advanced decreased. In other words, if the course taken by 8th graders is not considered a factor, the overall proficiency levels of students in California decreased from 7th grade to 8th grade in 2006.

**Examples of School Profiles.**

Four typical stacked bar graphs are used to illustrate some of the variations found among schools.

The profiles for Schools A (a high ranked school) and B (a middle ranked school) illustrate conservative algebra placement policies (*Figure 2* and *Figure 3*). That is, both schools limited enrollment of 8th graders taking a full year of algebra to students who scored proficient or higher in 7th grade. In both cases, the number of students who scored below basic or far below basic on the General Mathematics CST decreased (4th bar), as did the number of students who scored proficient or higher on the Algebra CST (3rd bar). However, aggregated proficiency levels for all 8th grade students (2nd bar) show that if the course taken is not considered a factor,

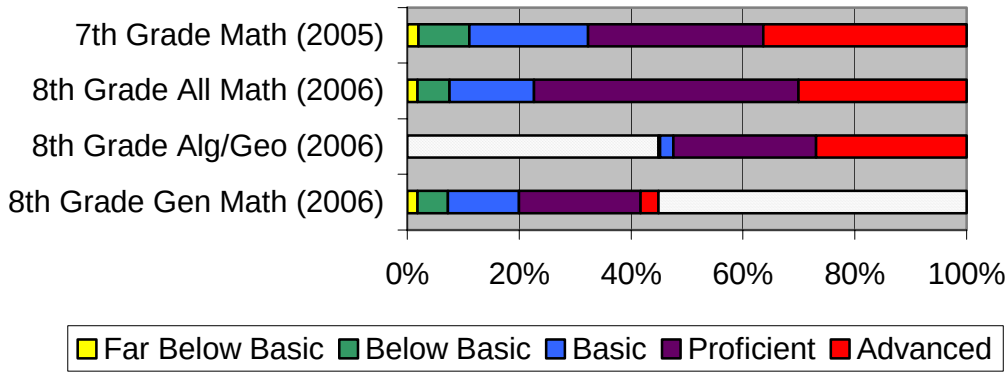
the number of students at the below basic level (or lower) decreased, while the number of students at the proficient level (or higher) increased.

These profiles suggest a hypothesis that conservative algebra placement policies (that is, placing students in algebra who are at proficient or advanced levels in 7th grade mathematics) may be beneficial for student academic growth from 7th grade to 8th grade because in these cases, fewer students fell into the below basic levels while more students demonstrated proficiency.

The profiles for Schools C (a high ranked school) and D (a low ranked school) illustrate aggressive algebra placement policies (*Figure 4* and *Figure 5*). That is, both schools enrolled students into algebra who were scoring below basic or lower on the CST. In both cases, the number of students who scored below basic or far below basic decreased (4th bar), as did the number of students who scored proficient or higher on the Algebra CST (3rd bar). Aggregated proficiency levels for all 8th grade students (2nd bar) show that if the course taken is not considered a factor, the number of students at the below basic level (or lower) increased, and the number of students at the proficient level (or higher) decreased.

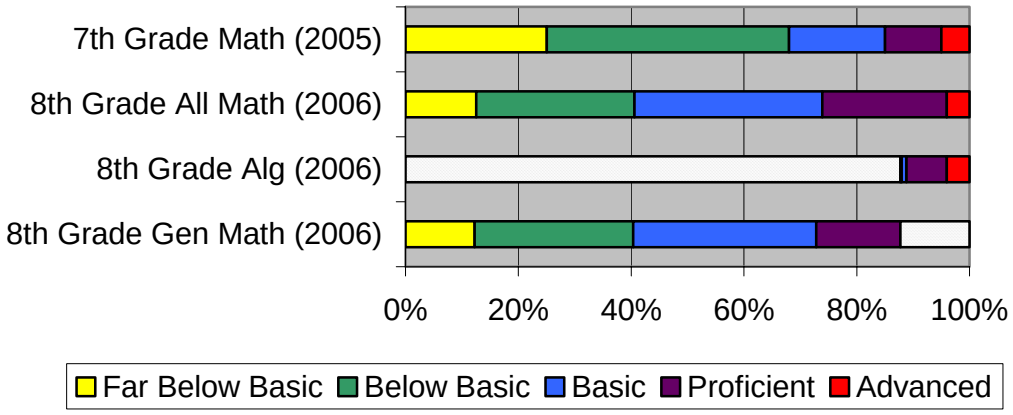
These profiles suggest a hypothesis that aggressive algebra placement policies (that is, placing students in algebra who demonstrated below basic or far below basic levels of achievement in 7th grade) may be problematic because fewer students score in the proficient range in 8th grade than in 7th grade. However, both profiles do show improvement for those taking the General Mathematics CST.

*Figure 2:* **Tracking the Progress of an 8th Grade Class (School rank = high )**



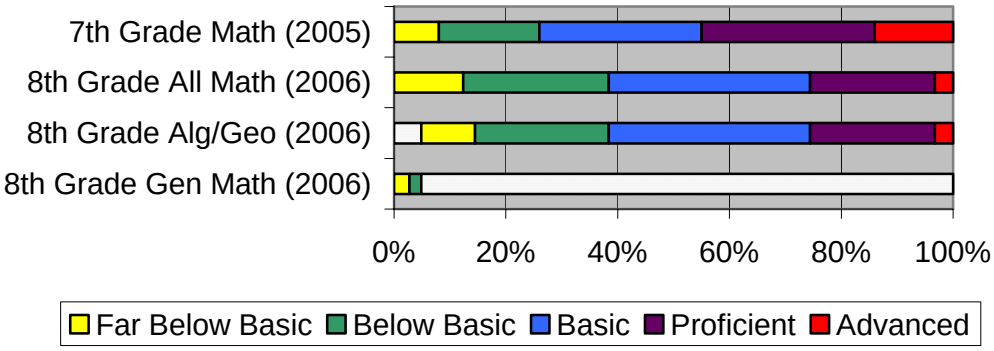

School A
about 445 students

*Figure 3:* **Tracking the Progress of an 8th Grade Class (School Rank = middle)**



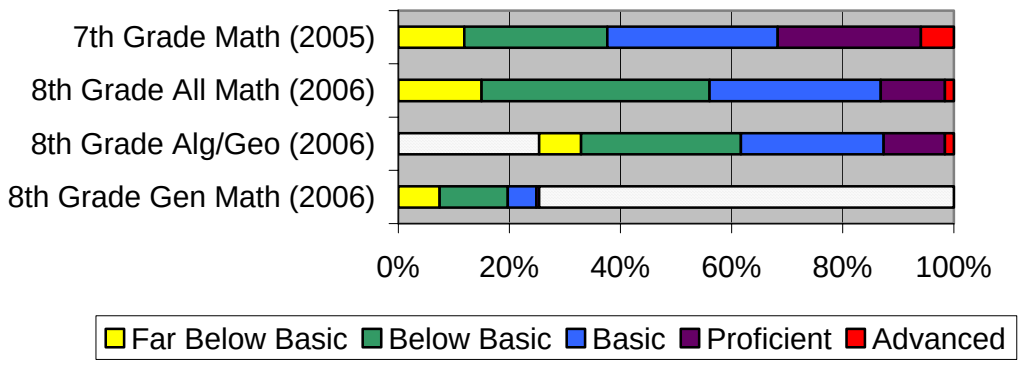

School B
about 375 students

*Figure 4:* **Tracking the Progress of an 8th Grade Class (School rank = high )**




School C
About 470 students

*Figure 5:* **Tracking the Progress of an 8th Grade Class (School Rank = low)**

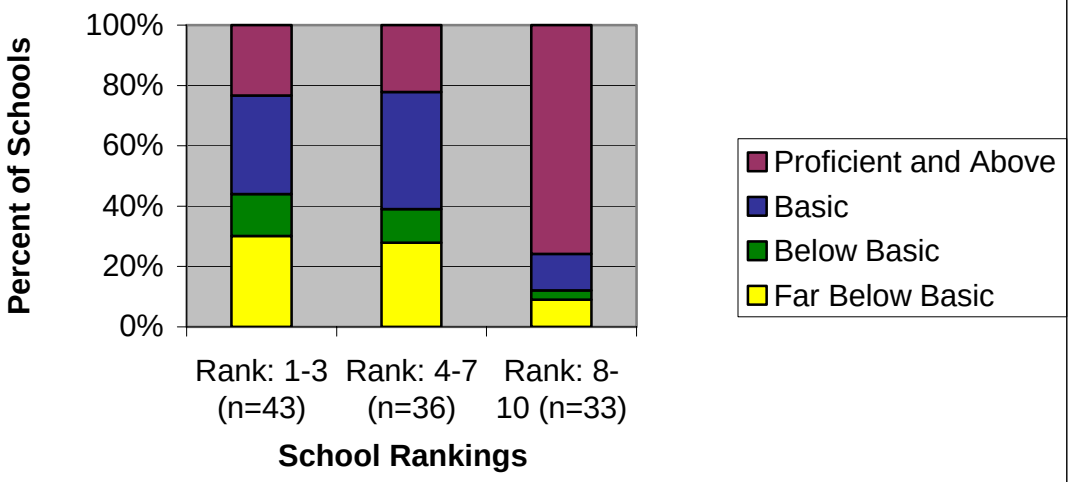



School D
About 340 students

## Patterns in Algebra Placement

To better understand the patterns and implications of aggressive 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 6* 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. High ranked School A, with its conservative policy for algebra placement, illustrates this finding. *Figure 6* also shows that about 40% of the middle and low ranked schools and 12% of high ranked schools used aggressive strategies for algebra placement. Low ranked school D, with its aggressive algebra placement strategy, illustrates this result. 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 6:* **Minimum Student Achievement Level of 7th Graders who Take 8th Grade Algebra**

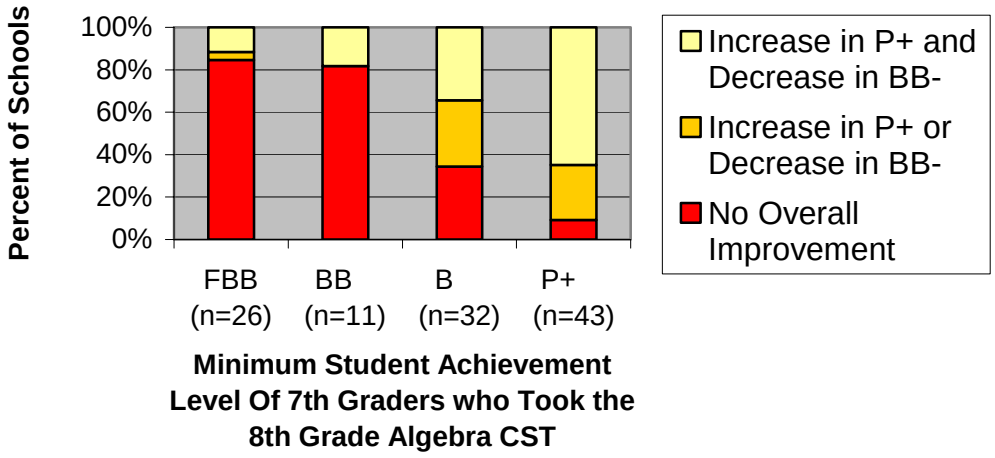



**Patterns in Student Achievement**

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. *Figure 7* 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. Schools A and B illustrate this result. *Figure 6* also shows that less than 20% of the schools using an aggressive placement policy I showed growth in at least one of the two ranges. Schools C and D illustrate this result.

The 3rd column of *Figure 7* shows that schools that enrolled basic students in algebra (consistent with the (typical) California profile) 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.

*Figure 7:* **Improved Proficency in CST scores from 7th Grade to 8th Grade**




P+: students scored proficient and above on the CST
B: students who scored basic on the CST
BB-: students scored below basic on the CST
FBB: Student who scored far below basic on the CST

## Summary of Results

From this analysis, three findings emerge:

- Although State and National policies offer strong incentives to schools to make algebra its 8th grade course, still only half of California's students are completing algebra in the 8th grade, and less than half of those students are demonstrating proficiency in the subject.

- High ranked schools were three times as more likely to only place students demonstrating proficiency in 7th grade mathematics into algebra, while low ranked schools were three times more likely to place students who were at below basic or far below basic proficiency levels into algebra.

- 90% of the schools that used conservative algebra placement policies saw an increase in the number of proficient students or decrease in the number of non-proficient students, while only 20% of the schools using an aggressive algebra placement policy saw improvement in at least one of these ranges.

## Conclusions and Comments

We are now able to answer the research questions and suggest some implications for education decision makers.

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

Analysis of school profiles 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.

2. How can a school use CST data as an indicator of mathematical growth for 8th graders who take algebra or general mathematics?

Schools where students are growing mathematically reduce the number of students from year-to-year who score below basic and far below basic, while increasing the number of students who score at the proficient or advanced levels. Creating stacked bar graph displays using CST data, such as the ones included in this study, give school decision makers a visual tool for assessing the effectiveness of math 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 8th grade. While tests should not be the only indicator, it seems clear to us that schools should consider enrolling proficient and advanced students in 8th grade algebra, and that the others should take some kind of general mathematics 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 on school rank.

We also applaud the writers of the 2006 California Mathematics Framework, who included a blueprint for an algebra readiness curriculum in the document. Inclusion of this new program will no doubt generate a reevaluation by school decision makers regarding placement policies of 8th grade 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.