# Pathways Report: Dead Ends and Wrong Turns on the Path Through Algebra

## Prepared for the Noyce Foundation

April 4, 2010

Steve Waterman

**ABSTRACT**

This report reflects on the implications of a study that examines the progression of students in several Bay Area school districts as they proceed from eighth to ninth grade math classes. The findings indicate that students and their parents face a bewildering array of course titles, that many students – even those who are successful – repeat Algebra, that repeating Algebra is not certain to yield better grades in ninth grade, and that placement decisions are correlated to ethnicity and parent education, but not gender.

# PATHWAYS REPORT:
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## Introduction

As we began what was to be a long-term evaluation study of the Noyce Foundation's ambitious mathematics staff development program in the San Francisco Bay Area, we discovered some troubling patterns. What we had believed was a straightforward pathway from one mathematics course to the next turned out to be closer to a labyrinth. With the completion of the original study, we have focused on some of the troubling findings. This paper looks specifically at findings that appear to impede student progress and provides some analysis and recommendations. The complete study is presented in the Appendix.

As we reviewed the data we found that an alarming number of students were taking Algebra I (standard freshman high school Algebra) for a second time in high school. This situation was a common thread throughout the districts studied and for most of the ethnic groups represented by the students. The more we probed, the more concerned we became that we were witnessing one of two possibilities – that middle schools were calling a class Algebra when they weren't teaching Algebra, or that high schools were not accepting eighth grade Algebra as a legitimate class. Not only were large numbers of students retaking Algebra in ninth grade, a majority of students who had received good grades in Algebra in eighth grade were retaking Algebra in ninth grade. Large numbers of students who had "passed" objective assessments of Algebra were retained in Algebra in ninth grade. Moreover, while it appeared that boys and girls were promoted through Algebra at equal rates, progression was more uncertain for students from some ethnicities than from others.

After reading this report, we are left with many questions, not the least of which is whether we educators are, inadvertently and unnecessarily, creating a California at risk of being unable to compete in an increasingly technological society – not because we are teaching badly, but rather because we are needlessly holding many capable students back from progressing through advanced mathematics in high school by flunking them in Algebra, destroying their confidence, and leaving them to languish in a mystifying morass of confusing course titles with bewildering and narrow exit gates.

The sin here, if such there is, is one of omission. There is no evidence that any school district deliberately set out to confuse students and parents and hold them back.

Likewise, there is no evidence that any district set out to hold back any students of color or to advance one ethnic group rather than others. Rather, the movement to Algebra in eighth grade seems to have run into a series of unwritten beliefs and rules. Unfortunately, belief systems are intractable precisely because they are rarely expressed. These belief systems include teacher beliefs about the ways students prove they understand math, the ways students demonstrate they have the "right stuff" to advance in math, how much math is needed, when topics should be introduced, whether mathematics is linear, how important homework is, how much a teacher should reach down, and what a teacher should do when a student fails to understand a concept. In the hope that beliefs are susceptible to evidence, we have provided a set of intervention points or strategies for changing the situation.

One might ask why anyone should worry about Algebra and whether it is offered in eighth grade. We contend that Algebra is a key to entry into the world of advanced high school classes. These are the classes where the environment is academic rather than remedial, where expectations are set for college, where students are seen and begin to see themselves as capable, where children whose first language is not English can still catch the brass ring, where children from financially limited backgrounds are not held back by the paucity of their outside-of-school experiences. Moreover, students who succeed in Algebra in eighth grade and go on to succeed in Geometry in ninth grade stand a good chance of passing advanced mathematics in high school – sparing them from college calculus classes with hundreds of students moving at a fast pace while they are adjusting to college life, and affording them entry into a range of STEM majors.

This report is organized so that the findings are followed by an analysis of pathways for students and strategies/interventions/pathways readers can use to assist schools and students to make more effective transitions into high school and thereby to increase the pool of students leaving high school confident in their math ability and with advanced mathematics courses under their belts. All of the findings should be considered preliminary in nature as the sample of schools was not random and may not be representative of the Bay Area or California. However, after discussions following early workshops based on these findings, we believe they may reflect practices in many other school districts.

A. We will begin with a brief summary of the intent of the Pathways Study and its role within the First in Mathematics Consortium.
B. This will be followed by the major findings of the study. These are essential to understand the context in which the analysis was made and the limits of the scope of interpretation of the data
C. The findings will be followed by possible interventions
D. Finally, we will provide some suggested long-term interventions to ameliorate this situation.

# A. The First in Mathematics Consortium

The First in Mathematics Consortium was an investment by the Noyce Foundation in the improvement of fourth through eighth grade mathematics instruction in a group of nine[1] California school districts that demonstrated a commitment to meeting California's goal of having all eighth graders succeed in Algebra. The logical chain of the program began with that commitment. The districts and the Foundation then teamed up to support intensive, multi-faceted staff development for large numbers of teachers. The training and commitment was vertical in that it included boards of education, teachers, principals and superintendents. The Foundation and districts believed that if teachers learned and tried out more effective strategies for assisting students to access more conceptual mathematics, the students would be more successful on tests and in more rigorous mathematics classes as they moved through junior high and into high schools.

## Purpose of Study

The main purpose of this study was to establish a starting point for a long-term, outcome or summative analysis of the impact of the First in Mathematics Consortium over the period of time between July 2007 and June 2010. Using the eighth grade class in the last, pre-treatment year as the control group, the full study will compare the success of that group with the success of the first and second cohort of students who benefited from the staff development program as they transitioned from middle to high school.

Thus, this study sought to determine dependent and independent variables of interest in conducting the research, to develop a useful database system that would yield good, pre-treatment baseline statistics, and to develop and report those statistics. Problem statements for the study itself might be framed as follows:

1. Did teacher training result in more eighth graders being placed in high school level Algebra in eighth grade?
2. Did teacher training result in more students completing high school level Algebra by the end of eighth grade?
3. Because of the training, did more girls and non-white students have access to and success in Algebra?
4. Did student success in eighth grade carry over into high school in terms of math course placement and success?

To determine whether sufficient data was available to carry out the study, the Foundation supported a mini-study in the summer and fall of 2008. The feasibility study uncovered the possibility of confounding variables that had the potential of overwhelming any long-term effects from any type of staff development program. The mini-study found that placement in eighth grade and success in that placement did not seem to be closely related to placement decisions or success in high school placements. As the study only included 70 students from one district, the Foundation believed it was essential to

[1] *One district dropped out of the program. Its data are not included here.*

discover whether this pattern was widespread. Thus, this study, while identifying the baseline data needed for a quasi-experimental design with a long-term evaluation, also looked specifically at the issue of transition into high school math. The information gleaned from these analyses may encourage middle school and high school teachers to work more closely together in insuring that students are placed in the most appropriate mathematics class in high school, and that high school teachers can then believe the students are placed appropriately and will commit to their success.

## Study Methodology

All nine participating districts were asked to provide several pieces of information about the eighth graders in the 2006-07 school year. These included eighth grade placement information and grades, eighth grade CST (California Standards Tests) and MARS (Mathematics Assessment Resource Services) test results, ethnicity, and gender. High school districts into which the eighth graders were zoned for matriculation were asked to provide the placement, final grades, and CST results for the 2007-08 ninth grade. This data was merged into the Noyce database with student names removed. The database already included information about MARS scores and teacher variables.

Once assembled, the database was to be used for a number of analyses to provide a baseline in a number of dimensions for an impact study. (The first group of students whose teachers received intensive training, completed eighth grade in June 2008 and ninth grade in June 2009. Their CST results for ninth grade are now available.)

# B. Major Findings

There are several major findings. Each has implications for further work with school districts and implications for maximizing the impact of the staff development:

- **There is a large and confusing array of names for math classes in eighth and ninth grades among the nine elementary schools, four high schools and one unified school district in the treatment group.**
- **Nearly 65% of the students who were placed in Algebra in eighth grade were placed in the same level of Algebra or Honors Algebra in ninth grade. (Note: All non-honors Algebra titles were merged into Algebra for this analysis.)**
- **Nearly half of the students who were successful in Algebra in the eighth grade and who were placed again in Algebra in ninth grade were no more successful in their second experience.**
- **For the group of students who took Algebra in eighth grade, success on either the MARS or CST assessments did not translate into Geometry placement for most students.**
- **There were indications that both placement decisions and final grades in mathematics classes differed by ethnicity – that is, the opportunity to take Algebra in eighth grade and the grade given in an Algebra class both differed by ethnicity.**

# Implications/Discussion

The findings from this study portray a mixed picture of progress toward increasing the number of students successful in Algebra in eighth grade, and an even more mixed picture for students of color and children whose parents have not completed college.

Alternative explanations include unintended consequences of the state push for STAR testing success, poorly coordinated data and decision systems for high school placement, unaligned performance expectations between middle and high schools, unsuccessfully trained teachers, insufficient numbers of teachers with skills in both content and teaching the content, teacher grading practices, pressure on middle school teachers from high school teachers, belief systems of math teachers about the value and need for Algebra in eighth grade, expectations of students that are biased by socio-economic status or ethnicity, and lack of supervision by principals.

While papers could be written about each of these possibilities, here we are going to assume that some or all of these are possible factors influencing success, and we are going to look at low- or no-cost strategies various stakeholders can take to improve the situation.

# Finding 1 – Math Course Titles are Multiple and Confusing

In the eight elementary school districts and their coordinating high school districts with data in the study, there were 27 names for Algebra. We do not know whether students and their parents understood what the course titles implied, and we were unable to find clear descriptions on most of the websites. The potential problem with this situation is that parents who are not sophisticated in the school verbiage would not know what the course titles mean. This possibility combined with their general unfamiliarity with the university system requirements and their lack of knowledge of the career possibilities that open through advanced math and their fear of or trust in the professionals lead them to accept teacher recommendations or their children's choices. A partial fix for this problem can be accomplished at little cost.

The first step in helping parents and students know what is happening is to label the courses clearly. For example: ***Algebra 1*** *– This course is designed as a one-year sequence of Algebra that will fulfill the California A-G high school requirement. Success in this class will set a student on a path to completing calculus by the end of her/his senior year. Student success in this class is determined by a final grade of "C" or higher or a score of "Proficient" or "Advanced" on the CST, or a score of "Meets Standards" or "Exceeds Standards" on the MARS test. Successful students will be matriculated into Geometry or Honors Geometry in ninth grade. Students who do not meet one or more of these criteria will repeat Algebra 1 in ninth grade unless they successfully complete a summer school intervention program.*

## Finding 2 – Most Eighth Grade Algebra Students Do Not Progress to Geometry in Grade Nine

Currently, placement in math classes in ninth grade does not clearly follow eighth grade placement. In this way, math classes are unique in the eighth grade. Students enrolled in English, science, and social studies classes in eighth grade are generally promoted to the ninth grade versions of these classes. It is only in Algebra that students are routinely retained. The study found that 65% of the students who were enrolled in one of the Algebra classes in eighth grade were retained in Algebra in ninth grade. A failure rate of this magnitude would not be tolerated in other academic fields.

Possible explanations for this include the following: The eight grade class is called Algebra but is not really a high school level Algebra class; the eighth grade teachers do not believe they can deliver a high school level class; the grading practices get in the way of student accomplishment; students come to the class unprepared to succeed; high school teachers undo the eighth grade teacher recommendations; a belief system operates that holds that Algebra in eighth grade is either unnecessary or too early; a belief system operates that some students who seem successful in eighth grade will fail in ninth grade, or that they will be more successful after repeating the course; a belief system that some students are not as deserving of advanced placement as others; passive parental involvement; and confusion among teachers about which concepts are core and how to measure competence in them. One possible solution is to look at the timetable and events that lead to placement decisions and to identify key intervention points. We do this after this section.

In an attempt to isolate the key variables at work, we then looked at those students who showed success in eighth grade Algebra. Again, our assumption was that success in eighth grade would automatically lead to advancement.

## Finding 3 - 46% of the Eighth Grade Algebra Students with Final Grades of ‘B-‘ or Above Were Retained in Algebra or Dropped to “Math” Classes in Ninth Grade.

We assumed that students whose eighth grade Algebra teachers had given them passing grades would surely have been promoted, as no one could argue that the students had not participated in class, completed homework, or had passed exams. We selected a grade of ‘B-‘ as a demonstration of success because most readers would consider that grade as demonstrating more than basic understanding and performance in a class. But with 46% of these students not progressing, it was clear that success by common sense criteria – good grades – was not sufficient for movement to Geometry.

Even in this relatively small sample, the result of opening the Geometry classes to an additional 247 students could have had a significant impact on the number of students completing advanced mathematics courses by twelfth grade.

The implications are staggering if this sample is even mildly representative of the state of California. If at every level of high school math the numbers of students doubled, the need to recruit engineers from other countries could disappear.

## Finding 4 – 45% of Eighth Grade Algebra Students Who "Met Standards" or "Exceeded Standards" on the MARS Assessment and 44% of Students Who Scored "Proficient" or "Advanced" on the CST Algebra Test Were Retained in Algebra in the Ninth Grade.

If success under the usual criterion of good grades by the teacher was not a clear pathway to Geometry in ninth grade, neither was success on two objective assessments of Algebra given to eighth graders in these districts.

Retention is not harmless. One can only imagine the bafflement of a students who did well on one or more of these three data points – grades, MARS, or CST, and then found him/herself back in Algebra as a ninth grader. Perhaps a self-assured adult would recover. Perhaps an insecure thirteen-year-old would form the belief that he or she is incapable of succeeding in and understanding mathematics, stop taking math courses as soon as possible in high school, and avoid math in college.

The CST Series were advertised to Californians as tests exemplifying "World Class Standards." Yet the system allows many students who pass these tests to be retained.

The combinations of Findings 2, 3, and 4 seem to remove many objective explanations for the overall 65% failure rate in Algebra for this sample. These findings leave belief systems and their implications as the most viable explanations for the findings. Finding 5 does nothing to dispel this conclusion.

## Finding 5 - Placement Differs by Ethnicity and Parent Education Level. Within Placement, Grades Differ by Ethnicity and Parent Education Level.

Both of these variables – ethnicity and parent education level – were self-reported by students in the sample on their CST tests. Thus, accuracy is not perfect.

It is not surprising that nearly all of the eighth graders in Geometry and Honors Algebra in eighth grade reported that their parents had college or graduate degrees. Degrees are correlated with family income and more understanding by parents of the value of taking geometry in ninth grade.

Placement by ethnicity in eighth grade also varied. For example, while 56% of Filipino students took Math or Pre-algebra in eighth grade, only 17.5% of Asians and 18.8% of white students were enrolled in courses below Algebra. It is not clear whether these differences were due to district practices about offering Algebra in eighth grade or because of different treatment of the students. Obviously, students enrolled in classes below Algebra in eighth grade had no access to Geometry in ninth grade. However, even among the "successful" eighth grade Algebra students, placement in ninth grade varied – with Asian students showing the highest percentages in Geometry or Advanced Geometry (77%) and Filipino students with the lowest (40%), while Latino and white

students were approximately equally successful at about 66% enrolled in Geometry. Other ethnic groups samples were too small for inclusion.

Thus, while Tables 7 and 8 in the study show a potential differentiation related to ethnicity, because the sample of students and school districts was not random, it is impossible to generalize these findings. However, it is an indication that a problem may exist. A replication study with a larger sample size would be needed to confirm the problem. Still, it is an area that these and other school districts could monitor as a potential problem.

# C. Pathway Timeline

The timeline below is an attempt to deconstruct the progress of students and provide school districts and agencies with possible structural and programmatic intervention points.

**Seventh Grade**

The seventh grade teacher determines class placements for eighth grade. Decisions are based on student progress, the course program of the middle school, and possibly by the availability of teachers. Students not recommended for Algebra in eighth grade cannot get beyond Pre-calculus in high school without extraordinary efforts.

**Eighth Grade – Refers to Students Enrolled in Algebra Only**

**Fall**

Because the decisions about fall placement are often made in January, fall is the time for students to gain confidence in Algebra and demonstrate understanding of fundamental concepts.

**January**

In January, parents of eighth graders are mailed high school course catalogs and enrollment materials. The students and their parents fill them out and they are signed by the parent, student, and the eighth grade teacher advisor. In some schools, the eighth grade teachers provide separate recommendations to the high school for placement in math.

**February**

In February, the high school counselors visit the eighth graders in middle school to review their program choices. Sometimes parents are involved, sometimes not. Programs are modified at this time and finalized.

**March through May**

Some high schools administer placement exams during the spring. Results of placement tests sometimes override already set placements. The programs are then entered into the high school program and classes are preliminarily set up.

Some districts administer and score MARS tests during this period. As the MARS requires students to apply knowledge and skills in open-ended performance questions, success in the MARS is a very good indicator of competence.

In May, students in California take the CST or STAR test in Algebra or eighth grade math. This test, a traditionally formatted, multiple-choice test, nonetheless has proven to be difficult for students. A relatively modest percentage of students who take the test are successful.

**June through August**

Students are notified of their class schedules during this period – usually in August, just before school starts.

CST results come back to the school districts in early August. Eighth grade administrators could take one last look to be sure that any students who pass this difficult test in Algebra be moved to Geometry in ninth grade.

# Analysis and Interventions

**Seventh Grade**

Structural interventions can be made here in clarifying the best predictors for success in Algebra, training teachers to provide more access paths to students in problem-solving, setting up programs that support access for students to Algebra in eighth grade, and clearly describing classes.

**Eighth Grade – Algebra Classes Only**

**Fall**

Interventions here include: (1) helping parents and students understand the value of Algebra as a pathway to many college majors and careers, and why it is a value for students to pass Algebra and move to Geometry in ninth grade; (2) providing early interventions for students who begin to struggle. There is some research to indicate that the most effective assistance for students in Algebra occurs immediately when a student has trouble understanding a new concept. These interventions are perhaps most effectively done by the classroom teachers, but coordinated tutoring can also work; (3) some schools have found “core” programs can provide the time teachers need to help students consolidate their learning before moving on. (Core programs are those in which math and science are taught in a double period by one teacher. This enables the teacher to have two periods available for science labs or for teaching difficult math concepts.)

Outside agencies could assist here with funding, volunteer tutors, etc.

**January**

In low-income communities, twelve- and thirteen-year-old students often rely on teachers for help in math, while in affluent communities, students are more likely to rely on parents for help. It is difficult to determine in January whether the concepts will kick in for a student by the end of the year. Teachers sometimes worry about "setting their students up for failure" in high school by recommending Geometry unless the student is acing Algebra already. Thus, students are often convinced to take courses that will "insure success."

The institution could change this practice in several ways. First, high schools could provide clear descriptions of ninth grade courses so parents and students understand the implications of the courses they are selecting. Second, teachers could encourage students to stretch, and could show them data that illustrates the students might do no better with Algebra the second time around and should instead sign up for some extra tutoring or study sessions. Third, the principal could request grades and placement recommendations for eighth graders, then monitor student success on the MARS and CST later in the year.

**February**

High school counselors sometimes appear to be schooled by math teachers to discourage students from tough math courses. Counselors have been observed talking students into lower level math classes on the rationale the students would have a better start to their high school careers. Principals could work with counselors and high school math teachers to change this practice. These discussions require considerable finesse as high school math teachers can argue that middle school simply isn't preparing students for high school. If principals cannot get their teachers past this stance, whatever the principal tries will fail for many students.

High school mathematics placement tests may or may not have any predictive validity. The tests most commonly used may not have been given to a random sample of students who were later placed without regard to the test results and then followed for indications of success. The schools could use the placement results only to move students up a level and never to move them down.

**March through June**

Usually while the high school is programming the students, the middle school has completed its task and goes on with the chaos of spring and eighth grade promotion and field trips. Instead, the eighth grade principal could monitor the progress of students recommended for retention in Algebra and review the results of the MARS tests and later report cards to possible recognize student growth or achievement based on more independent measures. The principal could then notify the high school of recommended placement changes before the high school program is in stone.

**August**

In the first week of August, the last chance for change occurs with the release of the CST results. This is the last chance for the elementary district to catch students who have somehow managed to score Proficient on the CST while not having been recommended for Geometry.

# D. Long Term Interventions

These structural interventions can increase the number of students who move on to Geometry in ninth grade. They will pick up students who are capable but need encouragement to challenge themselves, students who come to grasp Algebraic concepts later in the school year, and students who were capable but were not recognized as such by their teachers. Even a ten percent increase in numbers would dramatically change the number of students completing high school prepared to enter more technical fields in college

Reaching percentages of success approaching universality will require additional interventions that will require extra efforts or money. Below are some suggestions.

- School administrators might review the study findings in detail and help their staffs understand the study's implications and strategies for avoiding becoming a school that fails half or more of its math students. In addition to the study, the appendix includes some scenarios of real situations various players face in moving students through math classes. Staff development sessions could use these scenarios as discussion initiators.

- While elementary trained teachers are often more appreciative of varying strategies for approaching math solutions, their often limited understanding of mathematics hinders their ability to adequately prepare students for abstract concepts in math. Formal teacher training could help. On the other hand, teachers who were math majors were taught in traditional ways that only a few students understood and may not know alternative strategies for assisting students to access new concepts. Both groups would benefit from programs such as a Masters Degree in the Teaching of Mathematics – a program that would blend knowledge with teaching strategies.

- Schools could redirect some of their after-school tutoring funds from programs such as the ASES Program in California to assisting Algebra students after school.

- Businesses could provide volunteers with math backgrounds to tutor, teach short courses after school, monitor students' online, provide summer work, etc.

## Moving Forward

Obviously, the findings presented here have to be considered preliminary. Replicating the study in a broader context would provide leaders with a firmer foundation for compelling change in their systems.

In the meantime, every school district might benefit from reviewing these findings and timelines and comparing them to data and timelines within their own systems. The following questions could focus this work: Is the system rational? Does it truly maximize student success? Are unexamined assumptions impeding student progress? What strategic interventions might improve the system?

Success will be measured in the increase in numbers and percentages of students from all backgrounds who progress smoothly through Algebra in eighth grade and into Geometry in ninth. The beginning of this process is appreciating the possibility that nearly all students really do want to learn and that it might not be the "fault" of the students who do not immediately grasp each new concept.

Acknowledgements:
David Foster, Executive Director of the Silicon Valley Mathematics Initiative for editing and data retrieval
Sara Spiegel, Noyce Foundation for assembling the database
Dr. Ray Gamba, Professor of Mathematics, City College, and Michael Jang, Executive Director of the Institute for Scientific Analysis for statistical assistance
Aida Gamba, Brisbane School District, for database help and editing
Penny Noyce, Trustee, Noyce Foundation for editing
Jon Wagner, Professor of Education, U.C. Davis

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# Appendix

# Pathways Study

## Prepared for the Noyce Foundation

January 20, 2010

Steve Waterman

**ABSTRACT**

This Report examines the progression of students in several Bay Area School Districts as they proceed from eighth to ninth grade math classes. The findings indicate that students and their parents face a bewildering array of course titles, that many students repeat Algebra, that repeating Algebra is not certain to yield better grades in ninth grade, and that placement decisions are correlated to ethnicity and parent education, but not gender.

# PATHWAYS STUDY

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## The First in Math Program

The First in Math Program was an investment by the Noyce Foundation in the improvement of fourth through eighth grade mathematics instruction in a group of nine[1] California school districts that demonstrated a commitment to meeting California's goal of having all eighth graders succeed in Algebra. The logical chain of the program began with that commitment. The districts and the Foundation then teamed up to support intensive, multi-faceted staff development for large numbers of teachers. The training and commitment was vertical in that it included boards of education, teachers, principals and the superintendents. The Foundation and districts believed that if teachers learned and tried out more effective strategies for assisting students to access more conceptual mathematics, the students would be more successful on tests and in more rigorous mathematics classes as they moved through junior high and into high schools.

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Thus, this study sought to determine dependent and independent variables of interest in conducting the research, to develop a useful database system that would yield good, pre-treatment baseline statistics, and to develop and report those statistics. Problem statements for the study itself might be framed as follows:

1. Did teacher training result in more eighth graders being placed in high school level Algebra in eighth grade?

[1] *One district dropped out of the program. Its data are not included here.*

2. Did teacher training result in more students completing high school level Algebra by the end of eighth grade?

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To determine whether sufficient data was available to carry out the study, the Foundation supported a mini-study in the summer and fall of 2008. The feasibility study uncovered the possibility of confounding variables that had the potential of overwhelming any long-term effects from any type of staff development program. The mini-study found that placement in eighth grade and success in that placement did not seem to be closely related to placement decisions or success in high school placements. As the study only included 70 students from one district, the Foundation believed it was essential to discover whether this pattern was widespread. Thus, this study, while identifying the baseline data needed for a quasi-experimental design with a long-term evaluation, also looked specifically at the issue of transition into high school math. The information gleaned from these analyses may encourage middle school and high school teachers to work more closely together in ensuring that students are placed in the most appropriate mathematics class in high school, and that high school teachers can then believe that students are placed appropriately and will commit to their success.

## Study Methodology

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Once assembled, the database was to be used for a number of analyses to provide a multi-dimensional baseline for an impact study. (The first group of students whose teachers received intensive training, completed eighth grade in June 2008 and ninth grade in June 2009. Their CST results for ninth grade are now available.)

## Findings

There are several major findings. Each has implications for further work with school districts and implications for maximizing the impact of the staff development:

- There is a large and confusing array of names for math classes in eighth and ninth grades among the nine elementary schools, four high schools and one unified school district in the treatment group.

- Placement in ninth grade math class is not always clearly related to prior placement in eighth grade math class in the way one would expect – a movement from Algebra to Geometry, for example. Nearly 65% of the students who were placed in Algebra in eighth grade were placed in the same level of Algebra or Honors Algebra in ninth grade. (Note: All non-honors Algebra titles were merged into Algebra for this analysis. The term "Math" refers to general, non-Algebra, non-Geometry or other higher mathematics courses. )

- For the group of students who took Algebra in eighth grade, the best predictor of success in ninth grade, as defined by final grades, was the eighth grade MARS raw score.

- There were indications that grades and placement in math classes differ by ethnicity and parent education.

- Nearly half of the students who were successful in Algebra in the eighth grade and who were placed again in Algebra in ninth grade were no more successful in their second experience.

## Finding 1: Thirteen (at least) Ways of Characterizing Math[2]

School district websites were reviewed to try to ascertain the meaning of titles. In most cases, these titles were not on the websites, or were confusing. Titles are listed below:

**Mathematics** – Pre-Algebra, Math 8, Math 8-1, Math 8-H, Math Support, Math SDC, Math 6, Math 7/8, ELD Math, Math 8 I.L., Tutorial Math

**Eighth Grade Algebra** – Algebra A, Algebra 1, Fund Algebra, Acc. Algebra, Algebra, Algebra Honors, Algebra 8, Algebra 8A, Concrete Algebra,

**Ninth Grade Algebra** - Algebra 1 ($9^{th}$), Algebra 1 unit 6, Algebra 1A, Algebra 2, Algebra Concepts, Algebra 1A1B (9), Algebra A (9), Algebra B (9) (P), Algebra 1 (9) (P), Algebra Support, Fund Algebra A, Algebra 1 ($8^{th}$), P-Alg 2 Acc, P-Algebra 1, P-Algebra 2, P-Algebra 2-H, P-Seq Alg 1, P-SeqAlg1/'Geom

**Geometry** – Geometry (9) (P), Geometry, Geometry Acc.

From conversations with teachers, we gathered that placement decisions vary greatly both across and within high school districts. Many factors are involved:

- Eighth grade teachers make recommendations early in the second semester, before external assessments have been completed;

[2] *See poem by Wallace Stevens, "Thirteen Ways of Looking at a Blackbird"*

- Grading practices (mastery determinations) of teachers vary; some rely more on tests, others rely more on homework, others include effort;
- Students, with their parents' help, sign up for high school classes in January of their eighth grade year;
- High school counselors sometimes meet with eighth graders to confirm choices and provide further guidance in the spring;
- High schools sometimes modify decisions based on CST performance; and
- High schools and eighth grades sometimes give Algebra Placement tests.

This study did not focus on the types of explanations given to students during placement meetings held during the spring of their eighth grade year. Anecdotal comments from teachers indicate that at least sometimes, students are advised to re-take Algebra in ninth grade to be sure they "master" all of its concepts. High school teachers have been overheard castigating eighth grade teachers for placement recommendations the ninth grade teachers feel are too advanced for the students. This may have frightened eighth grade teachers into being conservative in their placement recommendations.

The number of course titles that include the word "Algebra" may confuse parents who are not sophisticated in unraveling the complexities of math class placement. These parents may rely on the teachers and counselors to advise them.

The various steps in the recommendation process almost never appear to encourage student placement in more academic classes, and may have been the single largest contributor to the re-placement of students who take Algebra in eighth grade back into Algebra in ninth grade – regardless of student success on the state's Algebra CST.

## Finding 2: Ninth Grade Placement, a Function of Eighth Grade Class?

The first data finding of the study deals with the way Algebra and general math classes are described by the schools and on transcripts. This finding deals with student placement in ninth grade.

As the chart below indicates, nearly all of the students who were in Math 8 classes (math or pre-Algebra) were placed in Algebra classes in ninth grade (Algebra two or three semesters are both considered Algebra here). Nearly all of the students who took Geometry in eighth grade were placed in Algebra II as ninth graders. Likewise, more than 80% of the students who were enrolled in Honors Algebra in eighth grade moved to either Geometry or Honors Geometry. Thus, for these three groups of students, the system provided predictable results.

This was not the case for the largest subset of students, those taking Algebra as eighth graders. Unfortunately, the findings of the study generalize the finding of the mini-study. Slightly more than half of the students took Algebra in eighth grade. Approximately 64% of those students were again placed in Algebra as ninth graders – or worse – were placed in pre-Algebra or general Math as ninth graders.

One could then look at the results from two perspectives. On the one hand, about 65% of 1653 students advanced from one level of math to the next as they moved from eighth to ninth grade. On the other hand, 35% did not advance. Moreover, the failure rate (if defined as non-advancement) was nearly 65% for students taking Algebra in the eighth grade.

*Table 1. Placement in ninth grade mathematics courses by eighth grade class, expressed in percentages on first line, number of students on the second line. Sample size: 1653, 57% of the total population. For example, 1.9% of the students who took Math 8 were placed in math or pre-Algebra in ninth grade.*

| Crosstab | Math Ninth Grade | Algebra Ninth Grade | Hon Algebra Ninth Grade | Geometry Ninth Grade | Hon Geometry | Total Number |
|---|---|---|---|---|---|---|
| Math 8 & Pre-algebra | 1.9%<br>8 | 94.3%<br>461 | 0% | 4.7%<br>20 | 0% | 489 |
| Algebra 8 | 4.2%<br>37 | 58.1%<br>513 | 1.9%<br>17 | 32.5%<br>287 | 3.3%<br>29 | 883 |
| H Algebra | 0% | 10.8%<br>25 | 1.3%<br>3 | 48.5%<br>112 | 39.4%<br>91 | 231 |
| Geometry | 0% | 2%<br>1 | 98%*<br>49 | 0% | 0% | 50 |

**This appears to have been Second Year Algebra*

*Table 2. Compares students by district who were placed in Algebra or honors Algebra in eighth grade to their placement in ninth grade. (The percentage in the Algebra eighth grade column indicates the percent of students from that district with matched scores who were placed in Algebra in eighth grade.)*

| Crosstab, district by Algebra | Algebra or Hon Algebra Eight Grade # of Students | Math Ninth Grade | Algebra or Hon Algebra Ninth Grade | Geometry Ninth Grade | Hon Geometry |
|---|---|---|---|---|---|
| Dist 1 | 182 (35.4%) | | 121 (66.5%) | 61 (33.5%) | |
| Dist 2 | 225(99.5%) | | 135 (60%) | 90 (40.0%) | |
| Dist 3 | 116 (50.6% | | 27 (23.3%) | 60 (51.7%) | 29 (25%) |
| Dist 4 | 242 (89%) | 45 (16.4%) | 116 (42.4%) | | 91 (33%) |
| Dist 5 | 93 (60.3% | | 26 (28%) | 67 (72.0%) | |
| Dist 6 | 146 (77.6%) | | 104 (71.2%) | 42 (28.8%) | |
| Dist 7 | 17 (54.8%) | | 3 (17.6%) | 14 (82.4%) | |
| Dist 8 | 38 (100%) | | 27 (71.1%) | 11 (28.9%) | |

## Finding 3: MARS performance as a Predictor of Ninth Grade Placement

As the MARS test is given in early March each year, with scores available to the districts by early May, it provides the strongest independent data for teachers to use in placing or adjusting the placement recommendations for ninth grade. One would predict that since the MARS is closely correlated with CST results, it would be a generally strong predictor of ninth grade placement.

From the chart below, it is clear that the MARS performance levels were not good predictors of later placement. Indeed, students were just as likely to be placed in Geometry in ninth grade if they did not meet standards as if they did. It is possible that teachers do not check placement decisions after the

MARS results come back to the local districts.

*Table 3. Compares student success on the MARS test administered in the spring of 2007 with the students' later placement in math classes in the high schools. There were 1410 valid matches for this analysis out of a total population of 2897 students. MARS has four levels. This analysis consolidated the analysis into two cells, those meeting or exceeding standards and those not meeting standards.*

| MARS to Placement | Math | Algebra | Hon Alg | Geometry | Hon Geom | Total |
|---|---|---|---|---|---|---|
| Met Standards | 34<br>4.4% | 440<br>56.4% | 48<br>6.2% | 169<br>21.7% | 87<br>11.2% | 780* |
| Standards not Met | 16<br>2.5% | 412<br>65.4% | 13<br>2.1% | 151<br>24% | 38<br>6% | 630 |
| Total | 50 | 852 | 61 | 320 | 125 | 1410 |

**Includes two students placed in Trig*

Because only about 50% of the eighth graders were enrolled in Algebra class, that was the only group to take the Algebra version of the MARS in 2007. Table 3a below summarizes the results for this group of students. This analysis is critically important to examine because historically, nearly all of the students who scored either "Met Standards" or "Above Standards" on the MARS Algebra tests also scored at "Proficient" or "Advanced" on the CST. Because the MARS proved to be a more difficult test than the CST and required greater understanding, and because the results come early enough in the year to change students' schedules for high school, these results could change a student's learning opportunities for the rest of her/his educational career.

The data in this table has profound implications. First, only a little over half of the students who met standards on this difficult test were promoted to Geometry. These were students who understood Algebra well enough to use it to solve new word problems. These students demonstrated competence in Algebra in the spring, early enough to have their programs changed. But their programs were not changed. If this percentage is representative of even a portion of the State of California, many thousands of students who demonstrated math capability, were effectively shut out of Calculus in high school – and all that completing such an AP class represents to their college and college major choices.

Second, about half of the students who took the assessment did not meet standards. These were students taking Algebra in eighth grade who were not succeeding by March of the school year. A fifty percent failure rate would not be acceptable in other core academic subjects, but in Mathematics, apparently a failure rate of this magnitude is accepted.

*Table 3a. Includes only students enrolled in Algebra in eighth grade in 2007. Compares student success on the MARS test administered in the spring of 2007 with the students' later placement in math classes in the high schools. There were 739 valid matches for this analysis out of a total population of 2897 students. MARS has four levels. This analysis consolidated the results into two cells, those meeting or exceeding standards and those not meeting standards.*

| MARS to Placement | Math | Algebra | Hon Alg | Geometry | Hon Geom | Total |
|---|---|---|---|---|---|---|
| Met Standards | 9<br>2.5% | 137<br>38% | 17<br>4.7% | 169<br>46.9% | 28<br>7.8% | 360 |
| Standards not Met | 26<br>6.9% | 307<br>81% | 0 | 45<br>11.9% | 1<br>0.3% | 379 |
| Total | 35 | 444 | 17 | 214 | 29 | 739 |

## Finding 4: Parent Education and Eighth Grade Placement

As one of the purposes of the staff development program was to open the availability of higher level math classes to students from lower socio-economic levels, the study looked at placement prior to training for baseline data. By looking down the column labeled "Math" one can see that there is an increase in the percent of each group who took lower level math classes based on socio-economic status. It is important to note that this information was self reported in some school districts by the students. Conversations with school secretaries in past years revealed that students have been hesitant to report their parents as not having at least a high school diploma – or students are simply unaware of their parent education level. This tends to be less the case for students whose parents hold jobs that clearly require college or advanced degrees. However, even assuming some uncertainty, the results show a clear bias for children of parents with college or graduate degrees to be placed in advanced math courses. This is not at all unexpected and forms a good baseline for change as brought about by program effects.

*Table 4. Compares parent education level to eighth grade placement in mathematics classes. Parent Education is self-reported and is taken from the students' CST results. Approximately 8% of the students who took the CST left this field blank.*

| Parent Ed / Eighth Grade Placement | | | Eighth Grade Placement | | | | Total |
|---|---|---|---|---|---|---|---|
| | | | Math | Algebra | Hon Alg | Geometry | |
| Parent Education Level | Graduate School | Count | 60 | 165 | 58 | 39 | 322 |
| | | % within | 18.6% | 51.2% | 18.0% | 12.1% | 100.0% |
| | College Degree | Count | 136 | 284 | 107 | 8 | 535 |
| | | % within | 25.4% | 53.1% | 20.0% | 1.5% | 100.0% |
| | Some College | Count | 117 | 186 | 41 | 3 | 347 |
| | | % within | 33.7% | 53.6% | 11.8% | .9% | 100.0% |
| | High School Grad | Count | 124 | 128 | 23 | 0 | 275 |
| | | % within | 45.1% | 46.5% | 8.4% | .0% | 100.0% |
| | Not HS Grad | Count | 44 | 39 | 1 | 2 | 86 |
| | | % within | 51.2% | 45.3% | 1.2% | 2.3% | 100.0% |
| | Blank | Count | 58 | 57 | 18 | 1 | 134 |
| | | % within | 43.3% | 42.5% | 13.4% | .7% | 100.0% |
| | Total Count | | 539 | 859 | 248 | 53 | 1699 |
| | % of Total | | 31.7% | 50.6% | 14.6% | 3.1% | 100.0% |

## Finding 5: Gender and Placement

There has been an assumption that, as they progress through the grades, girls do not enroll as often as boys, either by choice or by prejudice, in advanced math classes. If this phenomenon occurs generally, it did not occur in the target school districts during the 2006-07 school year. There were statistically insignificant differences in math placement between boys and girls overall. Only in Geometry placement were more boys than girls enrolled. See Table 5, below.

*Table 5. Comparison of gender to eighth grade placement in mathematics classes. Gender is self-reported and is taken from the students' CST results. Approximately 19% of the students who took the CST left this field blank.*

| | | Eighth Grade Placement | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | SDC | Math | Pre Alg | Algebra | Hon Alg | Geometry | |
| Female | Count | 0 | 253 | 0 | 413 | 124 | 18 | 808 |
| | % within | .0% | 31.3% | .0% | 51.1% | 15.3% | 2.2% | 100.0% |
| Male | Count | 0 | 286 | 0 | 447 | 124 | 35 | 892 |
| | % within | .0% | 32.1% | .0% | 50.1% | 13.9% | 3.9% | 100.0% |
| Missing | Count | 13 | 35 | 91 | 238 | 29 | 2 | 408 |
| | % within | 3.2% | 8.6% | 22.3% | 58.3% | 7.1% | .5% | 100.0% |
| Total Count | | 13 | 574 | 91 | 1098 | 277 | 55 | 2108 |
| % of Total | | 0.6% | 27.2% | 4.3% | 52.1% | 13.1% | 2.6% | 100.0% |

The findings for ninth grade mirror those for eighth grade. Again, the difference in placement between boys and girls was not statistically meaningful.

*Table 6. Comparison of gender to ninth grade placement in mathematics classes. Gender is self-reported and is taken from the students' CST results. Approximately 22% of the students who took the CST left this field blank.*

| | | Ninth Grade Placement | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | Math | Algebra | Hon Alg | Geometry | Hon Geom | Trig | Calculus | |
| Female | Count | 18 | 416 | 23 | 190 | 61 | 0 | 0 | 708 |
| | % within | 2.5% | 58.8% | 3.2% | 26.8% | 8.6% | .0% | .0% | 100% |
| Male | Count | 25 | 504 | 42 | 188 | 57 | 1 | 0 | 817 |
| | % within | 3.1% | 61.7% | 5.1% | 23.0% | 7.0% | 0.1% | .0% | 100% |
| Missing | Count | 28 | 250 | 6 | 84 | 45 | 9 | 1 | 423 |
| | % within | 6.6% | 59.1% | 1.4% | 19.9% | 10.6% | 2.1% | 0.2% | 100% |
| Total Count | | 71 | 1170 | 71 | 462 | 163 | 10 | 1 | 1948 |
| % of Total | | 3.6% | 60.1% | 3.6% | 23.7% | 8.4% | 5.0% | 0.1% | 100% |

## Finding 6: Mathematics Placement in FiMP Schools by Ethnicity

Opening access to higher level mathematics classes to children from diverse ethnic backgrounds was one of the goals of the First in Math Program. The table below clearly illustrates the differences in eighth grade placement for different ethnic groups, with white and Asian students being placed in more advanced classes much more often than students of other ethnicities. More than forty percent of the students from most of the ethnic groups were placed in math/pre Algebra classes in eighth grade, while fewer than twenty percent of the white and Asian students were so placed. In fact, for most of the minority groups, more than ninety percent of the students were placed in either Algebra or math classes, and aside from Filipino students, few non-Asian minority students were placed in higher-level math classes.

*Table 7. Comparison of ethnicity to eighth grade placement in mathematics classes. Ethnicity is self-reported and is taken from the students' CST results.*

| Ethnicity | Eighth Grade Math Placement (2006-07 School Year) | | | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Math/ Pre Alg | | Algebra | | Hon Algebra | | Geometry | | | |
| | N | % | N | % | N | % | N | % | N | % |
| **Am Indian** | 7 | 53.8% | 6 | 46.2% | 0 | 0% | 0 | 0% | 13 | 0.8% |
| **Asian** | 60 | 17.5% | 181 | 52.9% | 62 | 18.1% | 39 | 11.4% | 342 | 20.4% |
| **Filipino** | 183 | 56.1% | 111 | 34.0% | 32 | 9.8% | 0 | 0% | 326 | 19.5% |
| **Pac Islander** | 13 | 44.8% | 15 | 51.7% | 1 | 3.4% | 0 | 0% | 29 | 1.7% |
| **Latino** | 122 | 43.0% | 144 | 50.7% | 18 | 6.3% | 0 | 0% | 284 | 17.0% |
| **African Am** | 25 | 43.9% | 30 | 52.6% | 2 | 3.5% | 0 | 0% | 57 | 3.4% |
| **White, non-H** | 117 | 18.8% | 365 | 58.6% | 130 | 20.9% | 11 | 1.8% | 623 | 37.2% |
| **Totals** | 527 | 31.5% | 852 | 50.9% | 245 | 14.6% | 50 | 3.0% | 1674 | 100.0% |

The placement pattern for this cohort of students in ninth grade followed a similar pattern to their placement in eighth grade. While more than 80% of most of the minority groups were placed in Algebra in ninth grade, only 31% of the Asian students were so placed. The proportion of white students who moved from Algebra in eighth grade to Geometry in ninth grade was not as large as that for Asian students.

*Table 8. Comparison of ethnicity to ninth grade placement in mathematics classes. Ethnicity is self-reported and is taken from the students' CST results.*

| Ethnicity | Eighth Grade Math Placement (2006-07 School Year) | | | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Math/PreAlg | | Algebra | | Hon Algebra | | Geometry | | | |
| | N | % | N | % | N | % | N | % | N | % |
| **Am Indian** | 1 | 8.3% | 10 | 83.3% | 0 | 0% | 1 | 8.3% | 12 | 0.8% |
| **Asian** | 4 | 1.3% | 97 | 30.8% | 51 | 16.2% | 163 | 51.7% | 315 | 21.0% |
| **Filipino** | 0 | 0% | 189 | 70.3% | 0 | 0% | 80 | 29.7% | 269 | 17.9% |
| **Pac Islander** | 0 | 0% | 20 | 90.9% | 0 | 0% | 2 | 9.1% | 22 | 1.5% |
| **Latino** | 5 | 2.1% | 197 | 81.4% | 0 | 0% | 40 | 16.5% | 242 | 16.1% |
| **African Am** | 0 | 0% | 37 | 82.2% | 0 | 0% | 8 | 17.8% | 45 | 3.0% |
| **White, non-H** | 33 | 5.5% | 358 | 60.1% | 10 | 1.7% | 195 | 32.7% | 596 | 39.7% |
| **Totals** | 43 | 2.9% | 908 | 60.5% | 61 | 4.1% | 489 | 32.6% | 1501 | 100.0% |

## Finding 7: Issues Related to Performance of Students who were Placed in Algebra Classes in Eighth Grade

Because so many of the students who had been placed in Algebra in eighth grade, remained in Algebra in ninth grade, analyses were performed to try to determine variables that may have contributed to this static placement.

### Frequencies 8th Grade B- Grade and above....9th Grade Placement

One focus was on students with grades of 'B-' or better in eighth grade, on the assumption that teachers would have considered them to have "mastered" Algebra sufficiently to move on to Geometry in ninth

grade. As can be seen, despite their eighth grade teachers' determination that the students had earned grades of 'B-' or better, nearly 35% of the 993 students were placed either in Math or Algebra classes in ninth grade. The reasons for this placement can only be speculated upon.

*Table 9. Frequency distribution in ninth grade math classes for students enrolled **in Algebra or Honors Algebra** in eighth grade and who received final grades of "B-" or better in eighth grade.*

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Math | 9 | 1.0 | 1.2 | 1.2 |
| | Algebra | 234 | 25.1 | 31.1 | 32.3 |
| | H Algebra | 20 | 2.1 | 2.7 | 34.9 |
| | Geometry | 372 | 39.9 | 49.4 | 84.3 |
| | H Geom | 118 | 12.6 | 15.7 | 100.0 |
| | Total | 753 | 80.7 | 100.0 | |
| Missing | System | 180 | 19.3 | | |
| Total | | 993 | 100.0 | | |

The situation is somewhat more dramatic for students who were enrolled in Algebra classes in eighth grade. Table 10, below, illustrates the transition for these students. This chart shows that 46% of the students who were enrolled in Algebra classes in eighth grade repeated Algebra or were dropped to Math as ninth graders. By pulling the students enrolled in Honors Algebra in eighth grade, the numbers of students enrolled in Geometry drop considerably. Clearly, the Honors track of students makes the transition to ninth grade courses more successfully than those enrolled in straight Algebra classes in eighth grade.

As not all of the sampled school districts offered Honors Algebra, the differences represented in these two charts may well under-represent the differences in expectations for students. But where Honors Algebra is offered, it offers a more predictable path to Geometry and Honors Geometry than enrollment in Algebra classes.

*Table 10. Frequency distribution in ninth grade math classes for students enrolled in **Algebra** in eighth grade and who received final grades of "B-" or better in eighth grade.*

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Math | 9 | 1.3 | 1.7 | 1.7 |
| | Algebra | 221 | 32.8 | 41.2 | 42.8 |
| | H Algebra | 17 | 2.5 | 3.2 | 46.0 |
| | Geometry | 261 | 38.7 | 48.6 | 94.6 |
| | H Geom | 29 | 4.3 | 5.4 | 100.0 |
| | Total | 537 | 79.7 | 100.0 | |
| Missing | System | 137 | 20.3 | | |
| Total | | 674 | 100.0 | | |

As with placement overall, placement of students of various ethnicities differed for the subset of students with grades in eighth grade Algebra among the various ethnicities represented in the study. As can be seen from Table 11 below, there were fewer Asian students placed in ninth grade Algebra or Advanced Algebra than other ethnic groups, Filipino students fared worst in the sorting process, and

Latino and non-Latino white students fared about the same.

Because the different ethnicities were not represented proportionally across the various school districts, it is impossible to determine what impact, if any, the relationship between the high school districts and their respective feeder elementary districts played on class assignments.

*Table 11. Frequency distribution in ninth grade math classes for students enrolled in Algebra in eighth grade and who received final grades of "B-" or better in eighth grade by Ethnicity. (The numbers for African American, Native American and Pacific Islander Groups each had fewer than 25 students in this sample and are not included.)*

| | Asian | Latino | Filipino | White | Total Number |
|---|---|---|---|---|---|
| **Math** | **.5%** | **0%** | **1.6%** | **2.6%** | **9** |
| **Algebra** | **14.3%** | **32.6%** | **59%** | **37.3%** | **195** |
| **H Algebra** | **8.2%** | **0** | **0** | **0** | **16** |
| **Geometry** | **60.7%** | **67.4%** | **36.1%** | **31%** | **287** |
| **H Geom** | **16.3%** | **0** | **3.3%** | **29.2%** | **113** |
| **Total Num** | **196** | **92** | **61** | **271** | **620** |

## Frequencies 8th Grade B- Grade and above … 9th Grade Algebra Grades

The study then focused on students who had been successful in eighth grade Algebra and followed them through their final grades in ninth grade Algebra to determine whether they maintained their success level in ninth grade. From the table below, one can see that 50.6% of the students who had been successful in Algebra as eighth graders but were placed again in Algebra as ninth graders, received the same or lower grades the second time around.

*Table 12. Frequency distribution of final grades in Ninth Grade Algebra for students enrolled in Algebra in eighth grade and who received final grades of "B-" or better in eighth grade.*

| Grade in Algebra in Ninth Grade | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| F | 13 | 5.9 | 5.9 |
| D- | 5 | 2.3 | 8.2 |
| D | 5 | 2.3 | 10.5 |
| D+ | 7 | 3.2 | 13.7 |
| C- | 18 | 8.2 | 21.9 |
| C | 28 | 12.8 | 34.7 |
| C+ | 20 | 9.1 | 43.8 |
| **B-** | **15** | **6.8** | **50.6** |
| B | 33 | 15.1 | 65.7 |
| B+ | 14 | 6.4 | 72.1 |
| A- | 17 | 7.8 | 79.9 |
| A | 38 | 17.4 | 97.3 |
| A+ | 6 | 2.7 | 100 |
| Total | 219 | 100.0 | |

## CST Performance Level for Eighth Grade Algebra Students, Compared to Ninth Grade Placement

The CST Algebra test was created to independently assess the success of California students in Algebra. Parents and citizens are told each year that scoring "proficient" or "advanced" on these tests means that students have mastered the skills needed to move on to the next level. California's standards are reputed to be among the highest in the U.S. While teachers and administrators have long argued that these tests represent performance on a single day or in a single week, and that they do not measure all of the attributes students possess, those arguments have usually been made to rationalize lower test scores. That is, administrators and teachers rarely have argued to parents that their child's success on this test was only a fluke and that the child really did not master the material. Thus, one would expect a one-one correspondence between success on the CST and placement in the next level of class – here a passage from Algebra to Geometry.

While administered before the school year ends, the CST, or STAR tests arrive back in school districts by early August, several weeks before the start of the next school year. Thus, it is not too late for school districts to change the placement of students based on their success on the CST.

It is then surprising that more than 60% of the students who had scored Proficient or Advanced in Algebra in Eighth Grade were again placed in algebra in ninth grade.

*Table 13. Comparison of Ninth Grade placement in Math Classes as a Function of CST Performance levels in Eighth Grade for Students Taking Algebra as Eighth Graders*

| | | Math | Algebra | Hon Alg | Geometry | Hon Geom | Total |
|---|---|---|---|---|---|---|---|
| Far Below Basic | Count | 1 | 37 | 0 | 0 | 0 | 38 |
| | % within | 2.6% | 97.4% | 0% | 0% | 0% | 100.0% |
| Below Basic | Count | 8 | 117 | 0 | 4 | 0 | 129 |
| | % within | 6.2% | 90.7% | 0% | 3.1% | 0% | 100.0% |
| Basic | Count | 16 | 137 | 0 | 35 | 0 | 188 |
| | % within | 8.5% | 72.9% | 0% | 18.6% | 0% | 100.0% |
| Proficient | Count | 8 | 109 | 0 | 124 | 7 | 248 |
| | % within | 3.2% | 44.0% | 0% | 50.0% | 2.8% | 100.0% |
| Advanced | Count | 0 | 23 | 17 | 50 | 22 | 112 |
| | % within | 0% | 20.5% | 15.2% | 44.6% | 19.6% | 100.0% |
| Missing | Count | 4 | 90 | 0 | 74 | 0 | 168 |
| | % within | 2.4% | 53.6% | 0% | 44.0% | 0% | 100.0% |
| Total Count | | 37 | 513 | 17 | 287 | 29 | 883 |
| % of Total | | 4.2% | 58.1% | 1.9% | 32.5% | 3.3% | 100.0% |

## Statistical Analyses to Determine the Best Predictors of Ninth Grade Placement for Students who had Taken Algebra as Eighth Graders

Finally, the study attempted to determine which of four variables was the best predictor of placement in ninth grade. As this analysis for the entire group of schools yielded significant within-group variance, and as it had been determined that placement decisions seemed to follow a predicted pattern for students enrolled either in Math or Honors Algebra in eighth grade, these analyses focused only on those students who were placed in Algebra as eighth graders.

The analyses below indicate that the sum of the CST scores, grades and MARS results were able to explain about 45% of the variance in placement for students from this group who were passing from eighth to ninth grade. This was statistically significant. Moreover, the eighth grade grades, MARS scores and CST Scale scores were each statistically significant predictors of later placement. MARS raw scores explained 35% of the variance. MARS raw scores and CST scale scores were highly correlated, (.738).

Table 14. *Regression Analysis, Grades, CST scores, MARS scores and CST performance levels as predictors of ninth grade placement*

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .674(a) | .454 | .452 | .826 |

a Predictors: (Constant), Eighth Grade Class, MARS Raw, MARS Perf, CST Scale, CST Perf

**ANOVA(b)**

| Model | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 779.215 | 5 | 155.843 | 228.514 | .000(a) |
| Residual | 938.412 | 1376 | .682 | | |
| Total | 1717.627 | 1381 | | | |

a Predictors: (Constant), Eighth Grade Class, MARS Raw, MARS Perf, CST Scale, CST Perf
b Dependent Variable: Ninth Grade Placement

**Coefficients(a)**

| Model | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | | |
| (Constant) | .278 | .155 | | 1.791 | .074 |
| 8th class | .250 | .023 | .259 | 11.068 | .000 |
| MARS Raw | .075 | .008 | .605 | 9.385 | .000 |
| MARS Perf | -.349 | .069 | -.309 | -5.089 | .000 |
| CST Scale | .003 | .001 | .210 | 3.682 | .000 |
| CST perf | .017 | .053 | .017 | .310 | .756 |

a Dependent Variable: Ninth Grade Placement

*Table 15. Correlations between Eighth grade school performance as indicated by letter grades, MARS Scale Scores, MARS Performance, CST Scale Scores and CST performance levels with ninth grade placement.*

| | | 8th Gr. 2006-07 | MARS Raw | MARS Perform | CST Scale | CST Perform | 9th Placement |
|---|---|---|---|---|---|---|---|
| 8th Gr. 2006-07 | Pearson Correlation | 1 | .442(**) | .450(**) | .516(**) | .442(**) | .521(**) |
| | Sig. (2-tailed) | . | .000 | .000 | .000 | .000 | .000 |
| | N | 1072 | 839 | 839 | 808 | 812 | 862 |
| MARS Raw | Pearson Correlation | .442(**) | 1 | .943(**) | .738(**) | .642(**) | .588(**) |
| | Sig. (2-tailed) | .000 | . | .000 | .000 | .000 | .000 |
| | N | 839 | 862 | 862 | 830 | 834 | 739 |
| MARS performance | Pearson Correlation | .450(**) | .943(**) | 1 | .706(**) | .621(**) | .510(**) |
| | Sig. (2-tailed) | .000 | .000 | . | .000 | .000 | .000 |
| | N | 839 | 862 | 862 | 830 | 834 | 739 |
| CST Scale | Pearson Correlation | .516(**) | .738(**) | .706(**) | 1 | .933(**) | .566(**) |
| | Sig. (2-tailed) | .000 | .000 | .000 | . | .000 | .000 |
| | N | 808 | 830 | 830 | 830 | 830 | 715 |
| CST performance | Pearson Correlation | .442(**) | .642(**) | .621(**) | .933(**) | 1 | .484(**) |
| | Sig. (2-tailed) | .000 | .000 | .000 | .000 | . | .000 |
| | N | 812 | 834 | 834 | 830 | 834 | 718 |
| Math Placement 9th | Pearson Correlation | .521(**) | .588(**) | .510(**) | .566(**) | .484(**) | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | .000 | .000 | . |
| | N | 862 | 739 | 739 | 715 | 718 | 883 |

** Correlation is significant at the 0.01 level (2-tailed).

**Correlations for Students taking Algebra in Eighth Grade by Ethnic Group and Ninth Grade Placement**

The last table compares letter grades for the students as eighth graders, MARS scores and CST scores to ninth grade placement. One would expect the correlations to be similar for the three independent variables. This was the case for non-Hispanic white students. As can be seen, the correlation between final grades and ninth grade placement was much stronger for Asian students than for Filipino students, African American students, and Latino students. For these two groups of students, test scores proved better correlates with ninth grade placement than teacher-given grades. These results are not conclusive; however, they deserve further research in that they could relate to teacher expectations and how they might differ as teachers work with students of different ethnicities.

*Table 16. For eighth grade Algebra students only, correlations by race between final grade in eighth grade, MARS raw score, CST scale score and ninth grade placement.*

| Ethnicity | Number of Students | Grade to Placement | MARS Raw to Placement | CST Scale to Placement |
|---|---|---|---|---|
| Asian | 163 | 0.504 | 0.535 | 0.444 |
| Filipino | 111 | 0.258 | 0.450 | 0.515 |
| Latino | 96 | 0.444 | 0.677 | 0.625 |
| African Am | 24 | 0.543 | 0.606 | 0.640 |
| White | 313 | 0.452 | 0.467 | 0.482 |

## Final Thoughts/Recommendations

This study provides a baseline for determining whether the staff development program supported by the Noyce Foundation has resulted in an increase in the access of eighth graders to Algebra content, and whether that increase will carry forward to success in terms of the grades the eighth grade math teachers give the students, the students' CST success, and later placement and success in ninth grade. As expected, minority students and students coming from homes in which neither parent has graduated from college had less access to Algebra in eighth grade than their white and Asian and affluent peers.

On the way to providing the baseline data, the discovery that many students placed in Algebra in eighth grade, and who were successful in that placement based on common sense indicators, were not moved to Geometry in ninth grade raises a significant educational issue for the elementary and high school districts to confront. It appears that for many students, success on the usual indicators does not lead to the opportunity to move on with their math education. It would appear that earlier efforts by elementary and high school teachers to bridge the placement/recommendation gap have failed.

These findings lead to two recommendations to the Noyce Foundation:

**Recommendation 1: Create a Forum for Reducing the Arbitrariness of Placements**

> All of the work done so far by the elementary school districts in the collaborative can easily be undone by poorly conceived placement decisions by either or both of the eighth- or ninth-grade teachers. Moreover, there is reason to believe this situation is widespread in the state. The Foundation has the resources to provide a credible forum for the discussion of expectations and standards as they are presently conceived by teachers at this critical juncture in children's lives. The harm possible to the self-esteem of a child caused by being placed again in a class he/she has already passed is significant, and can at least partially explain the lag the United States experiences in producing graduates of high school and college with math acumen. The Foundation can expose the problem and provide a venue for districts to solve it.

**Recommendation 2: Continued, if Modified, Support to the First in Math Districts**

> It is apparent from both the findings of this report and those of the surveys that changing the culture of mathematics thinking in middle schools and high schools is extremely difficult. During the 2008-09 year, it was clear that some of the districts were really moving ahead, others not. In completing the three-year cycle of support for those districts the Foundation judged to be true leaders, the Foundation would be able to establish a credible database to support the efficacy of having districts across the country re-examine their belief systems.

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The author would like to acknowledge the contributions of the following individuals:

Aida Gamba for data base work, and editing and formatting this paper
Sara Spiegal for assembling the data base
Dr. Ray Gamba and Michale Jang for statistical analysis
David Foster for advice and guidance

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January 20, 2010

# Scenarios

## Principal

After hearing this presentation, you have gone back to your school and checked on the recommendations your teachers are making to the students for high school placement. (You now have 60% of your eighth graders taking Algebra. ) You have become aware that one of your Algebra teachers has only recommended a third of her students to Geometry in the ninth grade. You have asked her the reason and she says, "This class is just a weak one." The average for your other Algebra teachers is 60% being recommended to geometry.

Midterm grades for Algebra are as follows:

Teacher a – 70% 'B' or better
Teacher b – 60% 'B' or better
Teacher c – 40% 'B' or better

You check with your English teachers and find out what they are doing. They are recommending 25% to advanced English. 70% to college bound ninth grade English and 5% to remedial ninth grade English.

What do you think is the right proportion of Algebra students to be recommended to geometry?

What might you do between now and June to get to that percentage?

## Coach

Because of your influence, all of the students in eighth grade are now taking Algebra. The eighth grade teachers are angry and frustrated. They are giving failing grades to more than half of the students. You and a few of your math teachers have begun meeting with the high school math teachers to smooth the transition for students. The high school teachers are loudly telling your teachers that they are recommending too many students to geometry and the students are not doing well. In fact, the teachers are saying that the Algebra ninth graders are not prepared for Algebra. This is making your eighth grade math teachers feel they have made a big mistake in changing to an all-Algebra eighth grade.

What do you do?

**Assistant Superintendent, Instruction**

Last year, having heard of the research conducted by the Noyce Foundation, you talked the superintendent into increasing the number of students in Algebra classes at the eighth grade. Recently, parents have been trooping to your door to express their "concerns" that the addition of unprepared students in Algebra was causing teachers to water down the curriculums. They fear this is holding their Stanford-bound children back. They feel you should keep your liberal experiments for other people's kids.

You suspect that teachers and/or principals are propelling the parents with comments like – "There was nothing I could do, the central office told me to increase the number of sections," – the principal, and "I realize we are going slowly. I have to aim my instruction to the middle of the class, and now the middle of the class is lower," – a teacher's comment at the Back to School night.

What do you do?

**Principal**

After leaving this meeting you requested an ethnic breakdown of enrollment in the eighth grade Algebra and Advanced Algebra classes. You discovered a trend similar to that in the report given you at this meeting.

You share the data with your teachers. They reply, "These kids are simply less prepared than the Asian and white kids. We are taking kids as they are, not as we might wish them to be. We can promote more to Algebra next year, but either we will end up failing them or inflating grades for everyone. What do you want from us? We teach over one hundred kids a day. There is simply not enough time to bring these kids up to speed without holding back others."

What do you do?

**Coach**

The teachers in the middle school mathematics department have been reluctant to increase the number of students in Algebra 1. As more students are placed in Algebra 1, a vocal few continue to complain about how they have to water down the curriculum and cannot get through the topics. Their beliefs are reinforced by a couple of high school teachers, who claim that the high school teaches a more rigorous Algebra 1 program. These middle school and high school teachers are arguing for a two-year algebra 1 course sequence. You are worried that the data in this report will be cherry-picked to support their argument against allowing these students to take Algebra 1.

How might you address this issue?

**Parent**

Your daughter was enrolled in Algebra in eighth grade, and struggled through it during the early part of the year, but seemed to gain confidence as the year ended. While her midterm grade was a 'C', her second semester grade was an 'A-'. You didn't give placement much though during the summer, but were pleased when you say that she scored, "proficient" on the CAT. As with most teens, you have to pry information about school from your daughter, so didn't learn until the third week of school that she was again placed in Algebra this year.

You have gone to the new teacher, but she has told you that it is too late to switch classes this semester. The teacher goes on with comments about girls and math and that she thinks your daughter will gain by repeating the course because you she will be covering topics in more depth.

You leave the meeting shaking, but have held your tongue because you fear retaliation on the part of the teacher.

What steps can you take to help your daughter?

What steps can you take to try to see that other kids don't suffer the same fate?