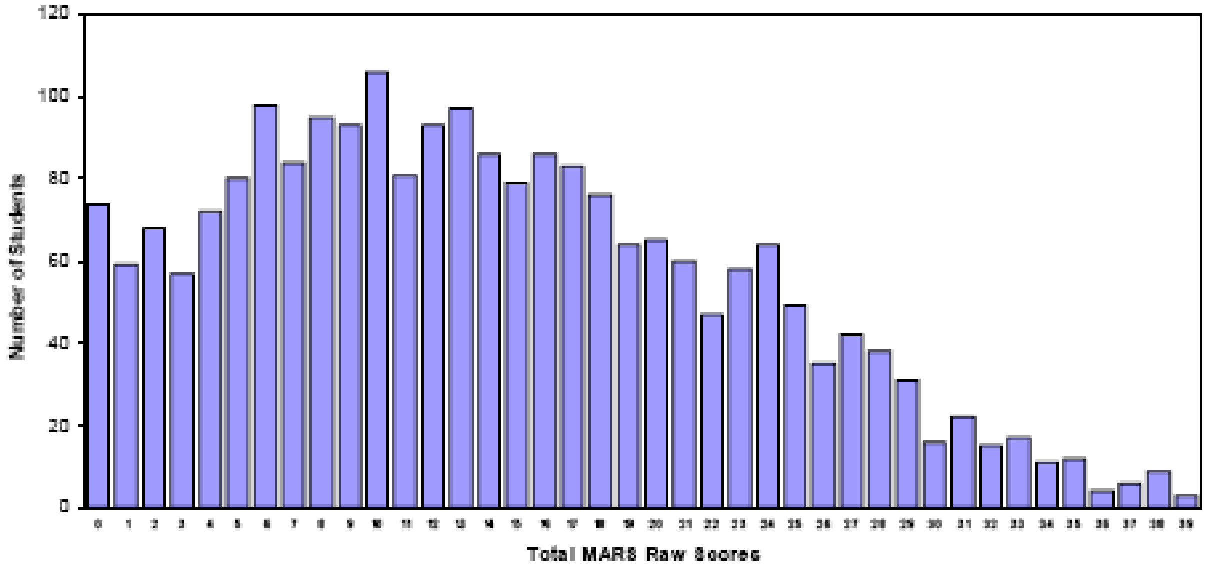
Figure 7: Overall Frequency Distribution by Total MARS Raw Scores, Grade 8

Mean: 14.06 StdDev: 8.80



MARS Test Performance Level Frequency Distribution Table and Bar Graph

2006 - Number of Students tested in 8th grade: 2235

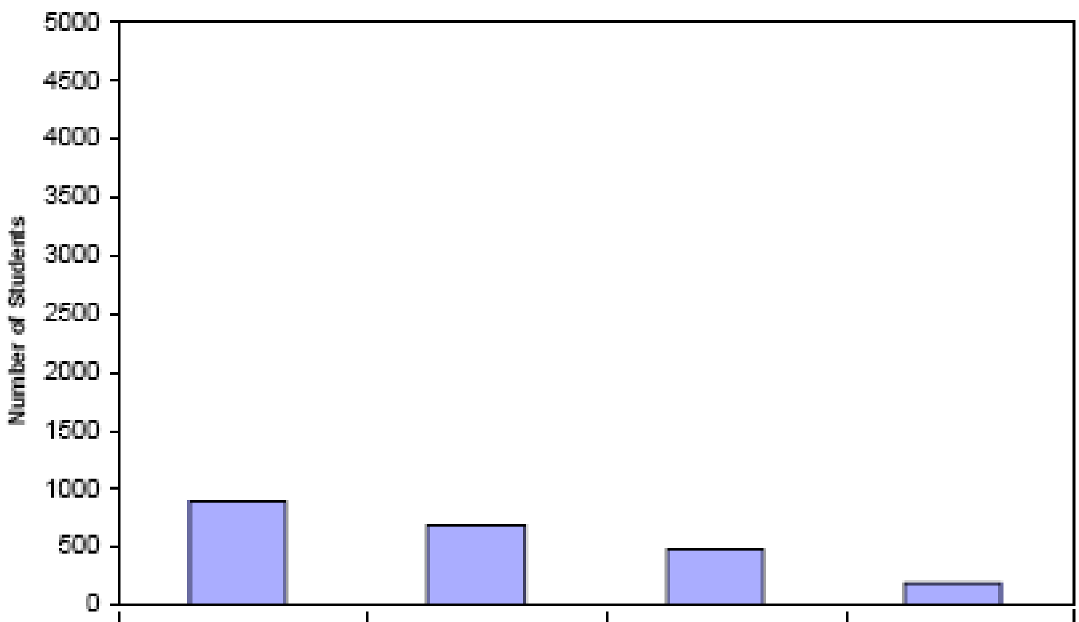
Table 7: Frequency Distribution of MARS Test Performance Levels, Grade 8

	Year of Testing					
	2001		2002		2003	
Perf. Level	% at	% at least	% at	% at least	% at	% at least
1	19%	100%	27%	100%	31%	100%
2	42%	81%	37%	73%	26%	69%
3	31%	39%	23%	36%	19%	43%
4	8%	8%	13%	13%	24%	24%

Table 7 (Cont.): Frequency Distribution of MARS Test Performance Levels, Grade 8

	Year of Testing					
	2004		2005		2006	
Perf. Level	% at	% at least	% at	% at least	% at	% at least
1	27%	100%	48%	100%	40%	100%
2	26%	73%	23%	52%	30%	60%
3	31%	48%	20%	29%	22%	30%
4	17%	17%	9%	9%	8%	8%

Figure 16: Bar Graph of 2006 MARS Test Performance Levels, Grade 8



	1-Minimal Success 0 - 10	2-Below Standard 11 - 18	3-At Standard 19 - 27	4-High Standard 28 - 40
Student Count:	886	681	484	184

MARS Performance Levels

* Total MARS raw scores is the summation of Tasks 1 through 5 on the MARS test.

The following figures show the distribution of raw scores with the median represented as a horizontal bar in the center of the box, the interquartile range (25 percentile to 75 percentile) represented by the box, and the extreme values* within a category lie between the highest and lowest horizontal bars. Groups with Ns of less than 5 students are not reported.

Figure 7.1 Box and whisker plot of Total MARS Raw Scores by Ethnicity

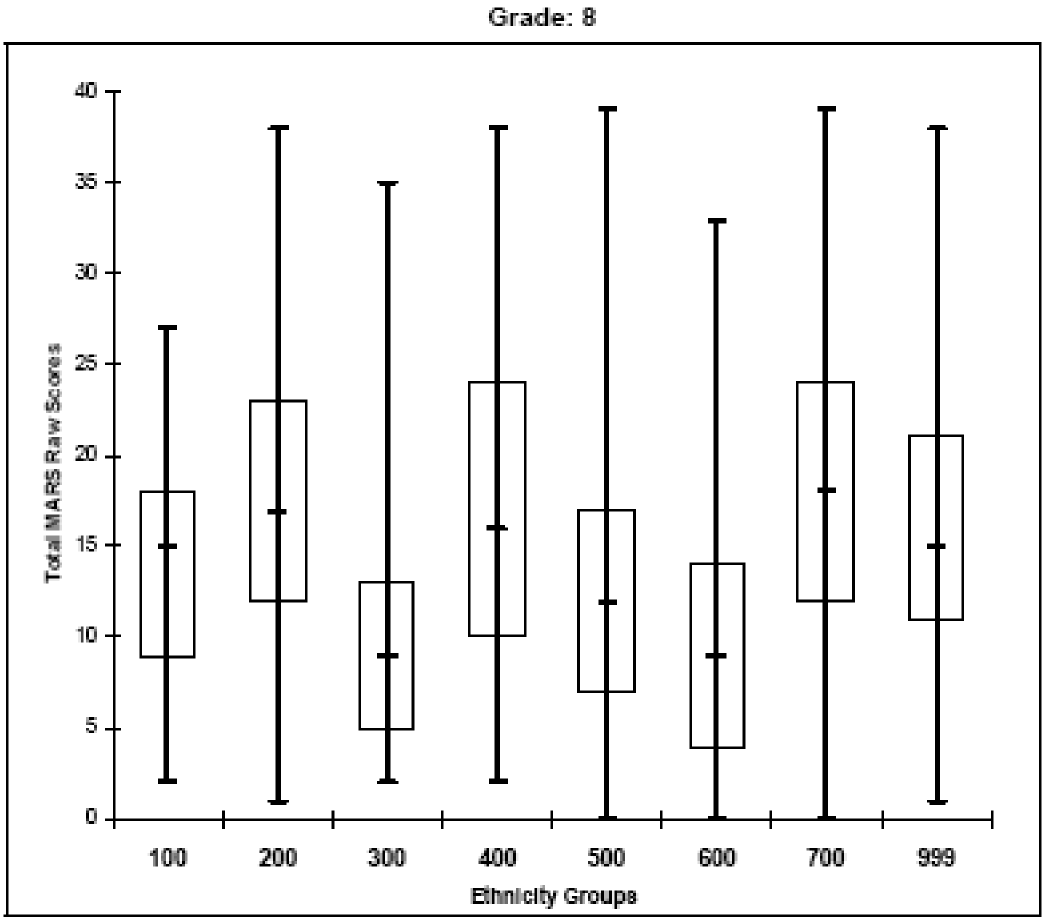


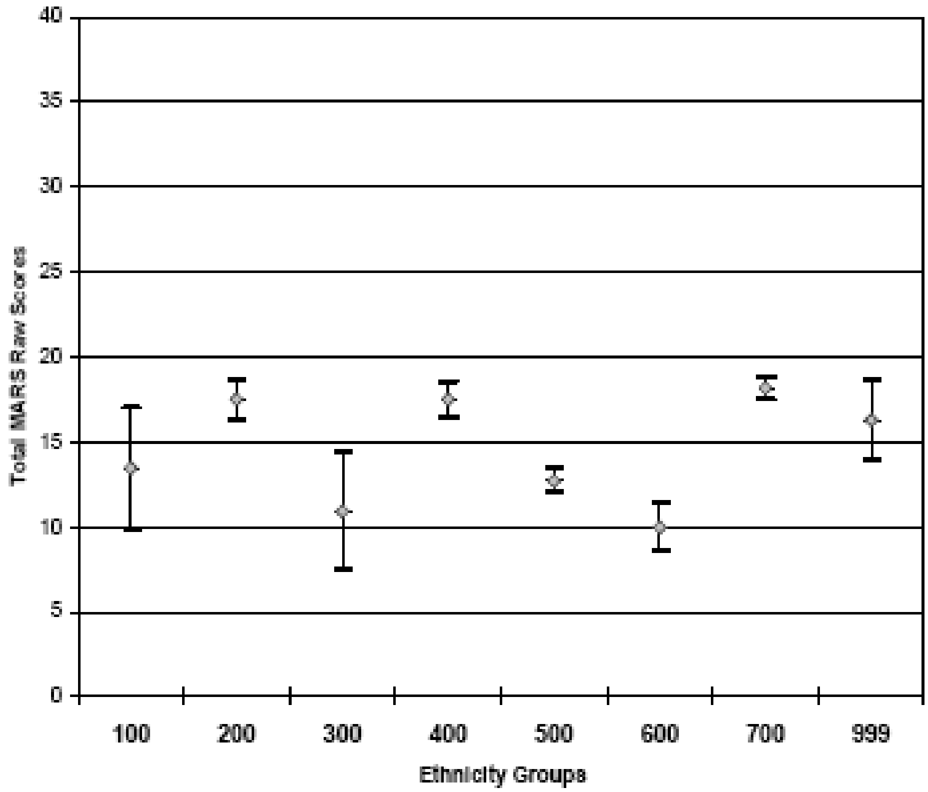
Table 7.1 Student count for Ethnicity

Ethnicity Groups	Ethnicity	Student Count
100	American Indian	13
200	Asian/Asian American	172
300	Pacific Islander	22
400	Filipino	241
500	Hispanic/Latino	485
600	African American	115
700	White (Not Hispanic)	651
999	Decline to state	48

*Extremes are cases with values more than three box lengths from the upper or lower edge of the box.

Figure 16.1 Distribution of sampling means by Ethnicity

Grade: 8



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500	Hispanic/Latino	485
600	African American	115
700	White (Not Hispanic)	651
999	Decline to state	48

Distribution of sampling means
Grade 8
Ethnicity

In this section, test scores are compared across different ethnic groups[1]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

The scores of Asian/Asian American and Whites are significantly higher than the scores of Pacific Islander, Hispanic and African American students.

The scores of Filipino students are significantly higher than those of Pacific Islanders, African Americans and Hispanics.

The scores of Hispanic students are higher than those of African Americans, but lower than the scores of Asian/Asian Americans, Filipinos, and Whites. The scores of African Americans are lower than all other groups except Indian/Alaskan Natives and Pacific Islanders (not significant differences).

[1] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Figure 7.2 Box and whisker plot of Total MARS Raw Scores by Home Language

Grade: 8

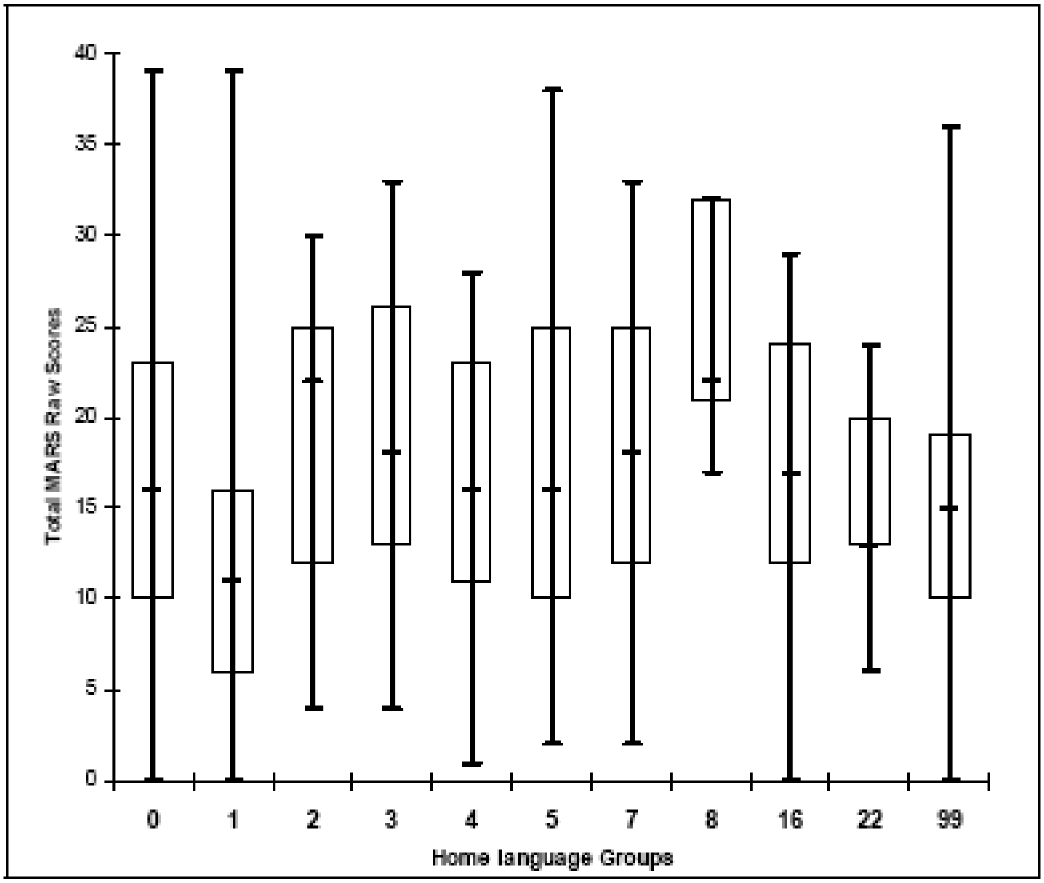
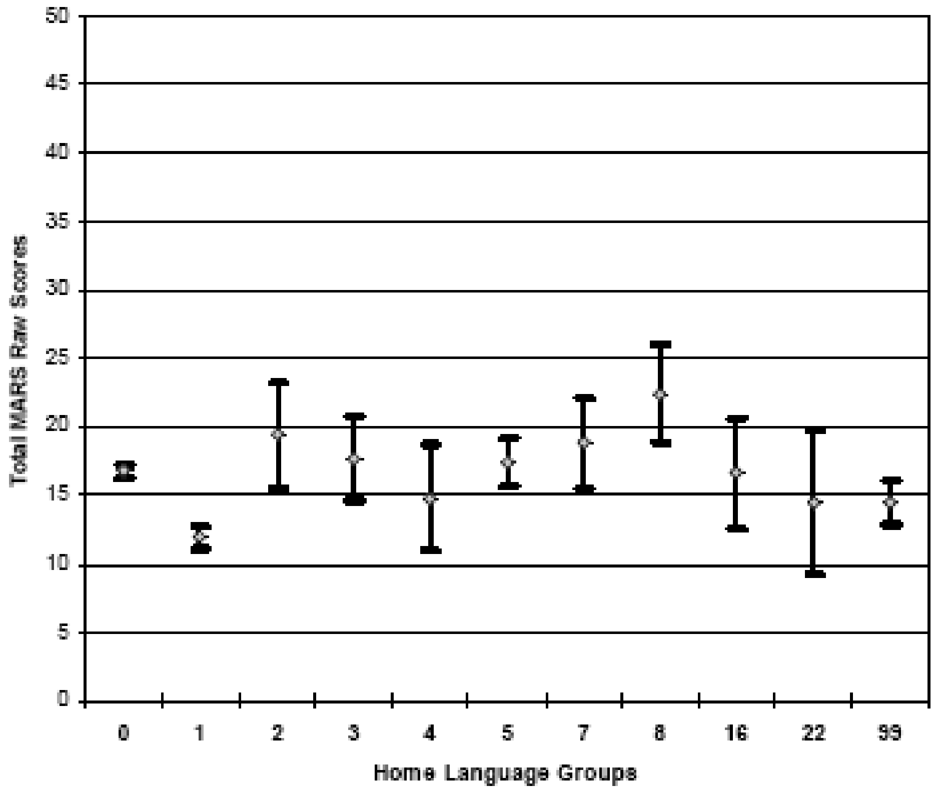


Table 7.2 Student count for Home Language

Home Language Group	Home Language	Student Count
0	English	1092
1	Spanish	342
2	Vietnamese	16
3	Cantonese	29
4	Korean	15
5	Filipino	105
7	Mandarin	26
8	Japanese	7
16	Farsi	16
22	Hindi	6
99	Others/Unknown	85

Figure 16.2 Distribution of sampling means by Home Language

Grade: 8



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2	Vietnamese	16
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4	Korean	15
5	Filipino	105
7	Mandarin	26
8	Japanese	7
16	Farsi	16
22	Hindi	6
99	Others/Unknown	85

Distribution of sampling means
Grade 8
Home Language

In this section, test scores are compared across groups of students who speak different languages at home[2]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

The score means by home language group for Grade 8 show relatively few significant differences. Students who speak Spanish at home had lower scores than all other groups except Farsi and Korean (not statistically different). Students who speak Korean or Farsi at home show no significant differences in score means with any other home language groups.

[2] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Figure 7.3 Box and whisker plot of Total MARS Raw Scores by Parent Education

Grade: 8

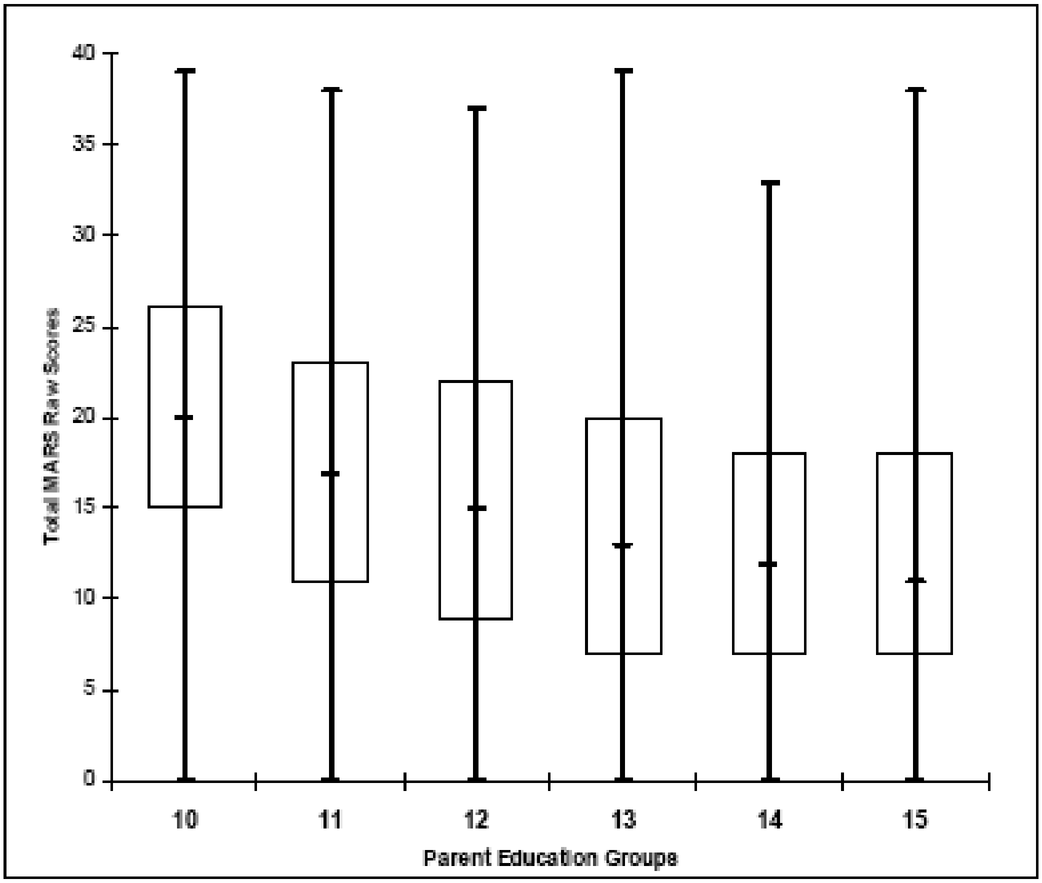
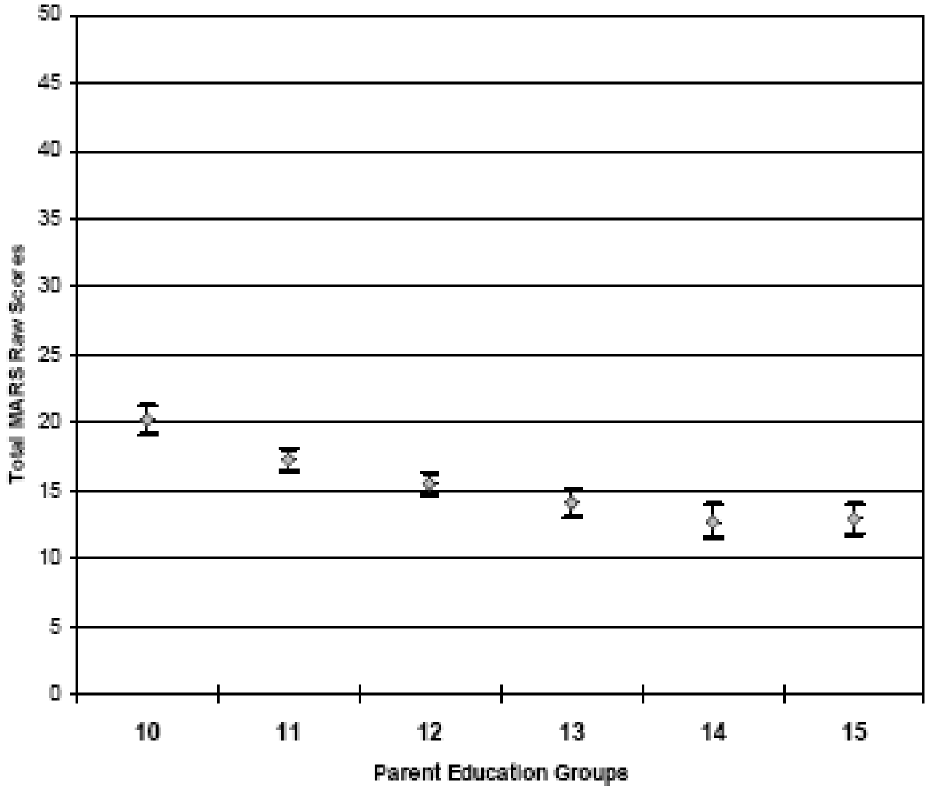


Table 7.3 Student count for Parent Education

Parent Education Group	Parent Education	Student Count
10	Graduate School	226
11	College graduate	446
12	Some college	399
13	High School graduate	335
14	Not a high school graduate	153
15	Others/Unknown	188

Figure 16.3 Distribution of sampling means by Parent Education

Grade: 8



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Parent Education Group	Parent Education	Student Count
10	Graduate School	226
11	College graduate	446
12	Some college	399
13	High School graduate	335
14	Not a high school graduate	153
15	Others/Unknown	188

Distribution of sampling means
Grade 8
Parent Education

In this section, test scores are compared across groups of students with different levels of parent education[3]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

The score means for groups whose parents had different levels of education fall as expected, with students whose parents have higher levels of education having statistically higher mean scores than students whose parents have lower levels of education. The scores of students whose parents have a graduate school education are higher than all other groups, followed by students whose parents are college graduates. The scores of students whose parents have some college education are higher than the scores of students whose parents are not high school graduates. The scores of students whose parents are or are not high school graduates are not statistically different from one another.

[3] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Figure 7.4 Box and whisker plot of Total MARS Raw Scores by Gender

Grade: 8

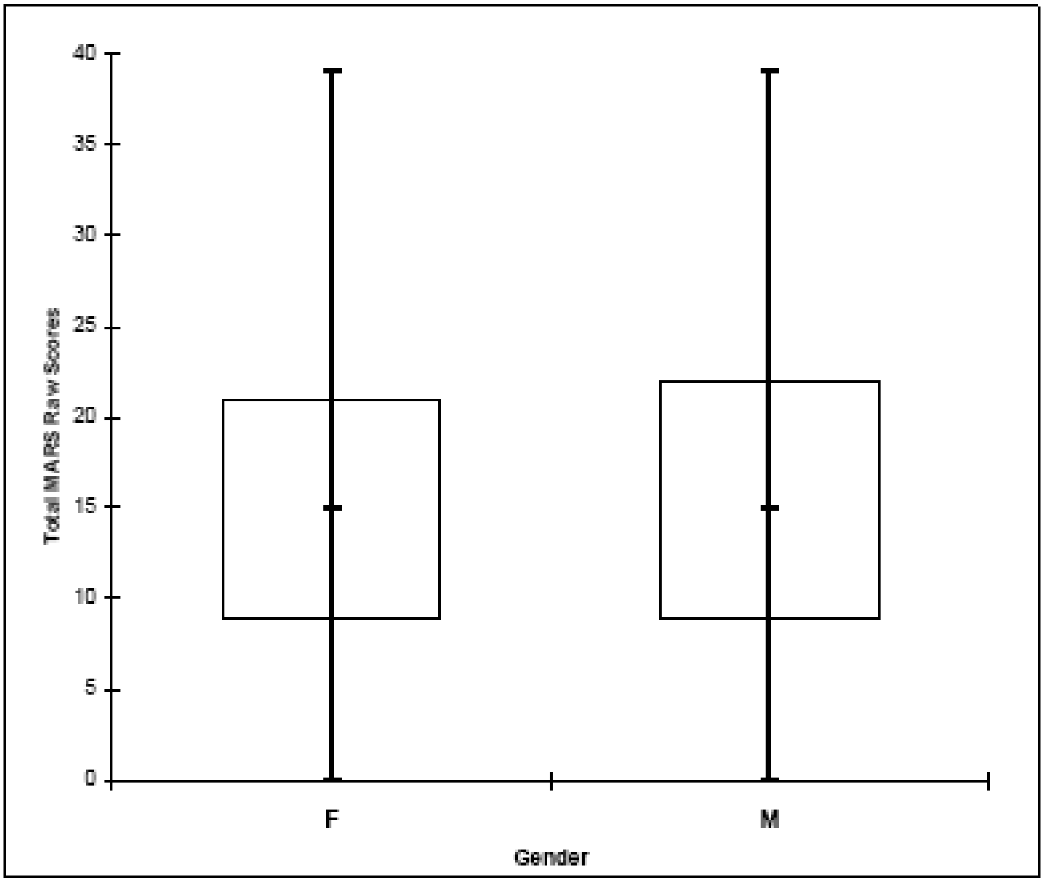


Table 7.4 Student count for Gender

Gender	Student Count
Female	832
Male	915

Figure 16.4 Distribution of sampling means by Gender

Grade: 8

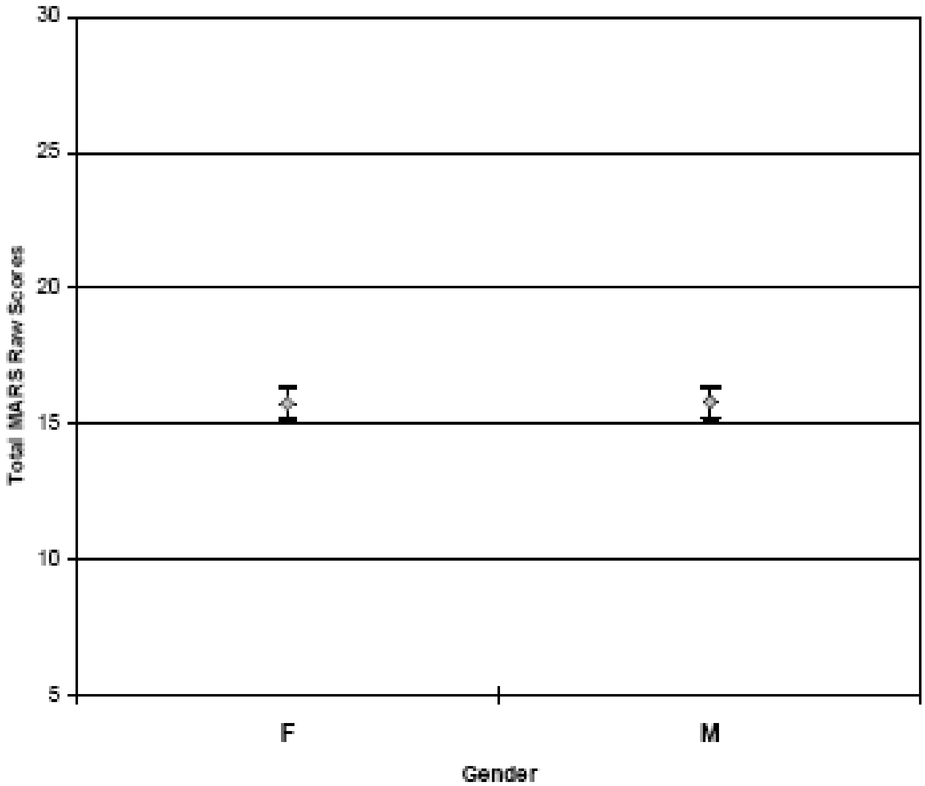


Table 16.4 Student count for Gender

Gender	Student Count
Female	832
Male	915

Distribution of sampling means
Grade 8
Gender

In this section, test scores are compared across genders[4]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

The difference in mean scores for males and females is not statistically significant.

[4] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Figure 7.5 Box and whisker plot of Total MARS Raw Scores by Language Fluency

Grade: 8

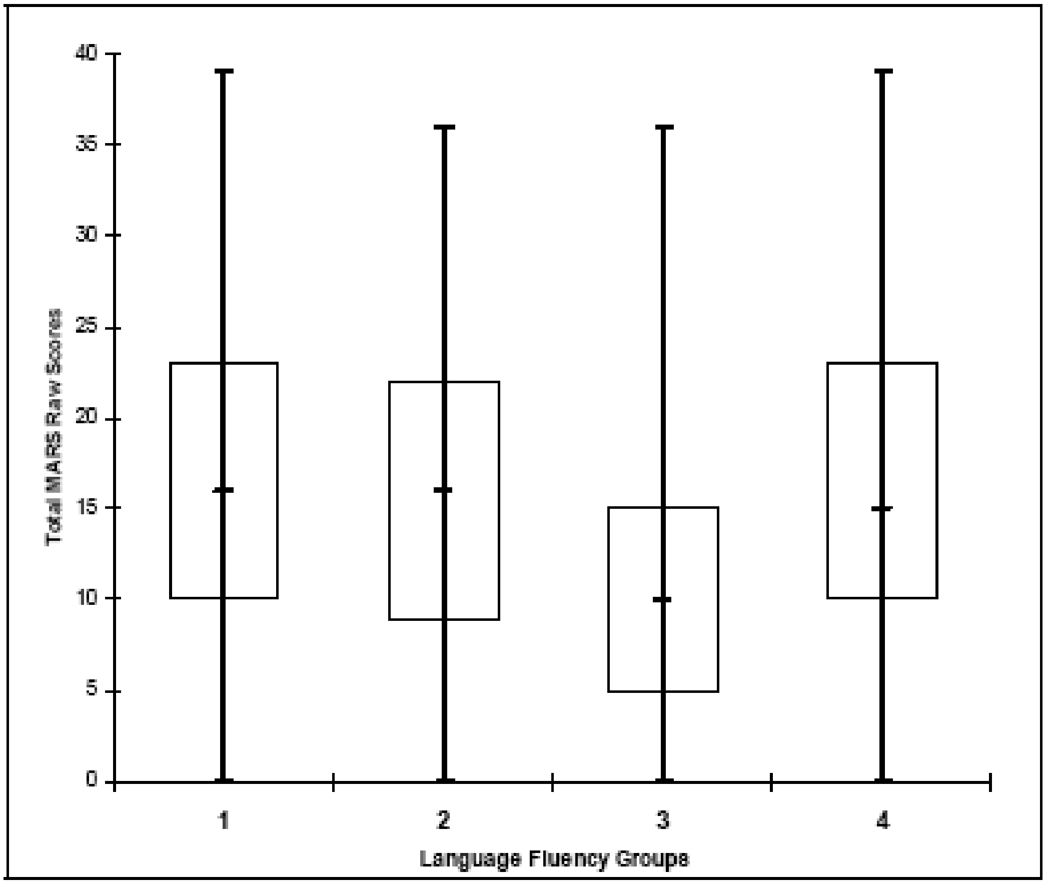


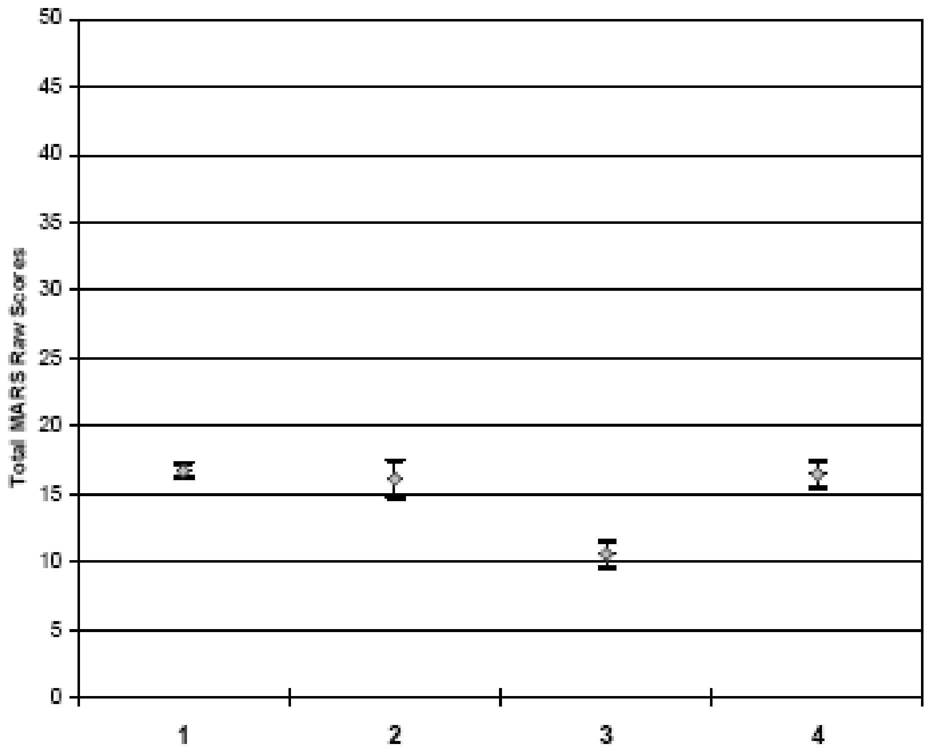
Table 7.5 Student count for Language Fluency

Language Fluency Group	Language Fluency	Student Count
1	English only	1092
2	Initially Fluent (I-FEP)	122
3	English Learner	246
4	ReDesignated (R_FEP)	285

Figure 16.5 Distribution of sampling means by Language Fluency

Grade: 8

Language Fluency



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Language Fluency Group	Language Fluency	Student Count
1	English only	1092
2	Initially Fluent (I-FEP)	122
3	English Learner	246
4	ReDesignated (R_FEP)	285

Distribution of sampling means
Grade 8
Language Fluency

In this section, test scores are compared across different English language proficiency groups[5]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

The scores of English learners are significantly lower than all other English language proficiency groups. There are no other significant differences between/among language proficiency groups.

[5] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Student Task	Draw reflections and rotations of a given figure on a grid. Describe transformations needed to make a given pattern.
Core Idea 4 Geometry & Measurement	**Apply transformations and use symmetry to analyze mathematical situations.** • Describe sizes, positions, and orientations of shapes under informal transformations such as flips, turns, slides, and scaling.

Based on teacher observation, this is what eighth graders knew and were able to do:

- Reflect shapes over the vertical axis and slightly less often over the horizontal axis
- Describe a reflection

Areas of difficulty for eighth graders:

- Rotations
- Describing direction and distance for slides or translations
- Maintaining shape and size or scale when making their drawings

Implications for Instruction

Students at this grade level need frequent exposure to activities that develop their spatial reasoning and ability to distinguish geometric shapes, properties of shapes, and to develop their reasoning and generalizing skills between properties of shapes. Research suggests that everyone develops through levels of understanding (van Hiele levels) based not on maturity, but on experiences. Research further suggests that the ability to make formal and informal deductions, such as that required in a high school geometry class, without first moving through these lower levels. More than half the students entering a geometry class may still be operating at a level 0 (visualization) or 1(analysis). Students need opportunities to sort and categorize shapes by their properties. For middle school working with a software program, like Geometer's Sketchpad, can be useful for exploring examples of classes of shapes and can further help students start to build and test conjectures.

Students need more work with drawing rotations, slides, and reflections. Students need to be able to describe the line of reflection or the distance of a slide or other transformation. By making their own drawings and transformations, students learn about the importance of scale and start to see more of the detail in the shapes or designs. Students need more opportunity to work with transformations on a coordinate grid. In a world dominated by special effects in movies, video cell phones, graphic design, missile technology, hdtv, sending images on computers, defense systems, as well as traditional work of engineers, architects, carpenters, it is more important than ever for students to have the visualization skills to function in today's world. Working with geometry can be very enjoyable for students and give some students a chance to shine, who may have not be so successful in other areas of mathematics. For most students these types of activities and learning experiences are very motivating. Their success can transfer to a positive attitude when they then attempt other activities in the classroom. There are a number of great resources for working with transformations: John Van de Walle – Teaching Student-Centered Mathematics, Connected Mathematics, and Mathematics in Context. Developing spatial skills is directly related to opportunity to learn.

MARS Test Task 1 Frequency Distribution and Bar Graph, Grade 8

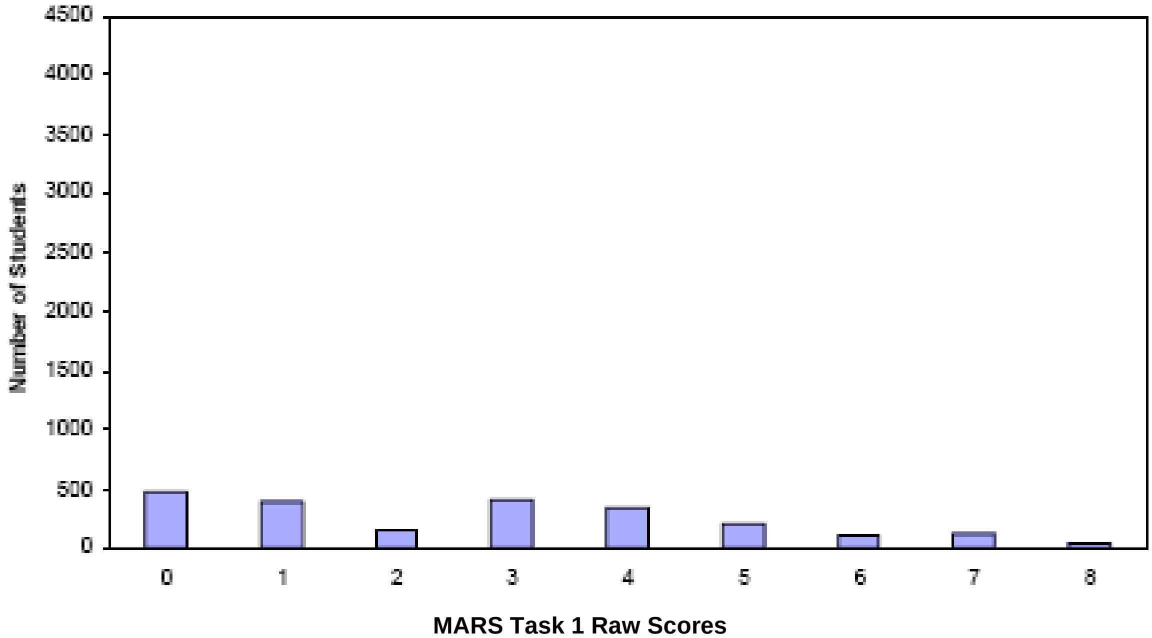
Task 1 – Aaron's Design's

Mean: 2.69 StdDev: 2.18

Table 40: Frequency Distribution of MARS Test Task 1, Grade 8

Task 1 Scores	Student Count	% at or below	% at or above
0	480	21.5%	100.0%
1	388	38.8%	78.5%
2	160	46.0%	61.2%
3	413	64.5%	54.0%
4	337	79.6%	35.5%
5	204	88.7%	20.4%
6	106	93.4%	11.3%
7	111	98.4%	6.6%
8	36	100.0%	1.6%

Figure 49: Bar Graph of MARS Test Task 1 Raw Scores, Grade 8



The maximum score available for this task is 8 points.
The minimum score for a level 3 response, meeting standards, is 5 points.

Many students, about 78%, could reflect a design across a vertical axis while maintaining the scale and shape of the original design. More than half the students, 54%, could accurately reflect a design across both a vertical and a horizontal axis. A few students, about 20%, could do reflections and also describe how a design had been reflected as well as give a direction for a slide or translation. Less than 2% of the students could meet all the demands of the task, including reflecting and rotating shapes, describing reflections and translations with direction and quantity for the moves. Almost 22% of the students scored no points on this task. 80% of the students with this score attempted the task.

Student Task	Work with perimeter and circumference of squares and circles. Use and interpret line graphs and their equations.
Core Idea 3 Algebra and Functions	**Understand relations and functions, analyze mathematical situations, and use models to solve problems involving quantity and change.** • Identify functions as linear or nonlinear, and contrast their properties from tables, graphs, or equations. • Explore relationships between symbolic expressions and graphs of lines, paying particular attention to the meaning of intercept and slope.

Based on teacher observation, this is what eighth graders knew and were able to do:

- Find perimeter of a square given the side length
- Graph the points
- Find the side length of a square given the perimeter

Areas of difficulty for eighth graders:

- Understanding slope or rate of change
- Connecting the origin to the context of the perimeter
- Using mathematical vocabulary to describe patterns or trends
- Understanding the "continuousness" of a line
- Explaining why a line is straight
- Comparing and contrasting linear functions, picking mathematically significant details of the graphs

Implications for Instruction

Students need frequent opportunities to relate equations to a familiar context, so that they can make conclusions about how the graph, equation, and context fit together. They need to think about what in the context causes the graph to go through the origin. Why does that make sense? When do graphs not go through (0,0)? What about the situation causes some other y-intercept to make sense?

Students need to have opportunities to compare and contrast graphs of different functions. Through rich classroom discussion they develop insights into the important features of graphs and why they are relevant. They should be comfortable with important properties of graphs: positive or negative slope, degree of steepness or rate of change, and y-intercept.

Some students had difficulty identifying the graph showing the relationship between the side length and perimeter of a square. They could usually state that the value was increasing by 4's. However many students saw this is additive, $y= x + 4$, rather than multiplicative, $y = 4x$. They do not see the relationship between "equal groups" and multiplication. Some students had difficulty graphing decimal values. Others had difficulty thinking about how rounding might have effected the values in the table for circumference. Students need to work with a variety of functions, which should include those where numbers are not always whole numbers and where rounding might be helpful to develop a more robust understanding of rounding and growth rates.

MARS Test Task 2 Frequency Distribution and Bar Graph, Grade 8

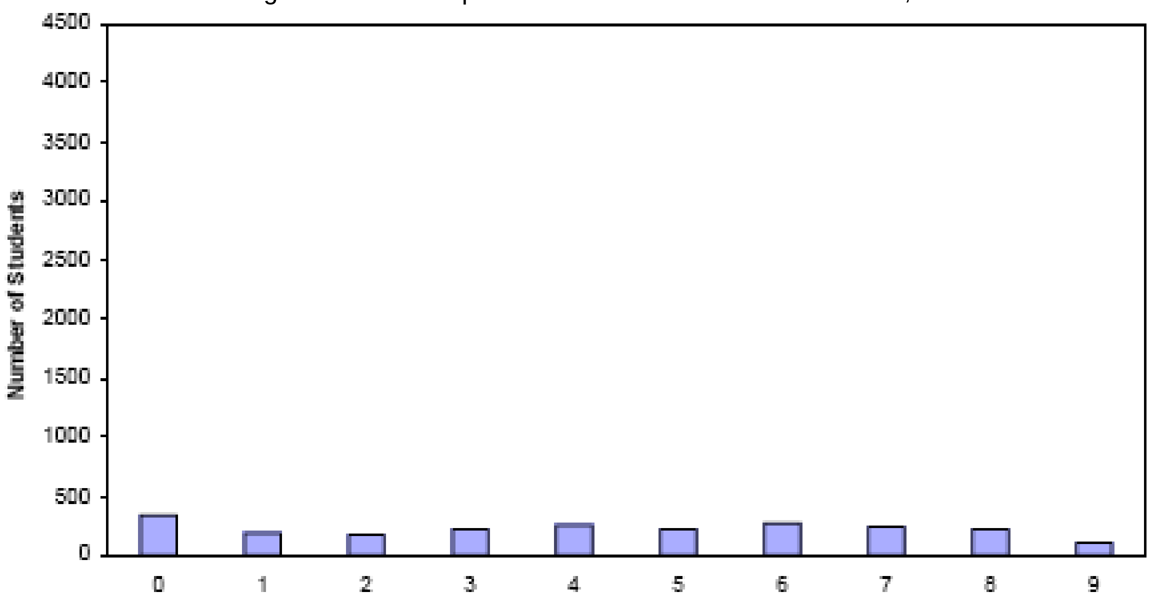
Task 2 – Squares and Circles

Mean: 4.21 StdDev: 2.82

Table 41: Frequency Distribution of MARS Test Task 2, Grade 8

Task 2 Scores	Student Count	% at or below	% at or above
0	332	14.9%	100.0%
1	191	23.4%	85.1%
2	175	31.2%	76.6%
3	221	41.1%	68.8%
4	248	52.2%	58.9%
5	219	62.0%	47.8%
6	271	74.1%	38.0%
7	241	84.9%	25.9%
8	227	95.1%	15.1%
9	110	100.0%	4.9%

Figure 50: Bar Graph of MARS Test Task 2 Raw Scores, Grade 8



The maximum score available on this task is 9 points.
The minimum score for a level 3 response, meeting standards, is 4 points.

Many students, 76%, were able to calculate the perimeter for a square with a side of 5”, plot the point, and draw a line through all the points on the graph. More than half the students, 59%, were able to find the perimeter, graph point one, connect the line, choose the equation for the square, and either find the side length or state what was the same between the square and circle graphs. About 1/4 of the students could find the perimeter and side length, draw the lines for squares and circles, explain why the line for squares was the same as circles, choose an equation to represent the squares, and state something that was the same about the square and circle graphs. About 5% of the students could meet all the demands of the task, including explaining why the graphs for squares went through the origin and finding a significant feature that was different between the square and circle graph. 15% of the students scored no points on this task. 90% of them attempted the task.

Student Task	Understand and interpret statistical graphs and diagrams showing real data. Compare and contrast data sets.
Core Idea 5 Data Analysis	**Collect, organize, analyze, and display relevant data.** • Select, create, and use appropriate graphical representations of data, including box plots and scatterplots. • Find, use, and interpret measures of center and spread, including interquartile range. • Discuss and understand the correspondence between data sets and their graphical representations, especially box plots and scatterplots.

Based on teacher observation, this is what eighth graders knew and were able to do:
- Identify similarities and differences
- Match the box and whisker plots to the appropriate states

Areas of difficulty for eighth graders:
- Understanding the distance between upper and lower quartiles as a range of values represented by the in the box plot
- Understanding that the line in the box represents median instead of average
- Reading the key incorrectly and therefore confusing Washington and California
- Quantifying their reasons for choosing the box and whisker plots
- Giving enough detail to eliminate other options

Implications for Instruction

Students need exposure to a variety of graphs, including line graphs and box and whisker diagrams. Students, to be literate in reading and interpreting graphs, should be able to compare and contrast key statistical features of a graph, such as range, highest and lowest, slope, direction of slope. Students should understand that the box and whisker diagram divides the data into four equal-size groups to help the reader understand the distribution of the data points. They should also understand the line dividing the box represents the median of the data.

Students need to work with data in context to think about why it might be important to see or think about the distribution of data. For example, students might look at test scores, ages of people attending a movie, temperatures for a vacation destination and then discuss what different box and whisker plots for those choices might represent. The purpose and nuances of box and whisker plots only becomes clear within a situation. It is also important for students to think about box and whisker plots with the idea of large amounts of data. There is not so much purpose in understanding distribution for a small number of data points, which can easily be sorted by a cursory glance. During discussions, it might be important to ask why might this be useful? How might it help in making decisions? Students need to connect making, reading, and interpreting graphs with conveying information and answering questions or making decisions.

MARS Test Task 3 Frequency Distribution and Bar Graph, Grade 8

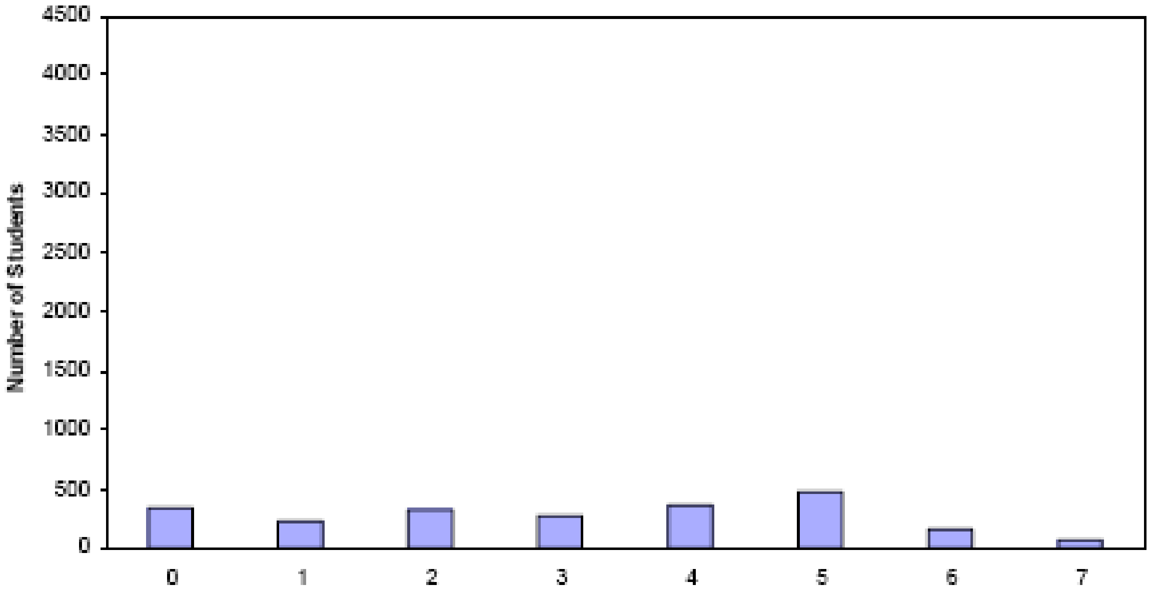
Task 3 – Temperatures

Mean: 3.14 StdDev: 2.02

Table 42: Frequency Distribution of MARS Test Task 3, Grade 8

Task 3 Scores	Student Count	% at or below	% at or above
0	342	15.3%	100.0%
1	218	25.1%	84.7%
2	323	39.5%	74.9%
3	273	51.7%	60.5%
4	363	68.0%	48.3%
5	482	89.5%	32.0%
6	161	96.7%	10.5%
7	73	100.0%	3.3%

Figure 51: Bar Graph of MARS Test Task 3 Raw Scores, Grade 8



The maximum score available for this task is 7 points.
The minimum score for a level 3 response, meeting standards, is 5 points.

Most students, 85%, could identify one similarity or difference between the temperature graphs for California and Washington. Many students could describe both a similarity and a difference between the two graphs. Less than half the students, 32%, could write a similarity and difference, choose the appropriate box plot to represent Washington and quantify the reason for their choice, and choose the box plot for California. Less than 5% of the students could pick the months where the temperatures fell between the upper and lower quartiles and explain how they knew. 15% of the students scored no points on this task. 63% of the students with this score attempted the task.

8th Grade **Task 4** **25% Sale**

Student Task	Work with percentage increase and decrease in the context of a sale. Develop a mathematical argument on the effects of decreasing price by 25% four times.
Core Idea 1 Number and Operation	• Work flexibly with fractions, decimals, and percents to solve problems.
Core Idea 2 Mathematical Reasoning	• Formulate conjectures and test them for validity • Verify and interpret results of a problem

Based on teacher observation, this is what eighth graders knew and were able to do:

- Find the 25% discount
- Find the sale price
- Reason about how successive reductions were based on the new price

Areas of difficulty for eighth graders:

- Calculating multiple reductions
- Organizing work
- Computing in multiplication, division, and subtraction accurately
- Understanding the difference between *percentage saved* and *percentage of original cost*

Strategies used by successful students:

- Using proportions
- Converting percents to decimals and multiplying
- Using benchmark percents
- Labeling work

Implications for Instruction

Students at this grade level should have a variety of strategies for finding percents. Some benchmark percents, like 50%, 25%, 33 1/3%, or 20%, should be readily convertible to fraction and decimal equivalents. At this grade level, students should be able to take simple percentages as mental math problems and easily be able to solve them in math talks. Consider a problem like 65% of 84. Students might be able to think that 10% is 8.4. So 60% is 48 + 2.4 = 50.4. Then 5% would be 4.2. Therefore the final answer would be 54.6. Students might also think that 1/4 or 25% of 84 would be 21. So, 75% would be 63. If 10% is 8.4, then 65% would be 63 – 8 = 55 and 55 – 0.4 = 54.6. Frequent experiences with these types problems helps students to build a sense of percents and a basic idea about relative size. This is a way to build a good understanding of the concept before reaching for more efficient strategies. Combining number talks with models such as the double bar model or double line model help students to see percents as a measuring or dividing up of a quantity and gives them a tool for thinking about the action of a problem.

MARS Test Task 4 Frequency Distribution and Bar Graph, Grade 8

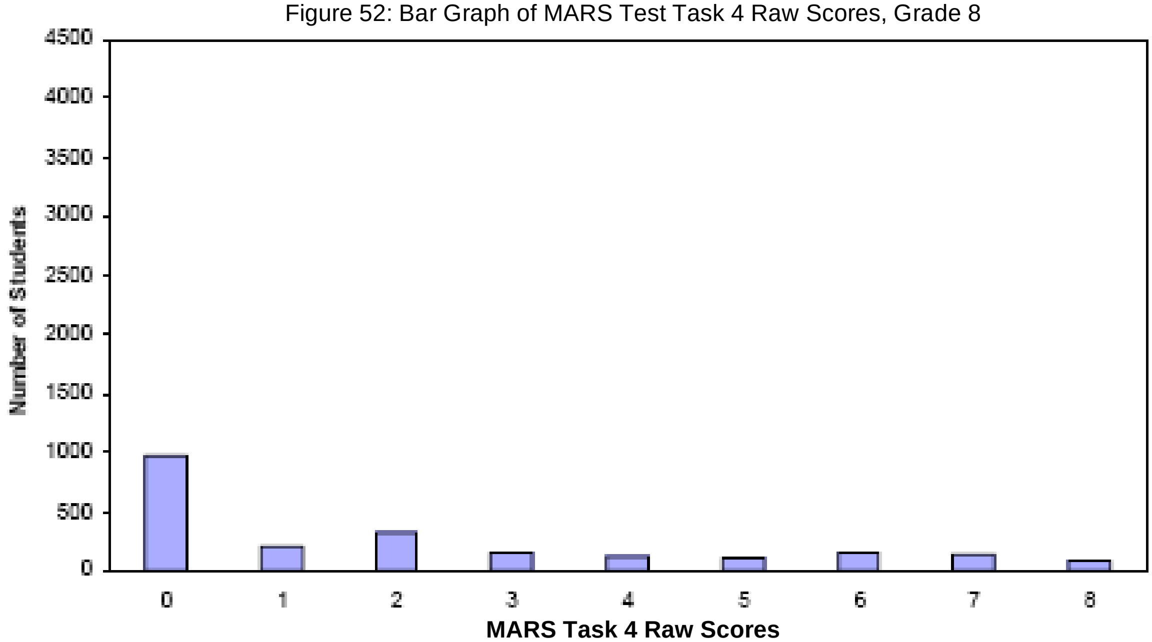
Task 4 – 25% Sale

Mean: 2.16 StdDev: 2.56

Table 43: Frequency Distribution of MARS Test Task 4, Grade 8

Task 4 Scores	Student Count	% at or below	% at or above
0	972	43.5%	100.0%
1	202	52.5%	56.5%
2	321	66.9%	47.5%
3	153	73.7%	33.1%
4	115	78.9%	26.3%
5	94	83.1%	21.1%
6	148	89.7%	16.9%
7	140	96.0%	10.3%
8	90	100.0%	4.0%

Figure 52: Bar Graph of MARS Test Task 4 Raw Scores, Grade 8



The maximum score available for this task is 8 points.
The minimum score for a level 3 response, meeting standards, is 4 points.

More than half the students, 56%, could discuss why taking 25% off 4 times did not give a price of "free". A little less than half the students, 47%, could find the discount in part one and use that to calculate the sale price. Some students, 26%, could find the sale price, talk about 25% as being on a new price for each reduction, and calculate the first 3 reductions. 17% of the students could find the new price after all 4 reductions. 4% of the students could meet all the demands of the task, including finding the percentage saved after the reductions. Almost 44% of the students scored no points on this task. 80% of the students with this score attempted the task.

Student Task	Interpret and complete a distance/time graph for a described situation. Work with rates in the context of slope.
Core Idea 3 Algebra and Functions	**Use models to solve problems involving quantity and change.** • Identify and describe situations with constant or varying rates of change and compare them. • Use proportional reasoning
Core Idea 2 Mathematical Reasoning	**Employ forms of mathematical reasoning and justification appropriately to the solution of a problem.**

Based on teacher observation, this is what eighth graders knew and were able to do:
- Recognize and graph a stop or rest break on a time/distance graph
- Interpret slope as faster or slower

Areas of difficulty for eighth graders:
- Using a graph to calculate slope or speed
- Combining units of time
- Interpreting scale on a graph
- Working from mph to time for a journey

Implications for Instruction

Students should be able to determine rates from looking at time/distance graphs by using division or extending lines to make unit rates. Students should be ale to think about the relationship between the steepness of the slope and the speed of travel. Common misconceptions include thinking that a flat or horizontal line represents a constant speed rather than a speed of zero or that the horizontal line represents the action "going in a straight line". Students also confuse steepness of the graph with going up a hill. Students had difficulty with the distance scale, confusing it with how you would read a bar graph; so each intersection on the graph equals a new distance traveled. Students also confused the distance scale with speed. Students need opportunities to make their own graphs to help them reason about the logic of a graph. A good exercise is to give them a story and have them graph the action of the story. It is important to give them situations where the look on the graph will be different from the action of a story. For example the distance traveled on a roller coaster or ferris wheel will not go up or down like the movement of the ride, but will continue to increase with changes in slope.

MARS Test Task 5 Frequency Distribution and Bar Graph, Grade 8

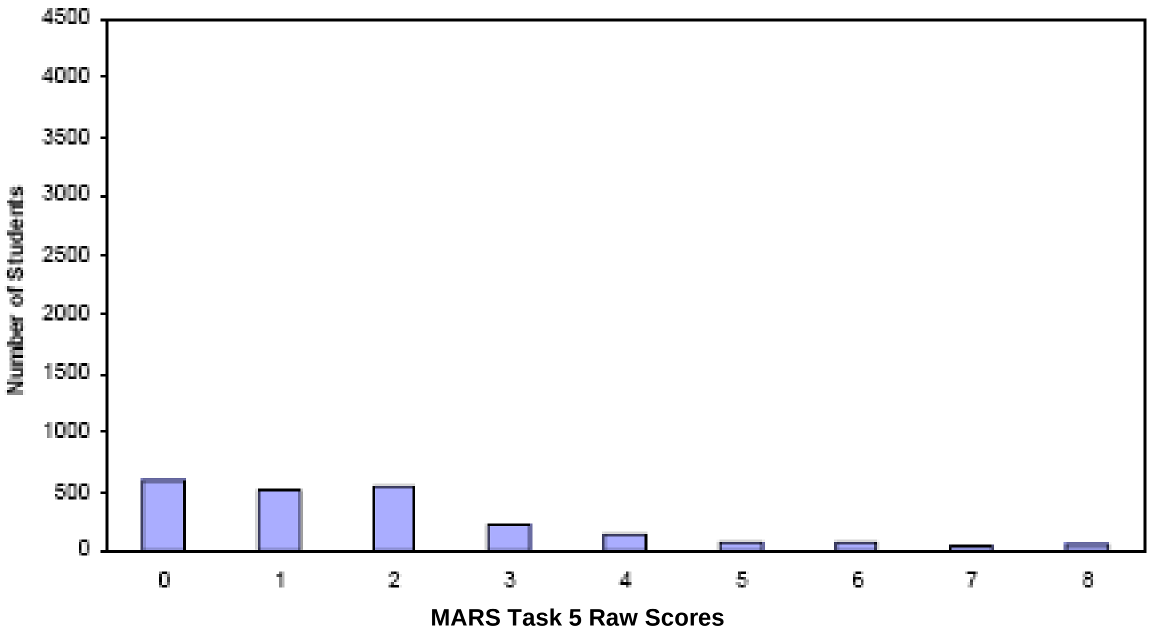
Task 5 – Going to Town

Mean: 1.86 StdDev: 1.85

Table 44: Frequency Distribution of MARS Test Task 5, Grade 8

Task 5 Scores	Student Count	% at or below	% at or above
0	598	26.7%	100.0%
1	516	49.8%	73.3%
2	545	74.1%	50.2%
3	221	84.0%	25.9%
4	142	90.4%	16.0%
5	75	93.7%	9.6%
6	71	96.9%	6.3%
7	26	98.1%	3.1%
8	43	100.0%	1.9%

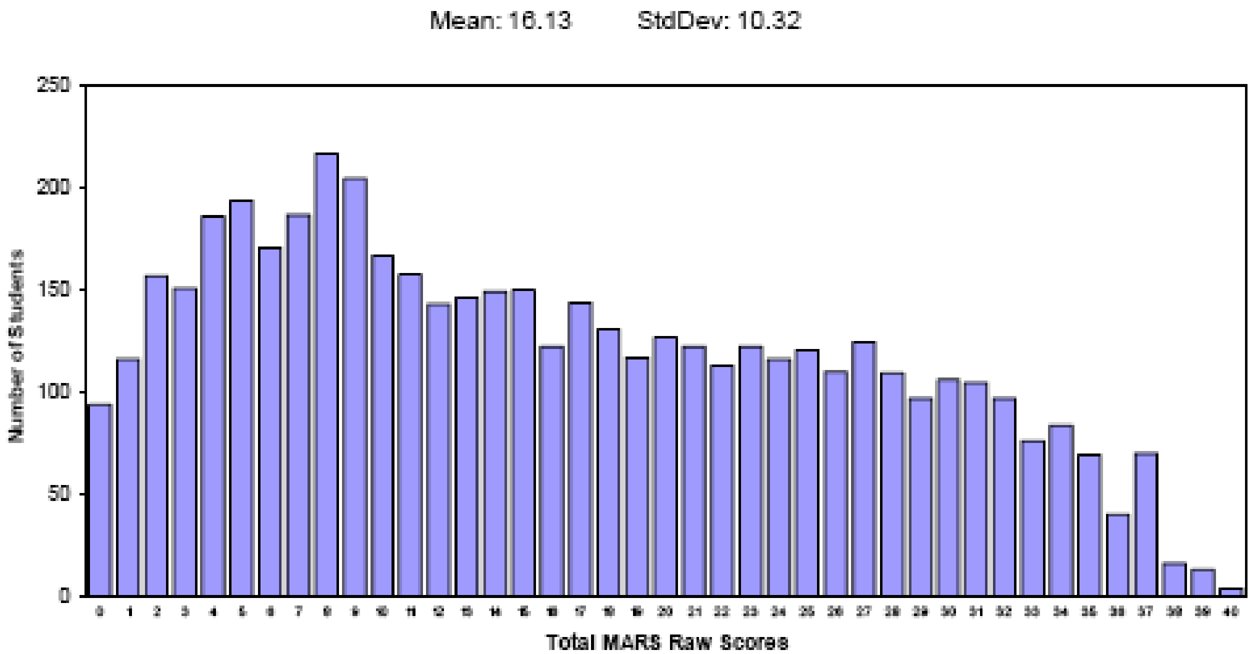
Figure 53: Bar Graph of MARS Test Task 5 Raw Scores, Grade 8



The maximum score available on this task is 8 points.
The minimum score for a level 3 response, meeting standards, is 3 points.

Many students, 73%, could reason about the slope and increased speed in part three of the task. Half the students could reason about a horizontal line on a time/distance graph as a stop or rest and about the relationship between slope and speed. Only 1/4 of the students could also graph a stop of 1 hour on the graph. Less than 20% of the students could calculate the speed for part one. Only 2% of the students met all the demands of the task, including calculating speed and using speed to calculate time, graphing information about time and distance, and reasoning about slope in relationship to the context. Almost 27% of the students scored no points on this task. 50% of the students with this score attempted the task.

Figure 8: Overall Frequency Distribution by Total MARS Raw Scores, Course 1



* Total MARS raw scores is the summation of Tasks 1 through 5 on the MARS test.

MARS Test Performance Level Frequency Distribution Table and Bar Graph

2006 - Number of Students tested in Course 1: 4947

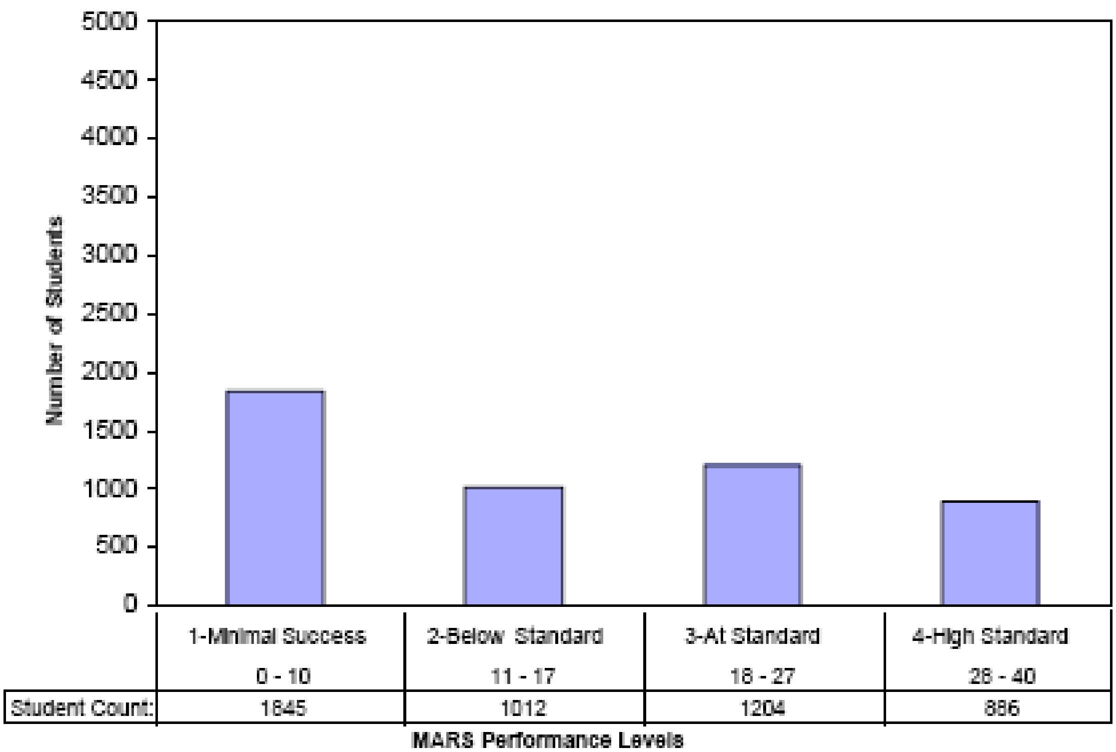
Table 8: Frequency Distribution of MARS Test Performance Levels, Course 1

	Year of Testing					
	2001		2002		2003	
Perf. Level	% at	% at least	% at	% at least	% at	% at least
1	22%	100%	18%	100%	66%	100%
2	62%	78%	61%	82%	29%	34%
3	15%	16%	20%	22%	5%	6%
4	1%	1%	2%	2%	1%	1%

Table 8 (Cont.): Frequency Distribution of MARS Test Performance Levels, Course 1

	Year of Testing					
	2004		2005		2006	
Perf. Level	% at	% at least	% at	% at least	% at	% at least
1	39%	100%	20%	100%	37%	100%
2	39%	61%	21%	80%	20%	63%
3	19%	23%	29%	59%	24%	42%
4	3%	3%	29%	29%	18%	18%

Figure 17: Bar Graph of 2006 MARS Test Performance Levels, Course 1



* Total MARS raw scores is the summation of Tasks 1 through 5 on the MARS test.

The following figures show the distribution of raw scores with the median represented as a horizontal bar in the center of the box, the interquartile range (25 percentile to 75 percentile) represented by the box, and the extreme values* within a category lie between the highest and lowest horizontal bars. Groups with Ns of less than 5 students are not reported.

Figure 8.1 Box and whisker plot of Total MARS Raw Scores by Ethnicity

Course: 1

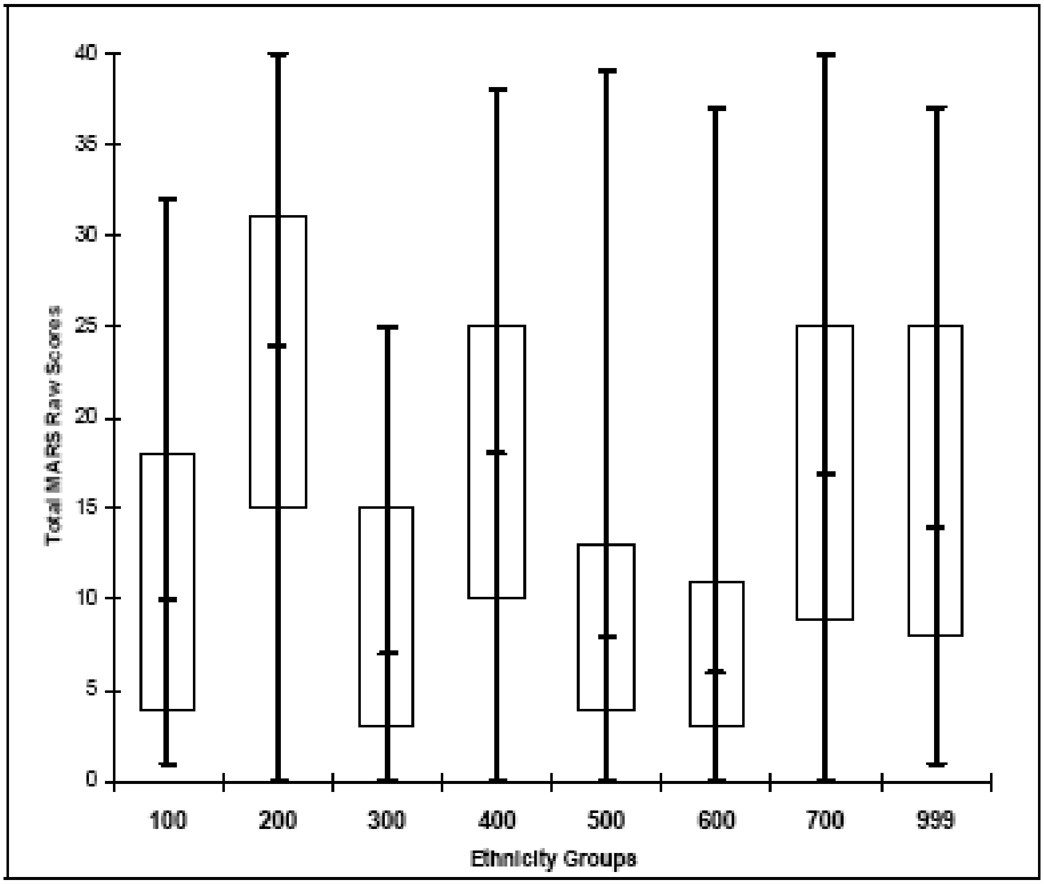
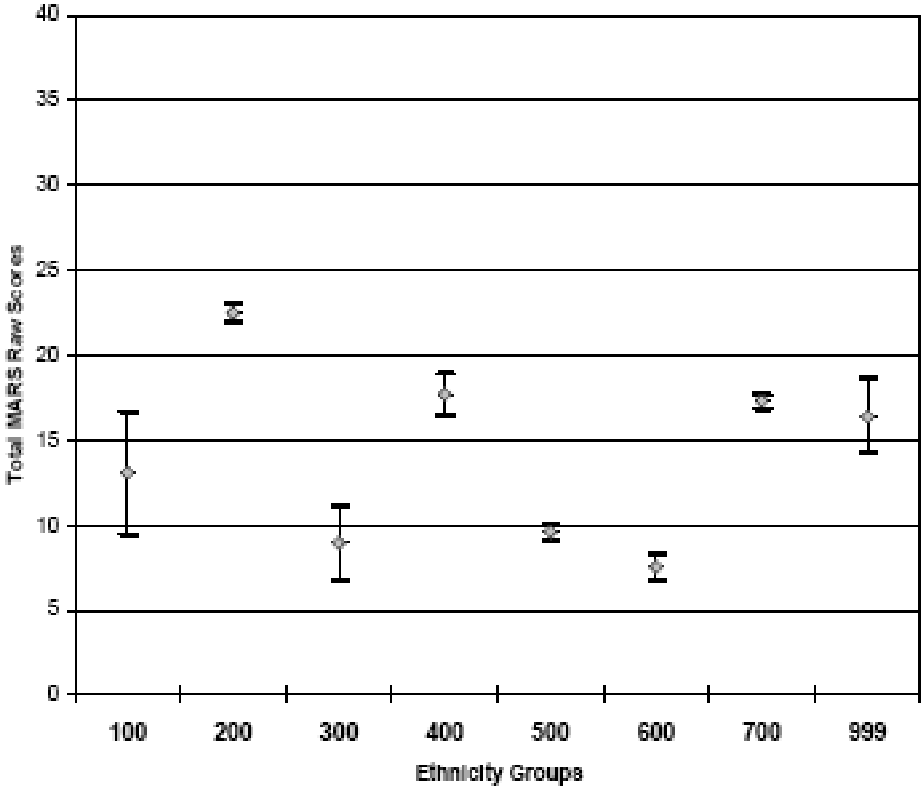


Table 8.1 Student count for Ethnicity

Ethnicity Groups	Ethnicity	Student Count
100	American Indian	26
200	Asian/Asian American	1134
300	Pacific Islander	72
400	Filipino	210
500	Hispanic/Latino	1179
600	African American	382
700	White (Not Hispanic)	1934
999	Decline to state	94

Figure 17.1 Distribution of sampling means by Ethnicity

Course: 1



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600	African American	382
700	White (Not Hispanic)	1934
999	Decline to state	94

Distribution of sampling means
Course 1
Ethnicity

In this section, test scores are compared across different ethnic groups[1]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

The mean score of Asian/Asian American students is higher than the mean scores of all other ethnic groups. The scores of Filipino and White students are not different from one another, and are higher than the scores of Pacific Islander, Hispanic, and African American students.

The scores of Hispanic students are higher than mean for African American students. Pacific Islander and African American students are at the low end of the mean scores – significantly lower than Asian/Asian American, White and Filipino students – and their scores are not significantly different from one another.

[1] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Figure 8.2 Box and whisker plot of Total MARS Raw Scores by Home Language

Course: 1

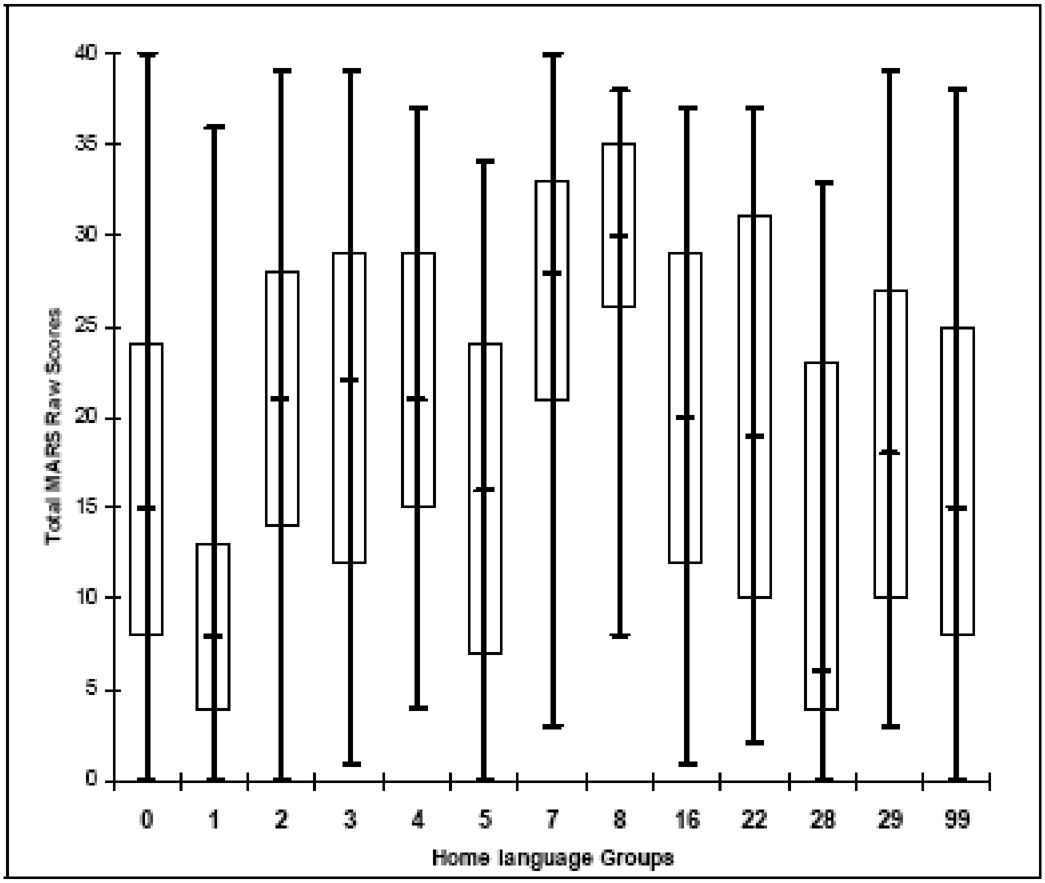
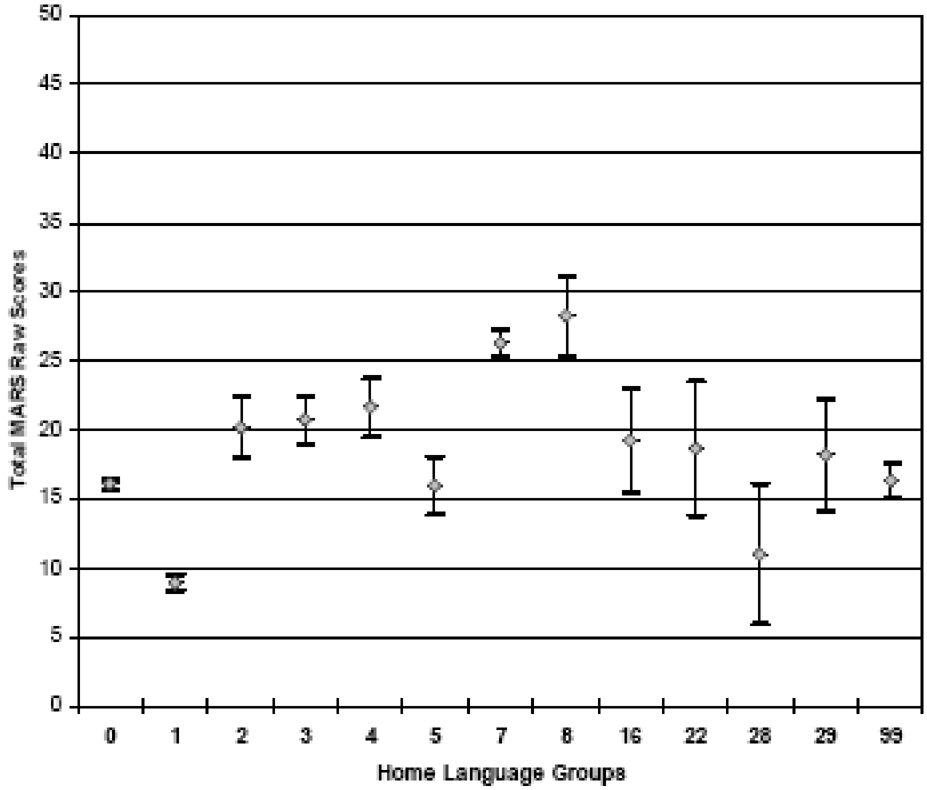


Table 8.2 Student count for Home Language

Home Language Group	Home Language	Student Count
0	English	3186
1	Spanish	813
2	Vietnamese	74
3	Cantonese	146
4	Korean	60
5	Filipino	76
7	Mandarin	243
8	Japanese	28
16	Farsi	29
22	Hindi	27
28	Punjabi	17
29	Russian	24
99	Others/Unknown	308

Figure 17.2 Distribution of sampling means by Home Language

Course: 1



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16	Farsi	29
22	Hindi	27
28	Punjabi	17
29	Russian	24
99	Others/Unknown	308

Distribution of sampling means
Course 1
Home Language

In this section, test scores are compared across groups of students who speak different languages at home[2]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

The comparison by home language is complex because there are 13 language groups with large enough numbers in the data set to be included in the analysis. This section summarizes some of the key points in terms of significant differences among home language groups.

The students who speak Mandarin at home have significantly higher score means than all of the other home language groups except Japanese (not significant). Students who speak Vietnamese, Cantonese or Korean at home had higher mean scores than students who speak English, Spanish or Punjabi at home, but lower scores than Mandarin speakers.

Students who speak English at home have a mean score that is higher than those of Spanish speakers, but lower than Mandarin, Korean, Vietnamese and Japanese-speakers. The students who speak Filipino, Vietnamese, Farsi, Hindi or Russian at home have higher mean scores than Spanish-speakers, but lower mean scores than many of the highest-scoring language groups (e.g. Mandarin, Cantonese, and Japanese).

The students who speak Spanish at home have the lowest mean score, significantly lower than all other home language groups except Punjabi (not statistically significant).

[2] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Figure 8.3 Box and whisker plot of Total MARS Raw Scores by Parent Education

Course: 1

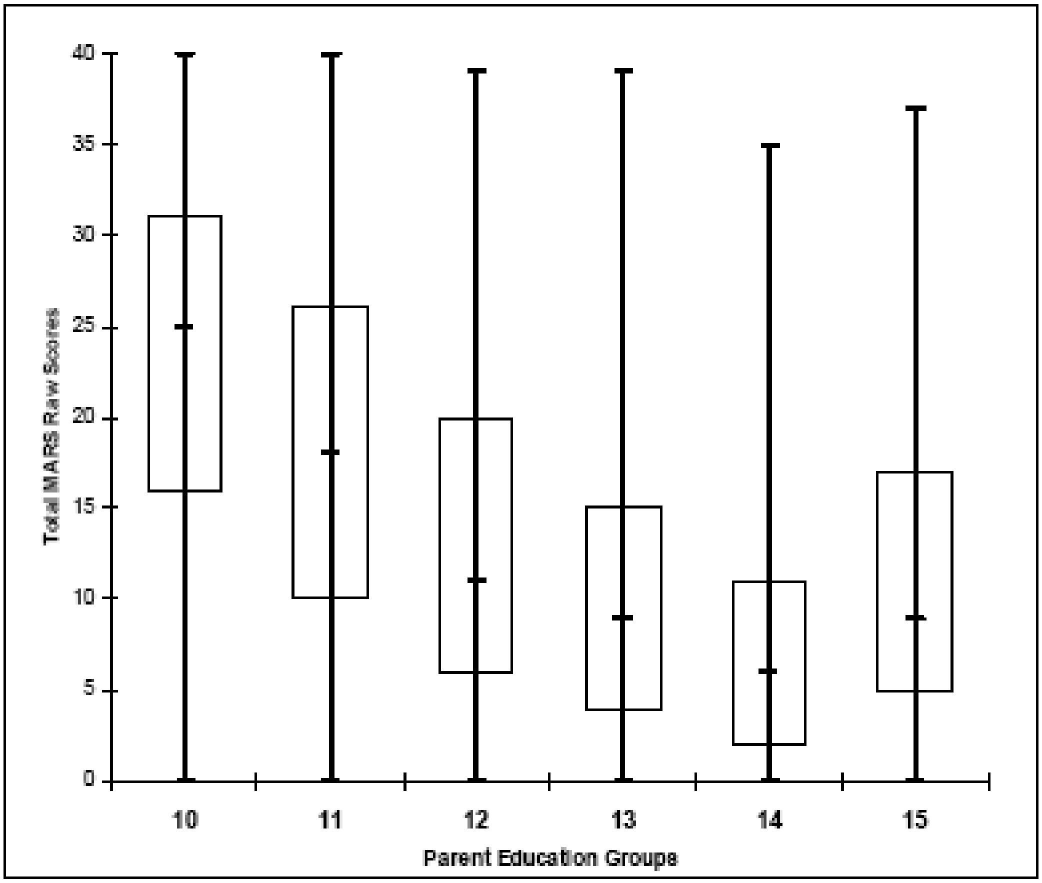
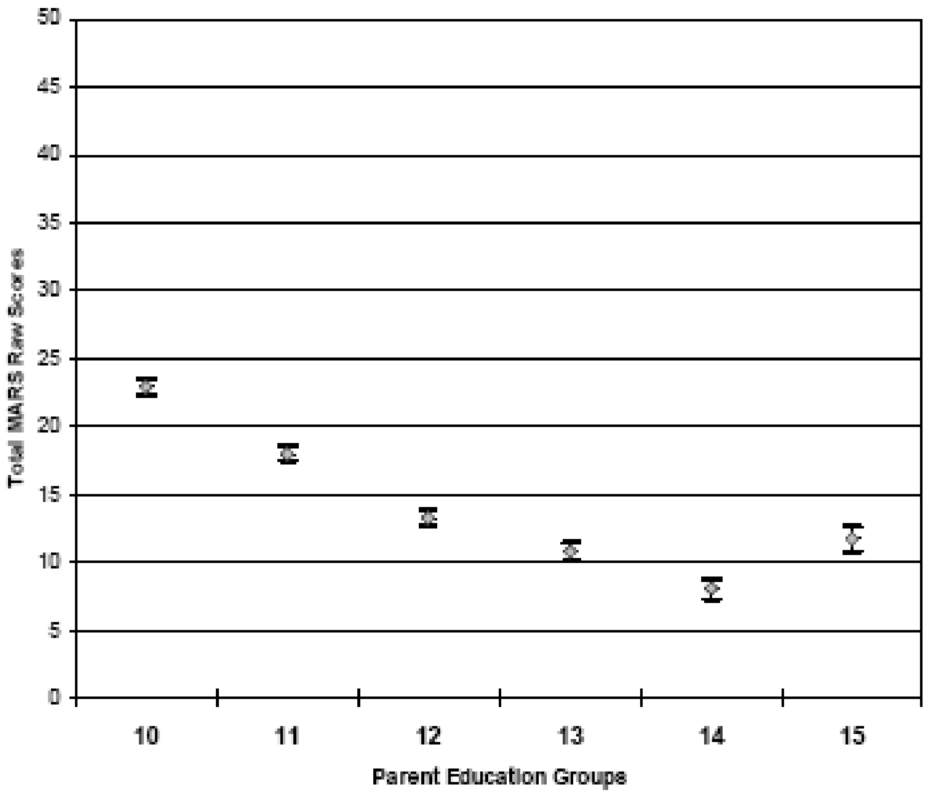


Table 8.3 Student count for Parent Education

Parent Education Group	Parent Education	Student Count
10	Graduate School	1087
11	College graduate	1377
12	Some college	1021
13	High School graduate	716
14	Not a high school graduate	426
15	Others/Unknown	404

Figure 17.3 Distribution of sampling means by Parent Education

Course: 1



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Parent Education Group	Parent Education	Student Count
10	Graduate School	1087
11	College graduate	1377
12	Some college	1021
13	High School graduate	716
14	Not a high school graduate	426
15	Others/Unknown	404

Distribution of sampling means
Course 1
Parent Education

In this section, test scores are compared across groups of students with different levels of parent education[3]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

The score means for groups whose parents had different levels of education fall as expected, with students whose parents have higher levels of education having statistically higher mean scores than students whose parents have lower levels of education. The scores of students whose parents have a graduate school education are higher than all other groups, followed by students whose parents are college graduates. Students whose parents have some college education have higher scores than students whose parents are high school graduates. Finally, the scores of students whose parents are not high school graduates are significantly lower than the scores of students in all other parent education categories.

[3] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Figure 8.4 Box and whisker plot of Total MARS Raw Scores by Gender

Course: 1

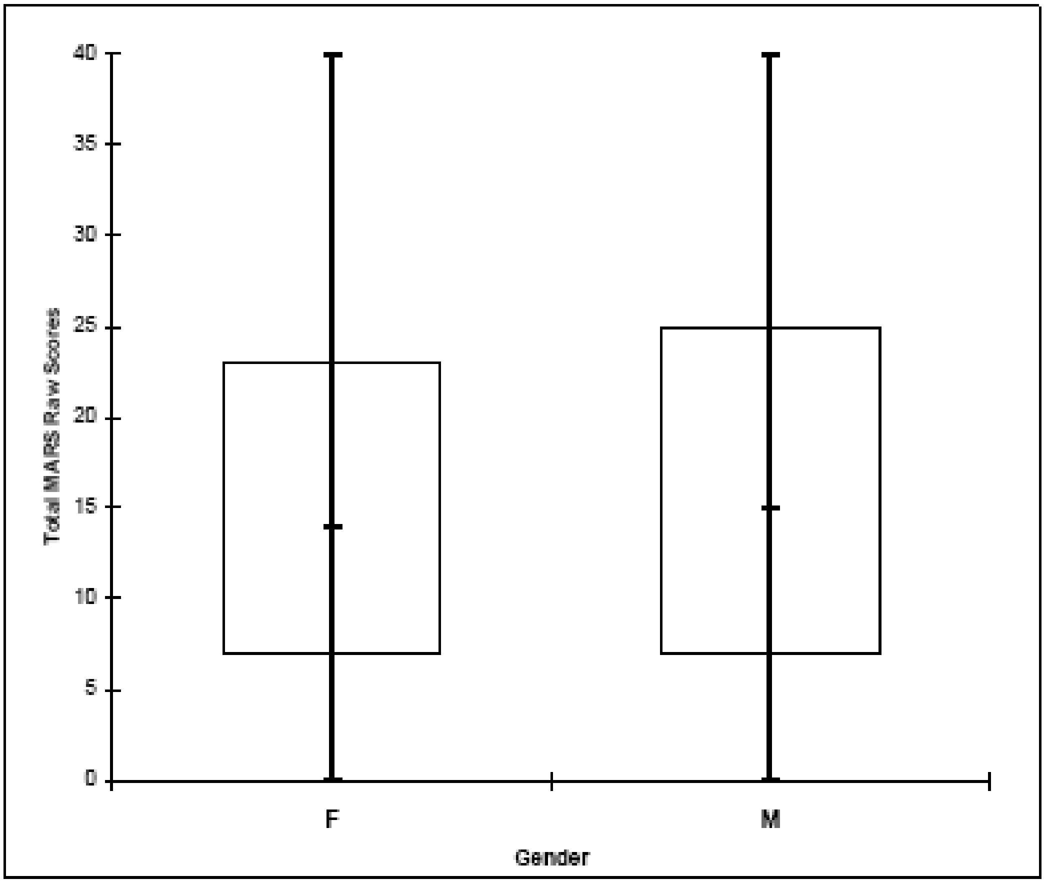


Table 8.4 Student count for Gender

Gender	Student Count
Female	2518
Male	2512

Figure 17.4 Distribution of sampling means by Gender

Course: 1

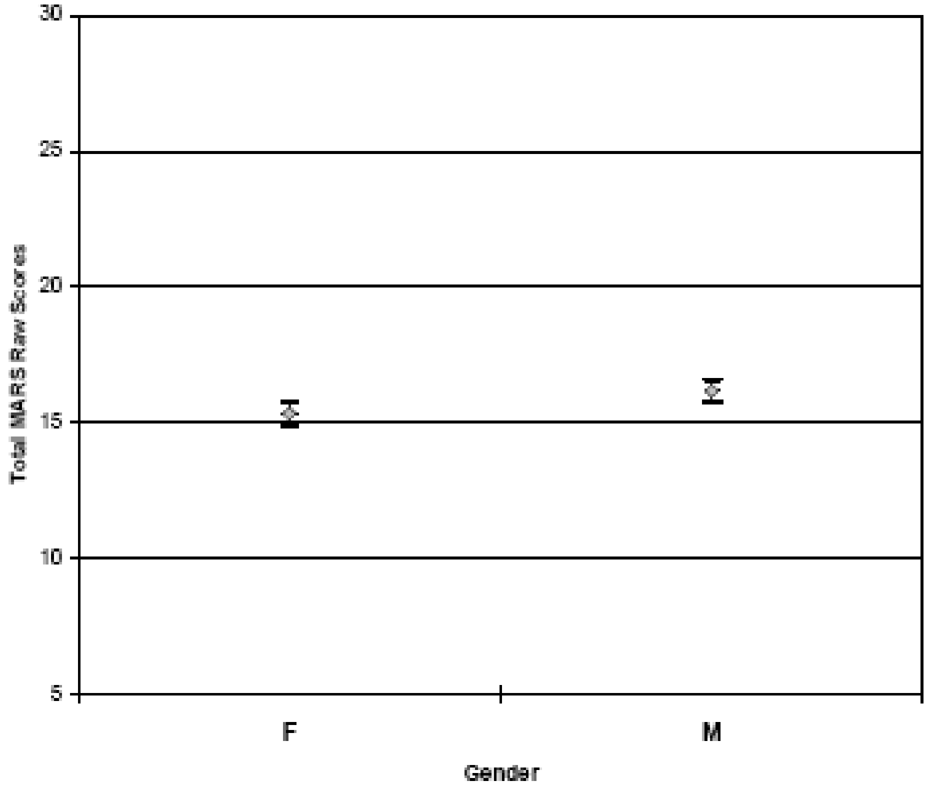


Table 17.4 Student count for Gender

Gender	Student Count
Female	2518
Male	2512

Distribution of sampling means
Course 1
Gender

In this section, test scores are compared across genders[4]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

The difference in mean scores for males and females is not statistically significant.

[4] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Figure 8.5 Box and whisker plot of Total MARS Raw Scores by Language Fluency

Course: 1

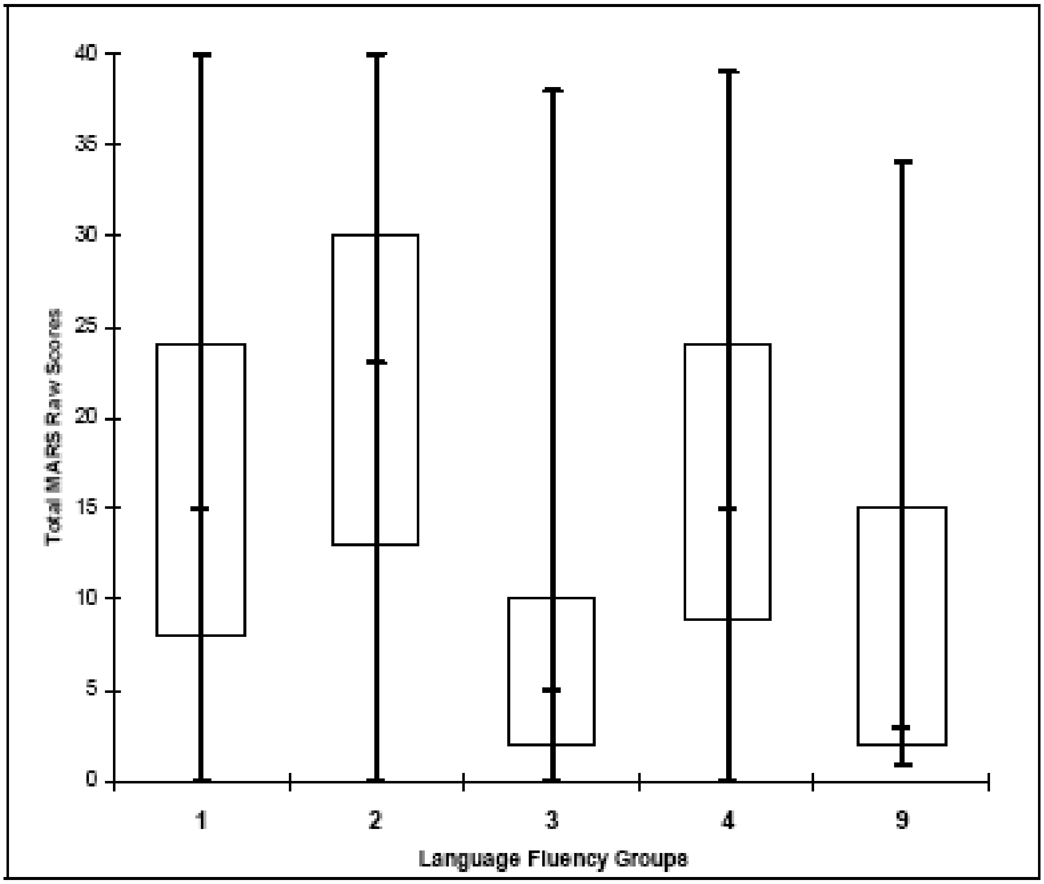


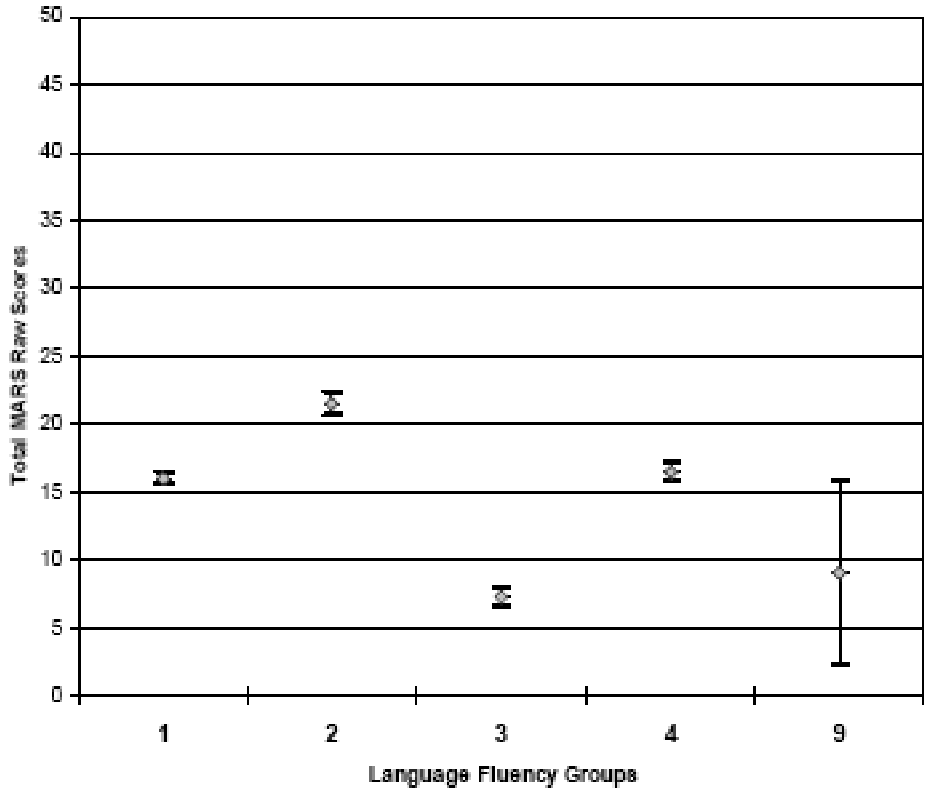
Table 8.5 Student count for Language Fluency

Language Fluency Group	Language Fluency	Student Count
1	English only	3139
2	Initially Fluent (I-FEP)	584
3	English Learner	549
4	ReDesignated (R_FEP)	749
9	Unknown	10

Figure 17.5 Distribution of sampling means by Language Fluency

Course: 1

Language Fluency



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1	English only	3139
2	Initially Fluent (I-FEP)	584
3	English Learner	549
4	ReDesignated (R_FEP)	749
9	Unknown	10

Distribution of sampling means
Course 1
Language Fluency

In this section, test scores are compared across different English language proficiency groups[5]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

Students who are classified as FEP have a higher mean score than any other group, and English learners are significantly lower than everyone except "Unknown". The mean scores of English only and R-FEP students are not significantly different from each other.

[5] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Student Task	Work with trapezoids, volume, rates and time graphs in the context of a swimming pool.
Core Idea 4 Geometry & Measurement	**Understand measurable attributes of objects; and understand the units, systems, and process of measurement.**
Core Idea 3 Alg. Properties & Representations	• Approximate and interpret rates of change, from graphic and numeric data.
Core Idea 1 Functions and Relations	• Analyze functions of one variable by investigating local and global behavior, including slopes as rates of change, intercepts and zeros.

Based on teacher observation, this is what algebra students knew and were able to do:

- Students were able to convert from seconds to hours, but were unsure what to do with the decimal

Areas of difficulty for algebra students:

- Finding volume of an unfamiliar shape
- Composing/ decomposing a shape into familiar parts
- Confusing a state rate of water flow with a steady rise in the depth of the pool
- Confusing the shape of the pool with the shape of the graph
- Not recognizing that after 5 feet the depth would increase at a steady rate

Implications for Instruction

Students need more experience with spatial visualization, including composing and decomposing geometric 2- and 3-dimensional shapes. By 7^{th} and 8^{th} grade students should start to work with taking slices of 3-dimensional shapes and being able to draw and measure those slices. Students need to think about rotations and flips of 3-dimensional shapes.

An important idea for solving geometric problems is the idea that lines can be added to 2-dimensional shapes or that extra shapes can be combined with 3-dimensional shapes. This ability to add on helps the problem solver find and use knowledge about more familiar shapes.

As students move into algebra, they should be pushed to generalize about geometric formulas; for example, moving from volume of a rectangular prism is "l *x* w *x* h" to thinking about volume as the area of the base times the height. This generalization can then apply to a wide variety of shapes, like cylinders and triangular prisms. A large piece of algebraic thinking is developing mathematical justification in words, diagrams, and symbols. Students should be able to connect the various representations. Students, at the algebra level, should also be encouraged to justify why formulas work; how do the various parts of the formula relate to the geometric context. Students should be able to make a strong case for why, when finding the area of a triangle, the length times width is divided by 2, or why when finding the area of a trapezoid the two bases are divided in two.

As students move through an algebra course they should have frequent experiences graphing functions of real-life contexts, such as time/distance graphs. Students need to see that graphs represent something different from the shape of object. For example, the graph of the height of a car on a ferris wheel over time is not a circle, but a peak shape, with a steady increase and decrease. Students need to discuss common misconceptions like this in order to see why these ideas are incorrect. Possible activities might include explaining the story of a graph, or given a story make a graph without the scale. Good examples can be found in the Language of Functions published by the Shell Centre.

MARS Test Task 1 Frequency Distribution and Bar Graph, Course 1

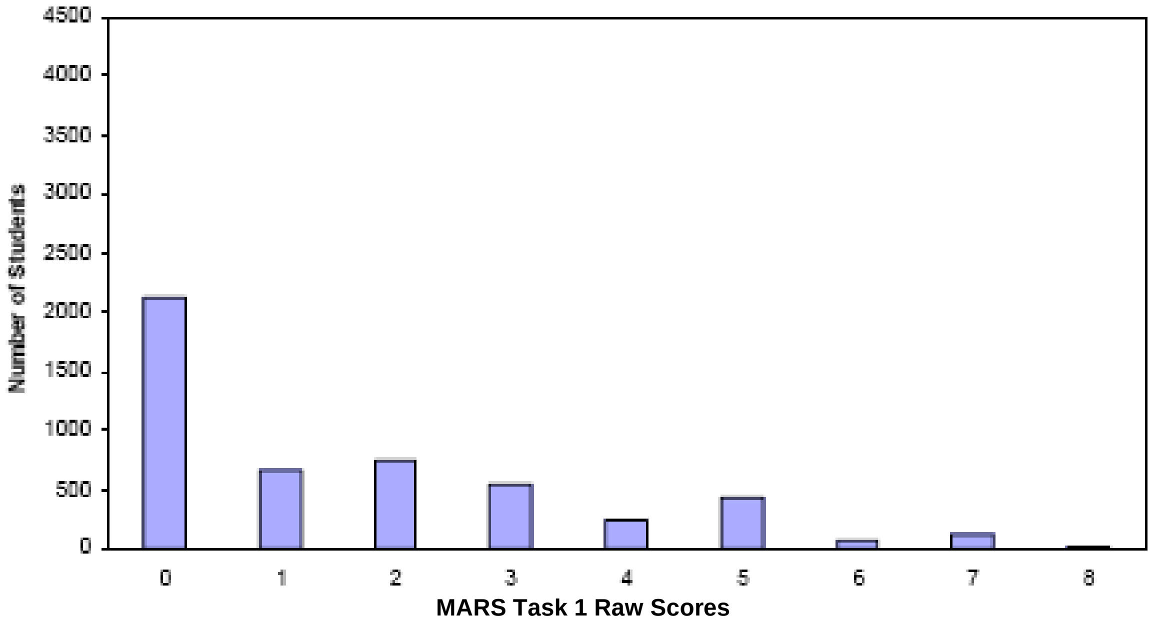
Task 1 – Swimming Pool

Mean: 1.67 StdDev: 1.95

Table 45: Frequency Distribution of MARS Test Task 1, Course 1

Task 1 Scores	Student Count	% at or below	% at or above
0	2130	43.1%	100.0%
1	655	56.3%	56.9%
2	747	71.4%	43.7%
3	538	82.3%	28.6%
4	240	87.1%	17.7%
5	428	95.8%	12.9%
6	70	97.2%	4.2%
7	114	99.5%	2.8%
8	25	100.0%	0.5%

Figure 54: Bar Graph of MARS Test Task 1 Raw Scores, Course 1



The maximum score available on this task is 8 points.
The minimum score for a level 3 response, meeting standards, is 5 points.

Less than half the students, 43.7%, knew to divide by 360, to change seconds to hours, and could do the calculation accurately. Some students, about 29%, could convert this answer to standard notation of hours and minutes by successfully changing the decimal from 0.625hrs. to 37.5 minutes. Only 13 % could make the conversion and then either find the volume of the pool or pick the correct graph with a partial explanation of why it was correct. Less than 1% of the students could meet all the demands of this task, including finding the volume of a trapezoidal prism and explaining how a graph of time and depth matches the situation of water filling the pool. 43% of the students scored no points on this task. 90% of the students with a score of zero attempted the task.

Student Task	Work with odd, even and consecutive numbers. Make and justify conjectures about consecutive numbers.
Core Idea 2 Mathematical Reasoning	**Employ forms of mathematical reasoning and proof appropriate to the solution of the problem, including deductive and inductive reasoning, making and testing conjectures and using counterexamples and indirect proof.** • Show mathematical reasoning in a variety of ways including words, numbers, symbols, pictures, charts, graphs, tables, diagrams, and models. • Draw reasonable conclusions about a situation being modeled.

Based on teacher observation, this is what algebra students knew and were able to do:

- Give examples to fit constraints using consecutive numbers
- Understand definitions of odd numbers, even numbers, and consecutive numbers
- Knew rules like an odd number plus and even number equals an odd number

Areas of difficulty for algebra students:

- Using algebra to make justifications
- Giving a process for finding the consecutive numbers rather than making a justification
- Noting the pattern of multiples of three in part four, rather than the more specific pattern of multiples of six
- Giving an explanation about the three consecutive numbers in part 4, instead of giving a rule for how to tell if the answer could be written as the sum of 3 consecutive numbers

Implications for Instruction

Students need more practice with the logic of proof and justification. Students should be able to reason about the structure of number or use algebra to explain why numerical patterns work. Students need frequent opportunities to conduct number experiments, organize their data, and make and justify their conjectures. Logic is learned and honed through practice and discourse. Students at this level should also be encouraged to apply the algebraic skills they are acquiring to their justifications.

Looking at problems, such as the many guess my number tricks, is one example where students might use algebra to justify why the number always works. The 2003 Course One Task: Criss Cross Numbers or Number Towers, are also good to get students to apply symbolic notation to making a justification.

Fostering Algebraic Thinking, by Mark Driscoll, is an excellent resource for problems to help students develop their logical reasoning skills in number theory, generalizing from arithmetic, and looking at functions.

Ask your coach for a copy of the Problem of the Month, Squirreling It Away. See if your students can work their way up to level E, making a generalization.

MARS Test Task 2 Frequency Distribution and Bar Graph, Course 1

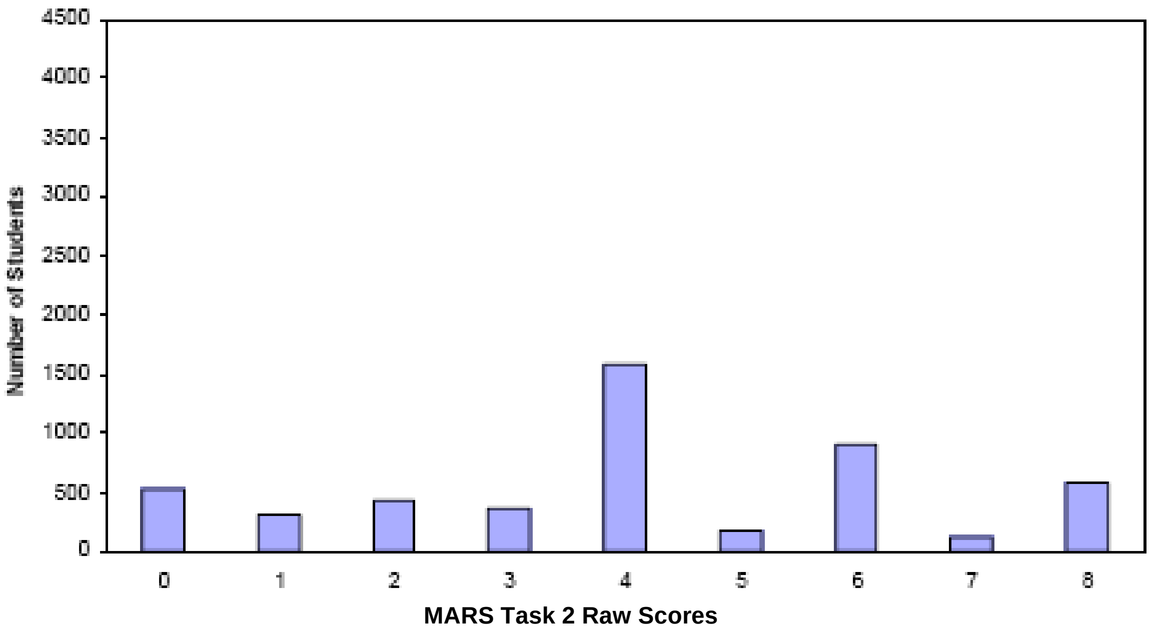
Task 2 – Odd Sums

Mean: 4.09 StdDev: 2.34

Table 46: Frequency Distribution of MARS Test Task 2, Course 1

Task 2 Scores	Student Count	% at or below	% at or above
0	523	10.6%	100.0%
1	303	16.7%	89.4%
2	417	25.1%	83.3%
3	350	32.2%	74.9%
4	1583	64.2%	67.8%
5	174	67.7%	35.8%
6	906	86.0%	32.3%
7	116	88.4%	14.0%
8	575	100.0%	11.6%

Figure 55: Bar Graph of MARS Test Task 2 Raw Scores, Course 1



The maximum score available on this task is 8 points.
The minimum score for a level 3 response, meeting standards, is 4 points.

Most students, 83%, could find examples of consecutive numbers to make 15 and 99. More than half the students could also give examples of three consecutive numbers that equaled an even sum. About one-third of the students could give a rule for telling if an even number could or could not be written as the sum of 3 consecutive numbers. Almost 12% of the students could meet all the demands of the task, including explaining why all odd numbers can be written as the sum of two consecutive numbers. Almost 11% of the students scored no points on this task. 83% of the students with this score attempted the task.

Student Task	Recognize and extend a number pattern for a geometric pattern. Express a rule using algebra. Use inverse operations to solve a problem.
Core Idea 1 Functions and Relations	**Understand patterns, relations, and functions.** • Generalize patterns using explicitly defined functions. • Understand relations and functions and select, convert flexibly among, and use various representations for them. • Recognize and generate equivalent forms of simple algebraic expressions and solve linear equations.

Based on teacher observation, this is what algebra students knew and were able to do:

- Extend the pattern to five and explain how they got their answer, usually noting the growth rate of 5.
- Work backwards to find the number of black hexagons needed for 66 white hexagons.

Areas of difficulty for algebra students:

- Writing a rule or formula
- Understanding the difference between a recursive rule and a generalized rule
- Understanding that a variable is not the same as a label
- Understanding how the first term is different or how the constant effects the progression of the pattern
- Expressing ideas in symbolic notation
- Order of operations

Implications for Instruction

Students at this mathematical level would benefit from working a variety of problems in context to help them quantify ideas in symbolic notation and gain a clearer understanding of the purpose and meaning of variables. Students need to see the usefulness of variables in solving problems. Working a mechanical procedure for solving an equation is quite a different skill from expressing an idea in the language of algebra.

Context of pattern problems allows students to search for generalizations and use the context to justify why the generalization holds true for all cases. One of the big mathematical ideas and purpose for algebra is to be able to make and prove generalizations.

Students at this grade level should be doing detailed investigations to explore proportions and functions to understand the properties of both. How are they the same? How are they different? Context makes these similarities and differences more apparent.

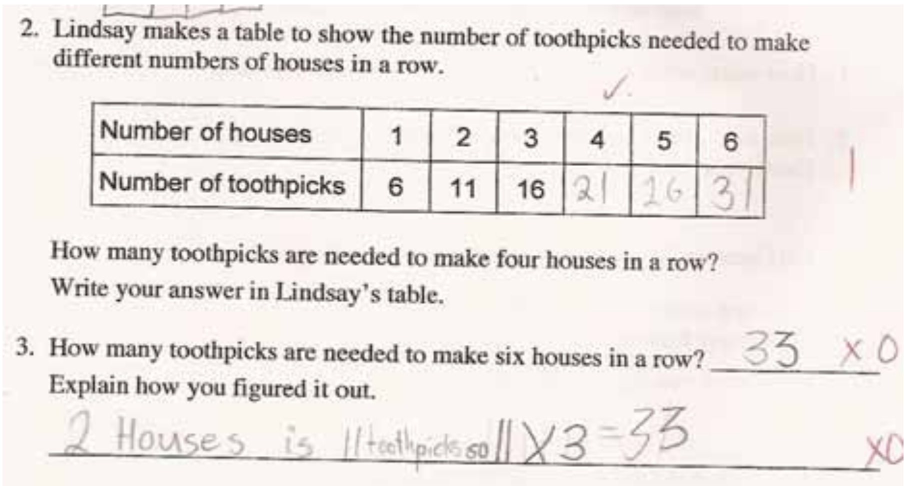
Consider a proportional situation, such as t-shirts cost $5 apiece. The table for this proportional relationship (5x) might look like:

1	2	3	4	5	6
5	10	15	20	25	30

Then it would be quite valid mathematically to take the second term (10) and multiply it by 3 to get 30 or add the 4th term + the 4th term + 3rd term to equal the 11th term (20+20+15 = 55 or 5 (11)= 55). However, this reasoning is not valid for functions with a constant. Students try to make generalizations such as these about patterns from work with proportion situations and don't realize that the procedures will not work for all patterns.

However for a pattern like Patchwork Quilt, or the 5th grade task: <u>Toothpick Houses</u>, both of which grow by 5's, the rules of proportions don't work. See the work of student E and F.

Student E



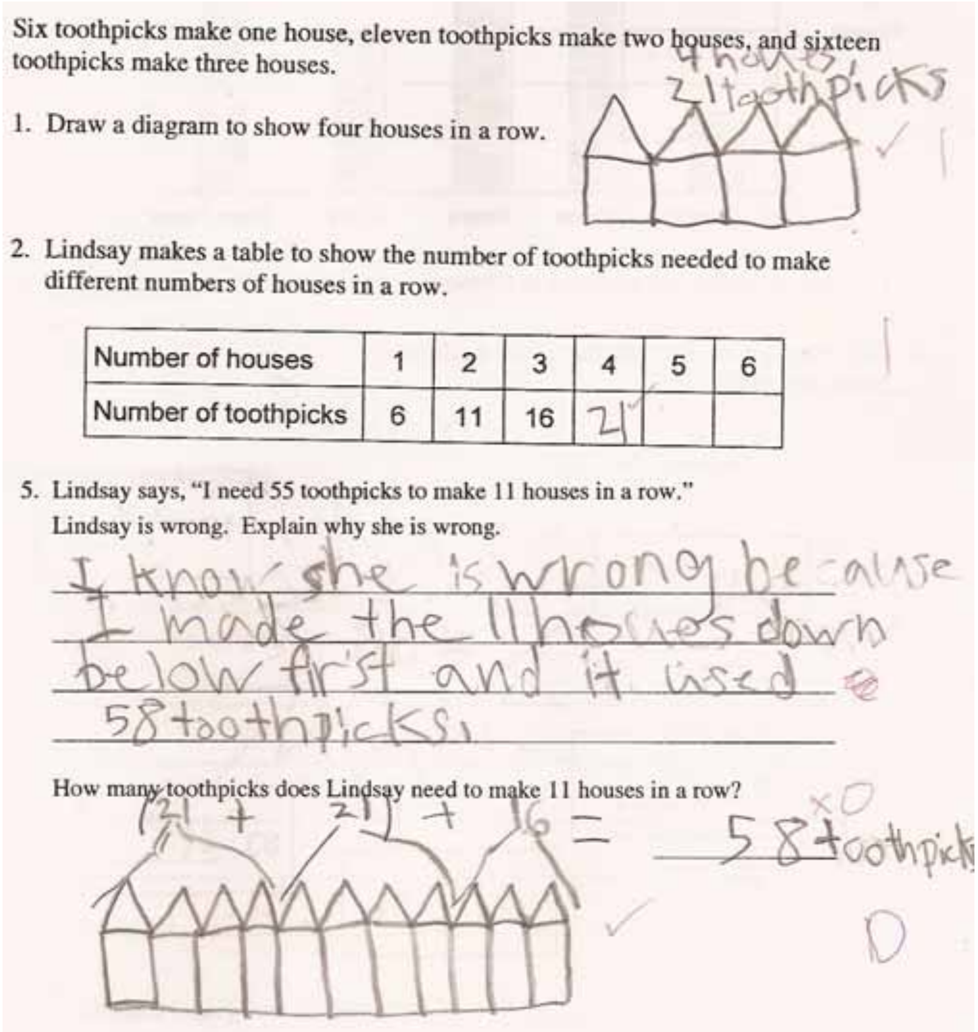
2. Lindsay makes a table to show the number of toothpicks needed to make different numbers of houses in a row.

Number of houses	1	2	3	4	5	6
Number of toothpicks	6	11	16	21	26	31

How many toothpicks are needed to make four houses in a row? Write your answer in Lindsay's table.

3. How many toothpicks are needed to make six houses in a row? 33 x 0
Explain how you figured it out.
2 Houses is 11 toothpicks so 11 X 3 = 33 x0

Student F



Six toothpicks make one house, eleven toothpicks make two houses, and sixteen toothpicks make three houses.

4 houses, 21 toothpicks

1. Draw a diagram to show four houses in a row.

2. Lindsay makes a table to show the number of toothpicks needed to make different numbers of houses in a row.

Number of houses	1	2	3	4	5	6
Number of toothpicks	6	11	16	21		

5. Lindsay says, "I need 55 toothpicks to make 11 houses in a row."
Lindsay is wrong. Explain why she is wrong.

I know she is wrong becalse I made the 11 houses down below first and it used 58 toothpicks.

How many toothpicks does Lindsay need to make 11 houses in a row?

(21 + 21) + 16 = 58 toothpicks

Exploring the properties of proportions and functions with constants should also include a comparison of their graphs. Students should be asked what the constant represents in the context of the problem to help them understand why it can't be repeated.

MARS Test Task 3 Frequency Distribution and Bar Graph, Course 1

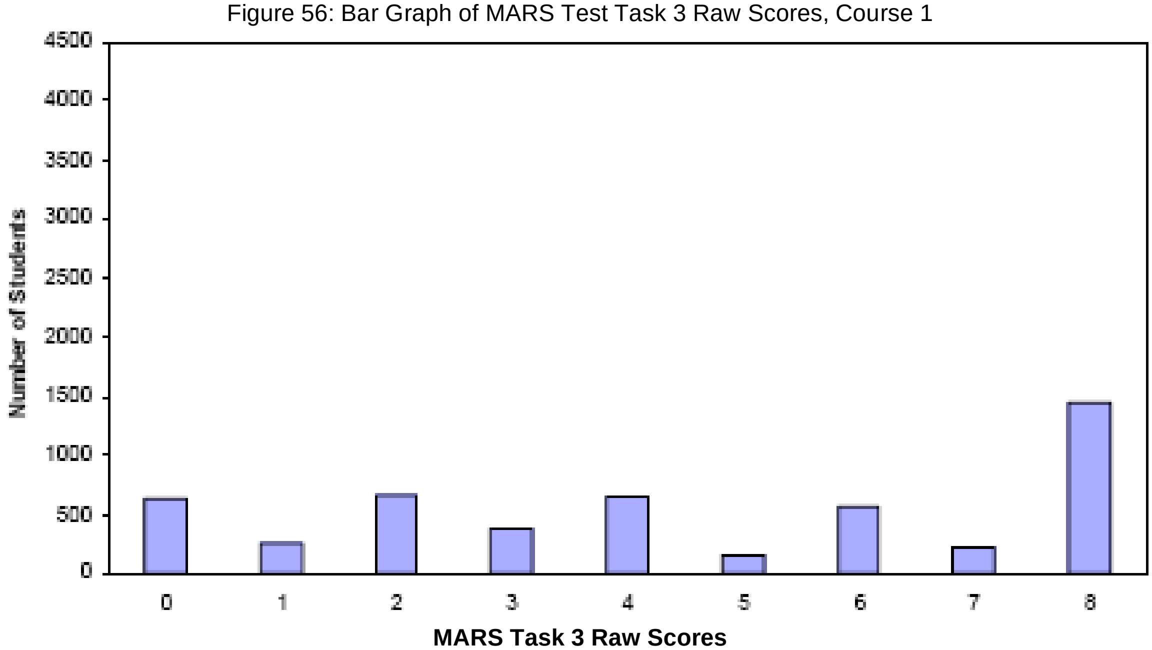
Task 3 – Patchwork Quilt

Mean: 4.56 StdDev: 2.89

Table 47: Frequency Distribution of MARS Test Task 3, Course 1

Task 3 Scores	Student Count	% at or below	% at or above
0	632	12.8%	100.0%
1	251	17.8%	87.2%
2	658	31.2%	82.2%
3	373	38.7%	68.8%
4	643	51.7%	61.3%
5	157	54.9%	48.3%
6	567	66.3%	45.1%
7	228	70.9%	33.7%
8	1438	100.0%	29.1%

Figure 56: Bar Graph of MARS Test Task 3 Raw Scores, Course 1



The maximum score available on this task is 8 points.
The minimum score for a level 3 response, meeting standards, is 5 points.

Most students, 82%, can extend the pattern to 6 black hexagons and explain how they figured it out. More than half the students, 61%, could extend the pattern to 6 black hexagons and work backwards from the number of border tiles to the number of black tiles, giving explanations for both. Almost half the students, 48%, could do some correct reasoning for extending the pattern to 77 black hexagons, but they may have made calculation errors. 29% of the students could meet all the demands of the task including writing an algebraic formula for extending the pattern to any number of black tiles. 13% of the students scored no points on this task. 89% of the students with this score attempted the task.

Course One/Algebra Task 4 Printing Tickets

Student Task	Compare price plans using graphs and formulae. Use inequalities in a practical context of buying tickets.
Core Idea 3 Alg. Properties & Representations	**Represent and analyze mathematical situations and structures using algebra.** • Write equivalent forms of equations, inequalities and systems of equations and solve them • Use symbolic algebra to represent and explain mathematical relationships • Judge the meaning, utility, and reasonableness of results of symbolic manipulations

Based on teacher observation, this is what algebra students knew and were able to do:

- Write an equation for Best Print
- Draw a graph to match their equation
- Interpreting graphs of two equations to determine best buy under different conditions

Areas of difficulty for algebra students:

- Understand how to use symbolic notation to represent a context
- Find a table of values before drawing a graph
- Using algebra to solve for 2 equations with 2 unknowns

Implications for Instruction

Students at this level need more opportunities to use algebra in a practical situation. Students should have practice making a table of values to help them graph equations. They should also understand how a constant effects the graph and be able to use the formula to think about slope.

Some students at this level are still struggling with understanding the meaning of variables. They see the letters or symbols as standing for labels. Others think that an equation is only for finding one specific value. They don't understand that the letter represents a quantity that can vary or change. Students need more experience with solving problems in context that promote discussion about how the variable may change and why. They need to connect the equation to a wide range of possibilities, to a representation of a more global picture of a situation. These nuances do not come through practice with just symbolic manipulation.

A few students struggle with the basic algebraic notation around order operations, combining algebraic fractions and whole numbers, and solving equations with divisors or fractional parts.

There are many situations where it is important to find the breakeven point or place where two functions intersect. Students should be familiar with these types of situations and be comfortable setting the two equations to equal each other. These problems might include choosing the best rate for a gym membership, picking a cell phone plan, or ways to price a store item with different costs having different volumes of sales.

(*See MAC tasks – 2003 6th Grade: Gym, 2005 8th:Picking Apples*)

MARS Test Task 4 Frequency Distribution and Bar Graph, Course 1

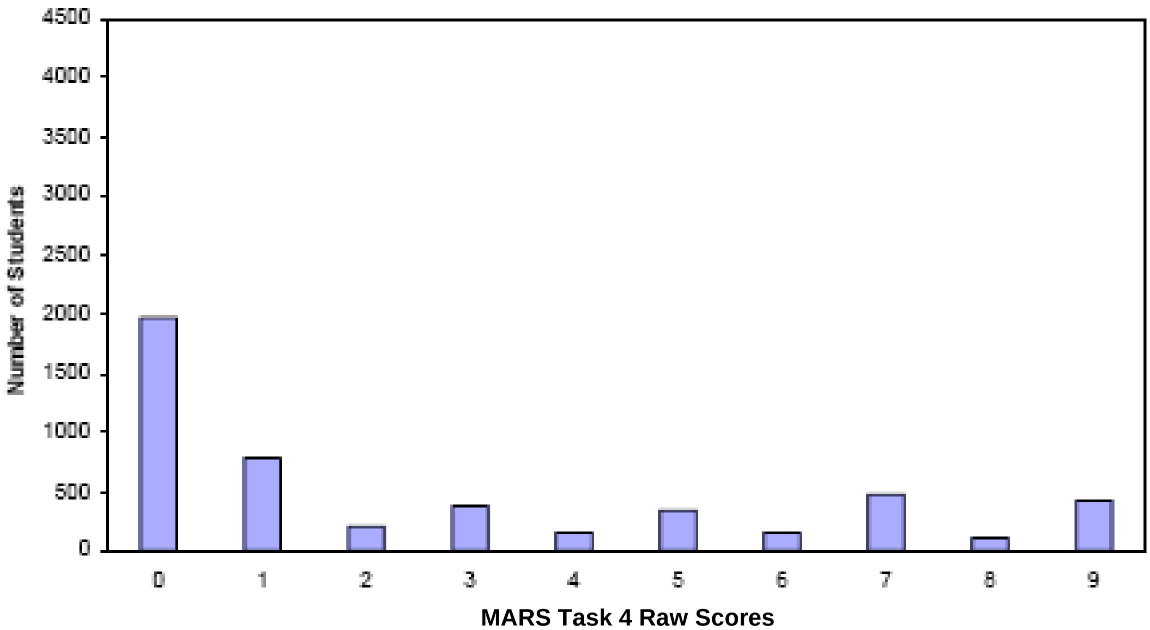
Task 4 – Printing Tickets

Mean: 2.70 StdDev: 3.14

Table 48: Frequency Distribution of MARS Test Task 4, Course 1

Task 4 Scores	Student Count	% at or below	% at or above
0	1963	39.7%	100.0%
1	777	55.4%	60.3%
2	207	59.6%	44.6%
3	372	67.1%	40.4%
4	153	70.2%	32.9%
5	332	76.9%	29.8%
6	150	79.9%	23.1%
7	468	89.4%	20.1%
8	104	91.5%	10.6%
9	421	100.0%	8.5%

Figure 57: Bar Graph of MARS Test Task 4 Raw Scores, Course 1



The maximum score available on this task is 9 points.
The minimum score for a level 3 response, meeting standards, is 4 points.

More than half the students, 60%, could write an equation to represent the cost of buying tickets at Best Print. Almost half the students, 40%, could also graph the cost of Best Print. Some students, could find when it was cheaper to use Best Buy or Sure Print. 8.5% of the students could meet all the demands of the task including using algebra to find the point where the costs for Best Buy and Sure Print are the same. Almost 40% of the students scored no points on this task. 90% of the students with this score attempted the task.

Student Task	Relate line graphs to their equations.
Core Idea 3 Alg. Properties & Representations	**Represent and analyze mathematical situations and structures using algebraic symbols.** • Understand the meaning of equivalent forms of expressions, equations, inequalities, or relations • Write equivalent forms of equations, inequalities, and systems of equations and solve them
Core Idea 1 Functions and Relations	• Analyze functions of one variable by investigating local and global behavior, including slopes as rates of change, intercepts and zeros.

Based on teacher observation, this is what algebra students knew and were able to do:
- Students could identify the origin
- Students could identify the equation x + y = 9
- Students could identify the equation y = 1/2 x
- Students could give the coordinates for the intersection of y=6 and x = 6

Areas of difficulty for algebra students:
- Confusing the order of x an y in a coordinate pair
- Recognizing the solutions for simultaneous equations
- Writing an equation for a line through a given point

Implications for Instruction

Students need more work with coordinate graphs and plotting points. Students at this level are still confusing x an y; for example choosing the line y= 0 foe x = 0. They may need more experience with making a table of values and plotting points in order to verify the graphs of lines. They didn't seem to use substitution of values to verify if the ordered pair would match their equation. They had difficulty finding the intersection of the equations on a graph.
- Is there some piece of conceptual understanding that gets missed if students don't get enough hands on experience before jumping to graphing calculators?
- How can you interview students or set up an experiment to find out what they understand about the connections between equations and graphs?
- How does understanding the intersection of two equations relate back to Printing Tickets?
- When teaching finding the solution to simultaneous equations is enough emphasis put on the meaning of the intersection or the connection between the solution and the graphs of the equations? How does context help to illuminate this significance?
- How does understanding the graphs of lines help students to develop a better understanding of the idea of a variable, something that can change or vary? What contexts help to support students' development of this big mathematical idea?

MARS Test Task 5 Frequency Distribution and Bar Graph, Course 1

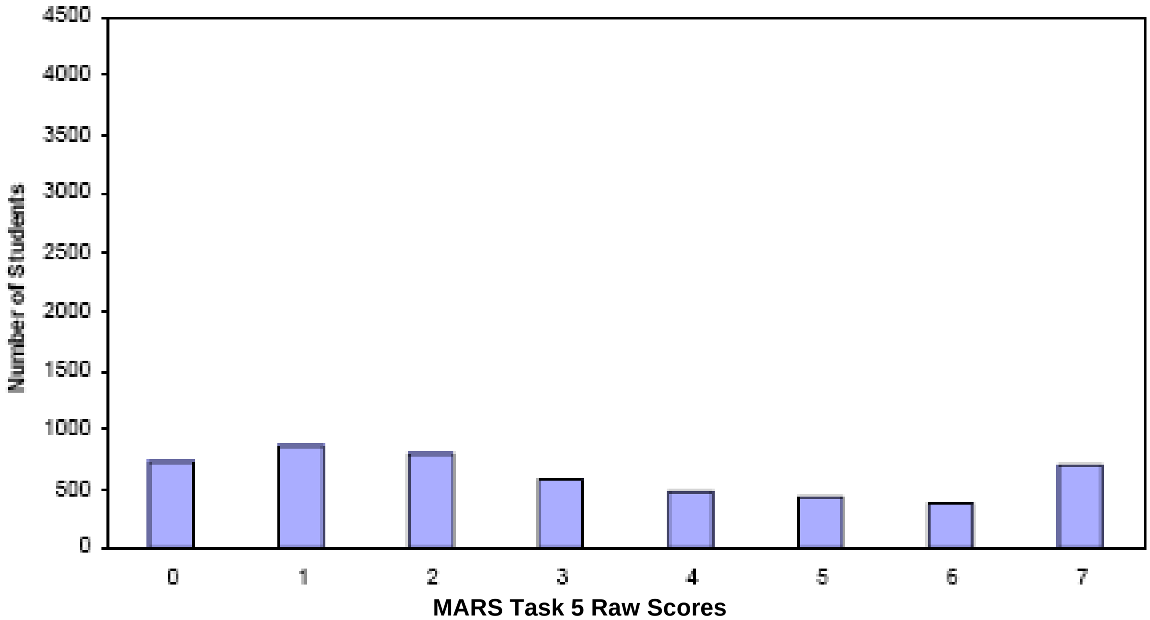
Task 5 – Graphs

Mean: 3.10 StdDev: 2.36

Table 49: Frequency Distribution of MARS Test Task 5, Course 1

Task 5 Scores	Student Count	% at or below	% at or above
0	732	14.8%	100.0%
1	874	32.5%	85.2%
2	790	48.4%	67.5%
3	585	60.3%	51.6%
4	468	69.7%	39.7%
5	425	78.3%	30.3%
6	378	86.0%	21.7%
7	695	100.0%	14.0%

Figure 58: Bar Graph of MARS Test Task 5 Raw Scores, Course 1

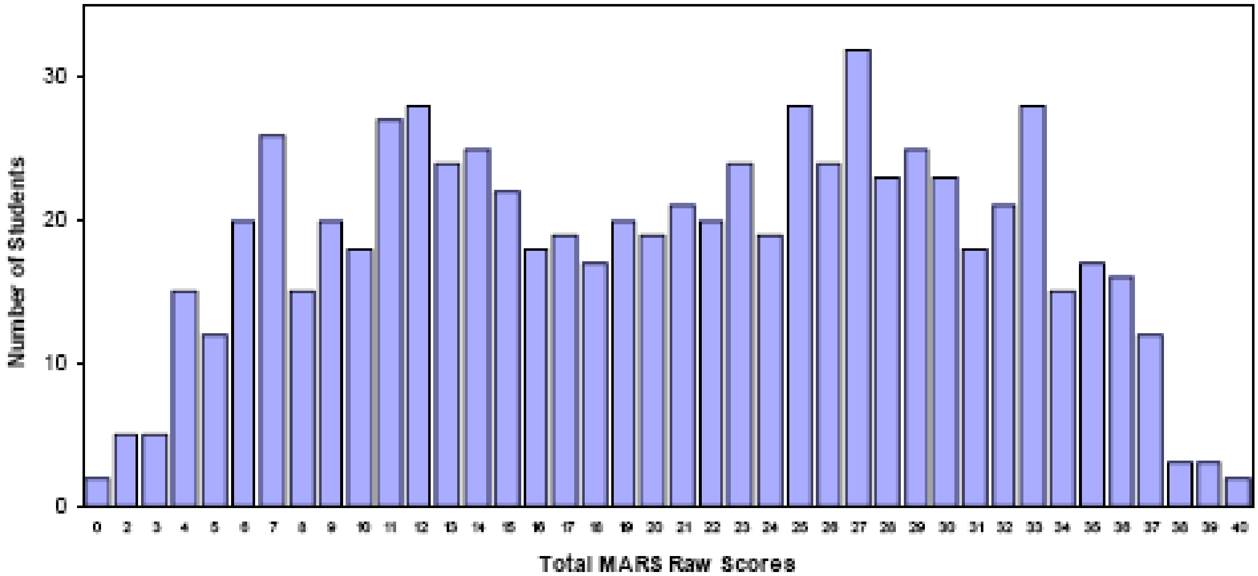


The maximum score available on this task is 7 points.
The minimum score for a level 3 response, meeting standards, is 3 points.

Most students, 85%, could identify the origin and the line x + y = 9. About half the students could also identify the line y = 1/2 x. Some students, about 35%, could also identify the lines x= 0 and y = 0 and x + 6. 14% of the students could meet all the demands of the task including identifying the simultaneous solution for x + y =9, giving the coordinates for the intersection of y=6 and x=6, and writing the equation for a line going through (3,6). Almost 15 % of the students scored no points on this task. 57% of the students with this score attempted the task.

Figure 9: Overall Frequency Distribution by Total MARS Raw Scores, Course 2

Mean: 20.46 StdDev: 9.71



* Total MARS raw scores is the summation of Tasks 1 through 5 on the MARS test.

MARS Test Performance Level Frequency Distribution Table and Bar Graph

2006 - Number of Students tested in Course 2: 731

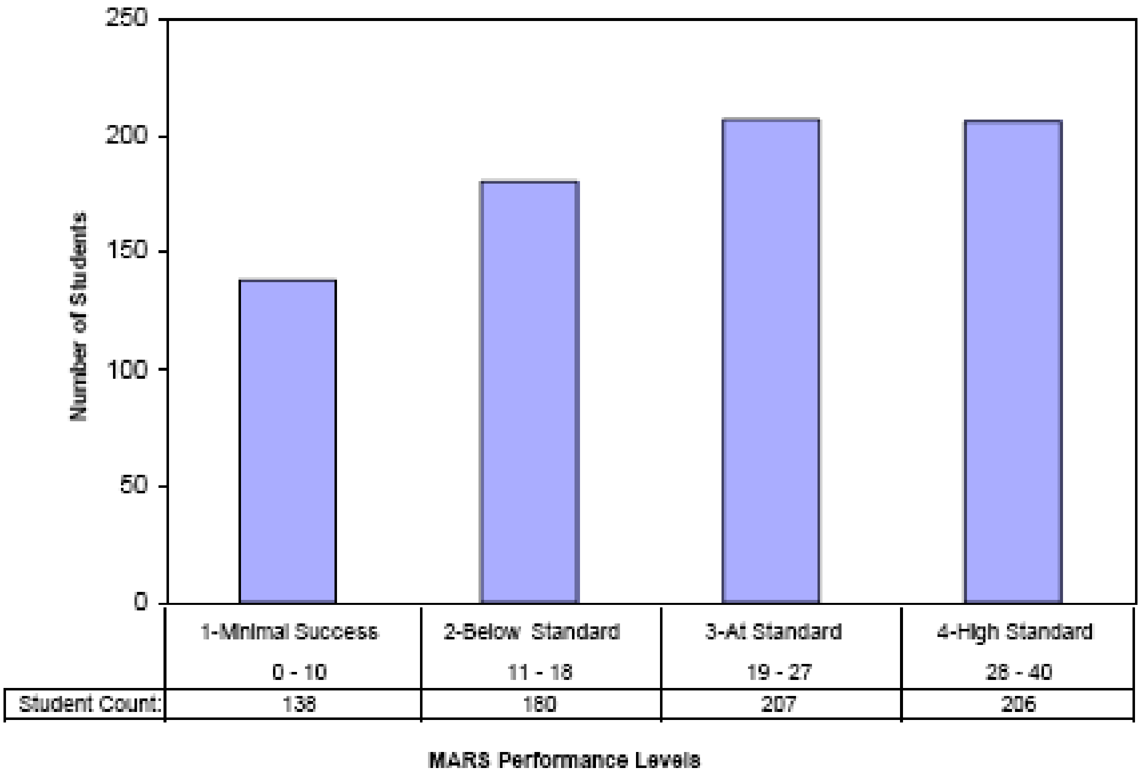
Table 9: Frequency Distribution of MARS Test Performance Levels, Course 2

	Year of Testing					
	2001		2002		2003	
Perf. Level	% at	% at least	% at	% at least	% at	% at least
1	32%	100%	44%	100%	25%	100%
2	52%	68%	40%	56%	39%	75%
3	14%	16%	9%	16%	23%	37%
4	2%	2%	6%	6%	14%	14%

Table 9 (Cont.): Frequency Distribution of MARS Test Performance Levels, Course 2

	Year of Testing					
	2004		2005		2006	
Perf. Level	% at	% at least	% at	% at least	% at	% at least
1	6%	100%	22%	100%	19%	100%
2	27%	94%	19%	78%	25%	81%
3	29%	67%	29%	59%	28%	56%
4	38%	38%	30%	30%	28%	28%

Figure 18: Bar Graph of 2006 MARS Test Performance Levels, Course 2



* Total MARS raw scores is the summation of Tasks 1 through 5 on the MARS test.

The following figures show the distribution of raw scores with the median represented as a horizontal bar in the center of the box, the interquartile range (25 percentile to 75 percentile) represented by the box, and the extreme values* within a category lie between the highest and lowest horizontal bars. Groups with Ns of less than 5 students are not reported.

Figure 9.1 Box and whisker plot of Total MARS Raw Scores by Ethnicity

Course: 2

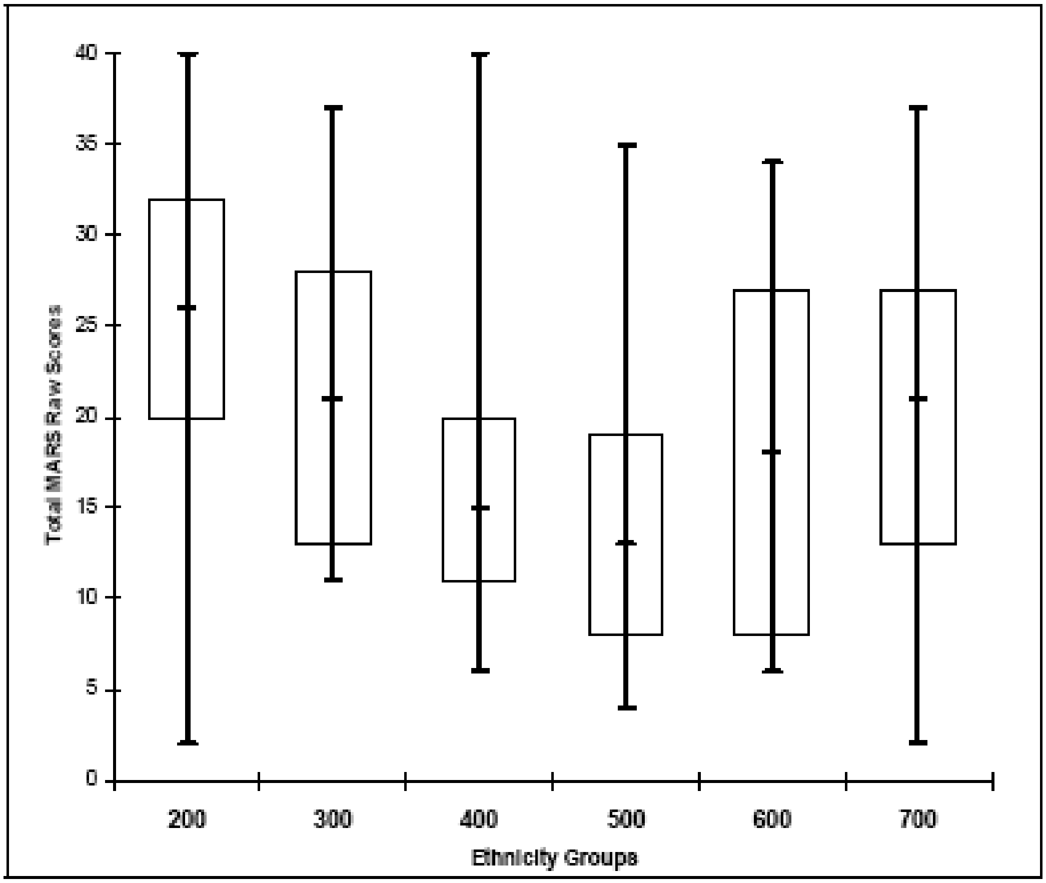


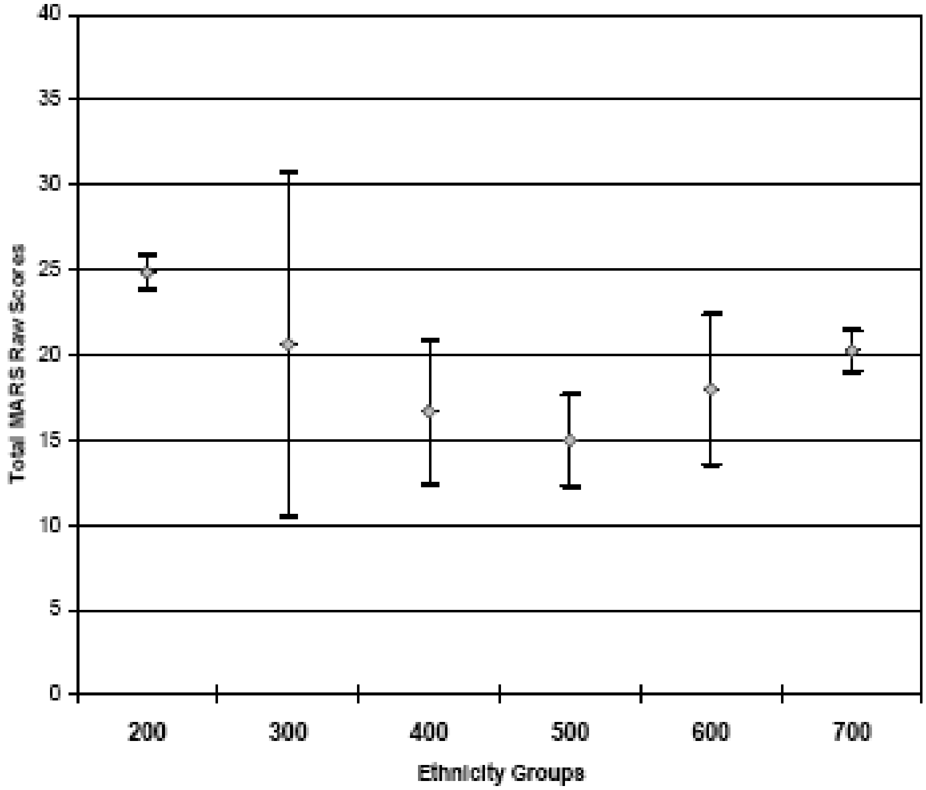
Table 9.1 Student count for Ethnicity

Ethnicity Groups	Ethnicity	Student Count
200	Asian/Asian American	312
300	Pacific Islander	5
400	Filipino	19
500	Hispanic/Latino	43
600	African American	17
700	White (Not Hispanic)	217

*Extremes are cases with values more than three box lengths from the upper or lower edge of the box.

Figure 18.1 Distribution of sampling means by Ethnicity

Course: 2



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700	White (Not Hispanic)	218

Distribution of sampling means
Course 2
Ethnicity

In this section, test scores are compared across different ethnic groups[1]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

The scores of Asian/Asian American students are significantly higher than the scores of students from all other ethnic groups. Aside from that there are not many significant differences among means for ethnic groups in the Course 2 data. The scores of Hispanic students are lower than those of White students (in addition to being lower than the Asian/Asian American mean score).

[1] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Figure 9.2 Box and whisker plot of Total MARS Raw Scores by Home Language

Course: 2

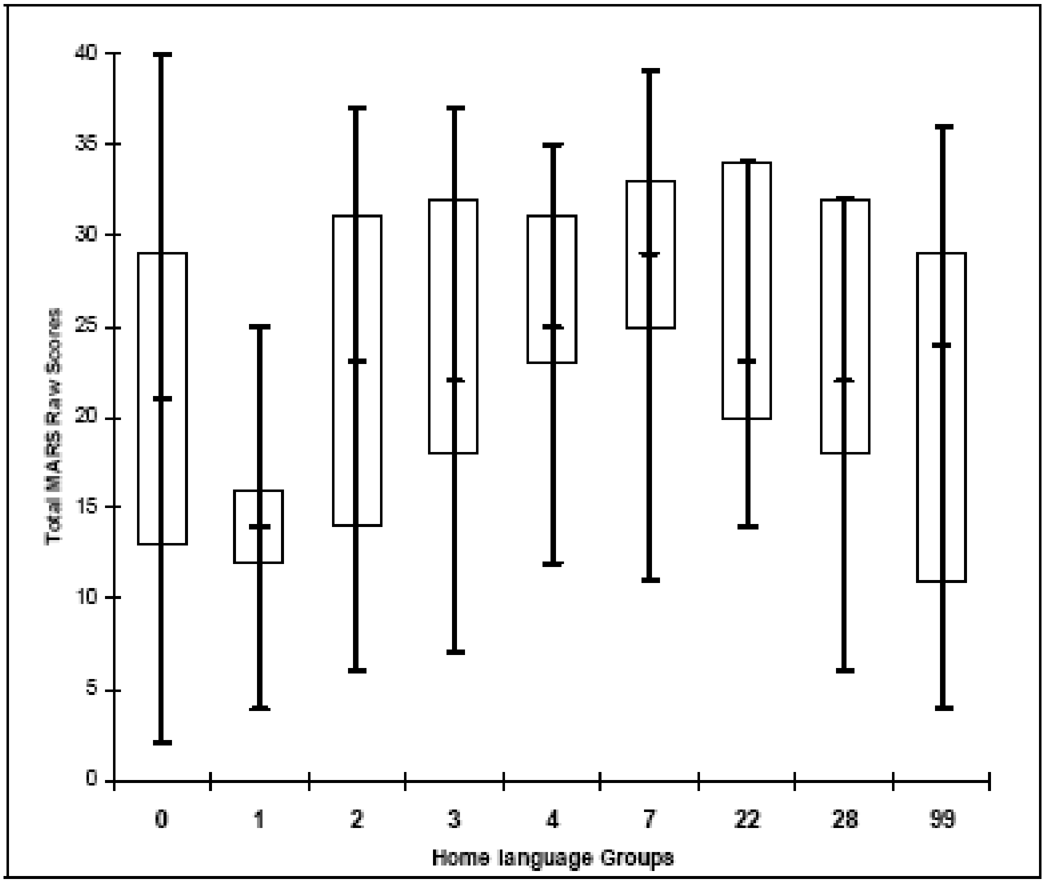
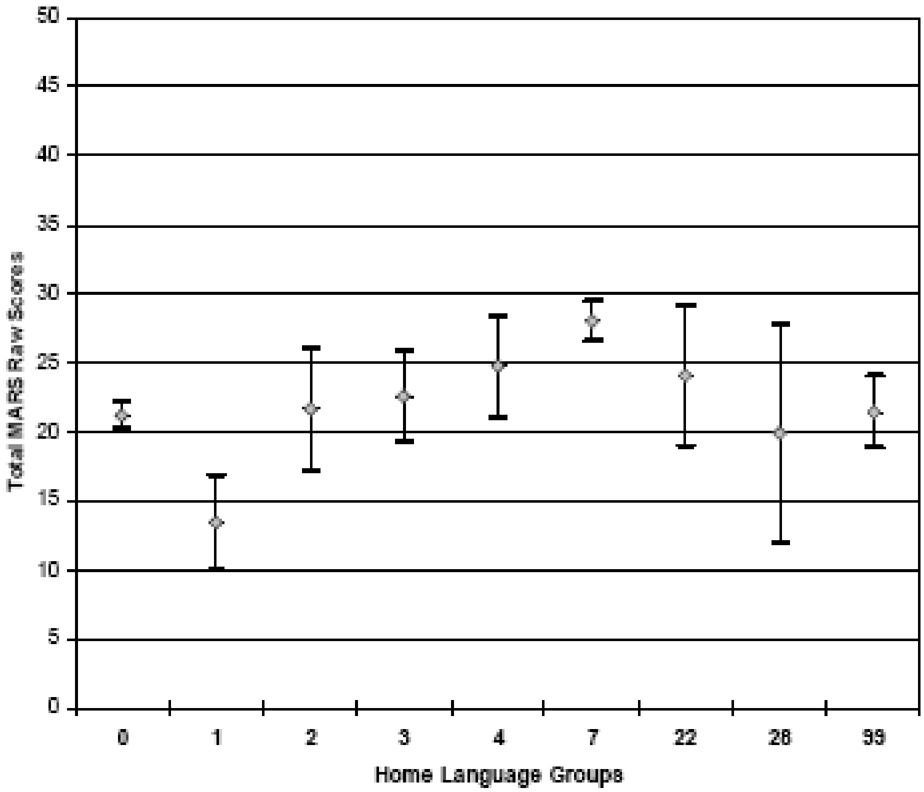


Table 9.2 Student count for Home Language

Home Language Group	Home Language	Student Count
0	English	373
1	Spanish	14
2	Vietnamese	20
3	Cantonese	27
4	Korean	13
7	Mandarin	80
22	Hindi	9
28	Punjabi	7
99	Others/Unknown	58

Figure 18.2 Distribution of sampling means by Home Language

Course: 2



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3	Cantonese	27
4	Korean	13
7	Mandarin	80
22	Hindi	9
28	Punjabi	7
99	Others/Unknown	58

Distribution of sampling means
Course 2
Home Language

In this section, test scores are compared across groups of students who speak different languages at home[2]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

The mean score for students who speak Mandarin at home is higher than the scores of English and Spanish-speakers. Students who speak English, Cantonese or Korean at home also have higher mean scores than students who speak Spanish at home.

[2] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Figure 9.3 Box and whisker plot of Total MARS Raw Scores by Parent Education

Course: 2

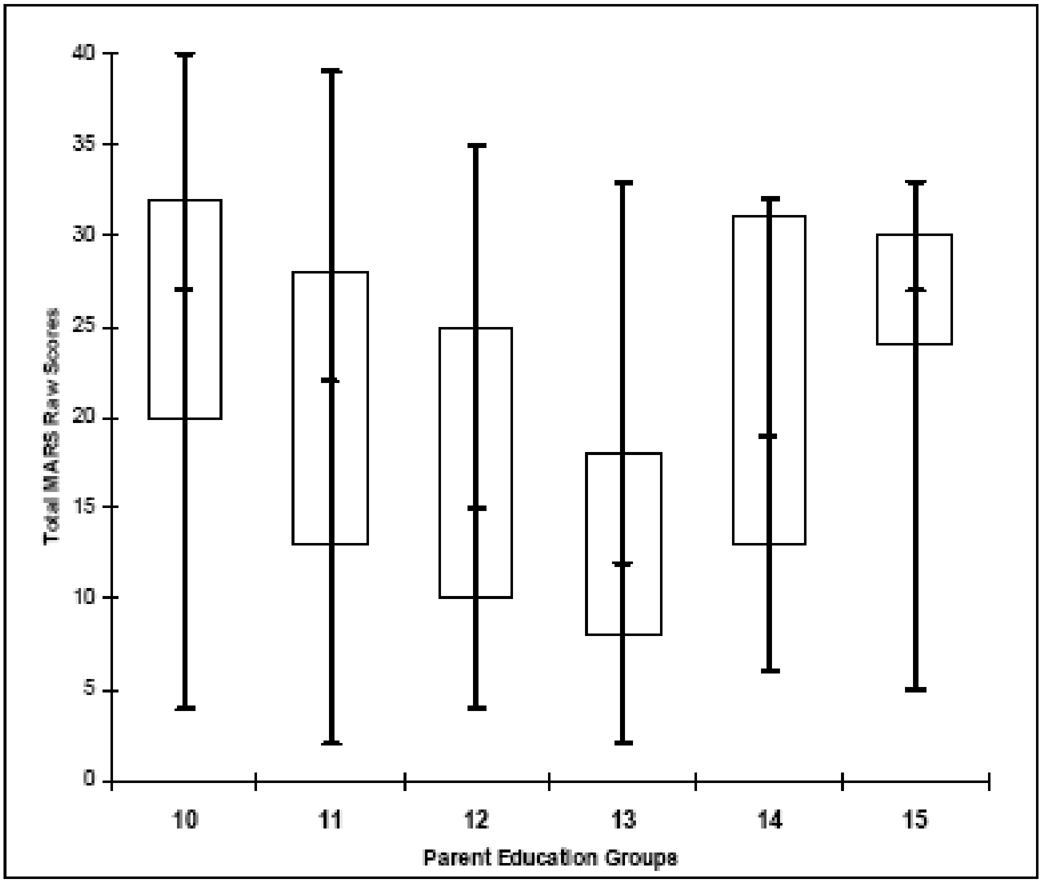
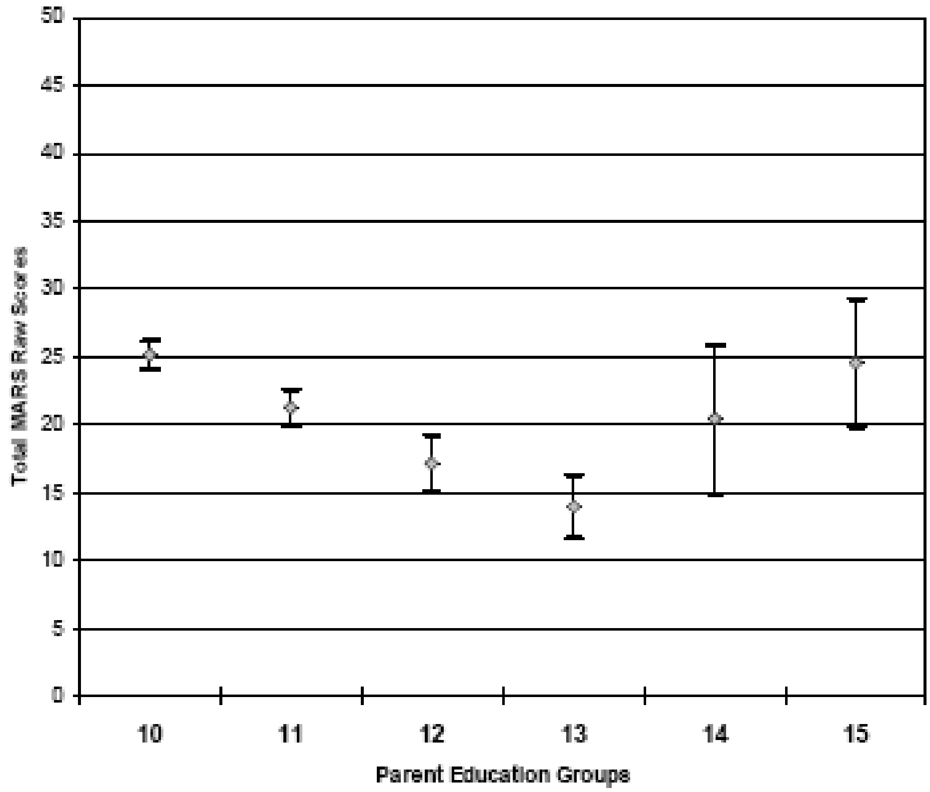


Table 9.3 Student count for Parent Education

Parent Education Group	Parent Education	Student Count
10	Graduate School	273
11	College graduate	195
12	Some college	81
13	High School graduate	40
14	Not a high school graduate	12
15	Others/Unknown	15

Figure 18.3 Distribution of sampling means by Parent Education

Course: 2



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Parent Education Group	Parent Education	Student Count
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11	College graduate	195
12	Some college	81
13	High School graduate	40
14	Not a high school graduate	12
15	Others/Unknown	15

Distribution of sampling means
Course 2
Parent Education

In this section, test scores are compared across groups of students with different levels of parent education[3]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

Students whose parents have higher levels of education typically have statistically higher mean scores than students whose parents have lower levels of education. For Course 2, however, the mean for students whose parents did not graduate from high school is not statistically different from any other group. The scores of students whose parents have a graduate school education are higher than all the remaining groups, followed by students whose parents are college graduates. The mean score of students whose parents have some college education are not significantly higher scores than the mean score of students whose parents are high school graduates.

[3] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Figure 9.4 Box and whisker plot of Total MARS Raw Scores by Gender

Course: 2

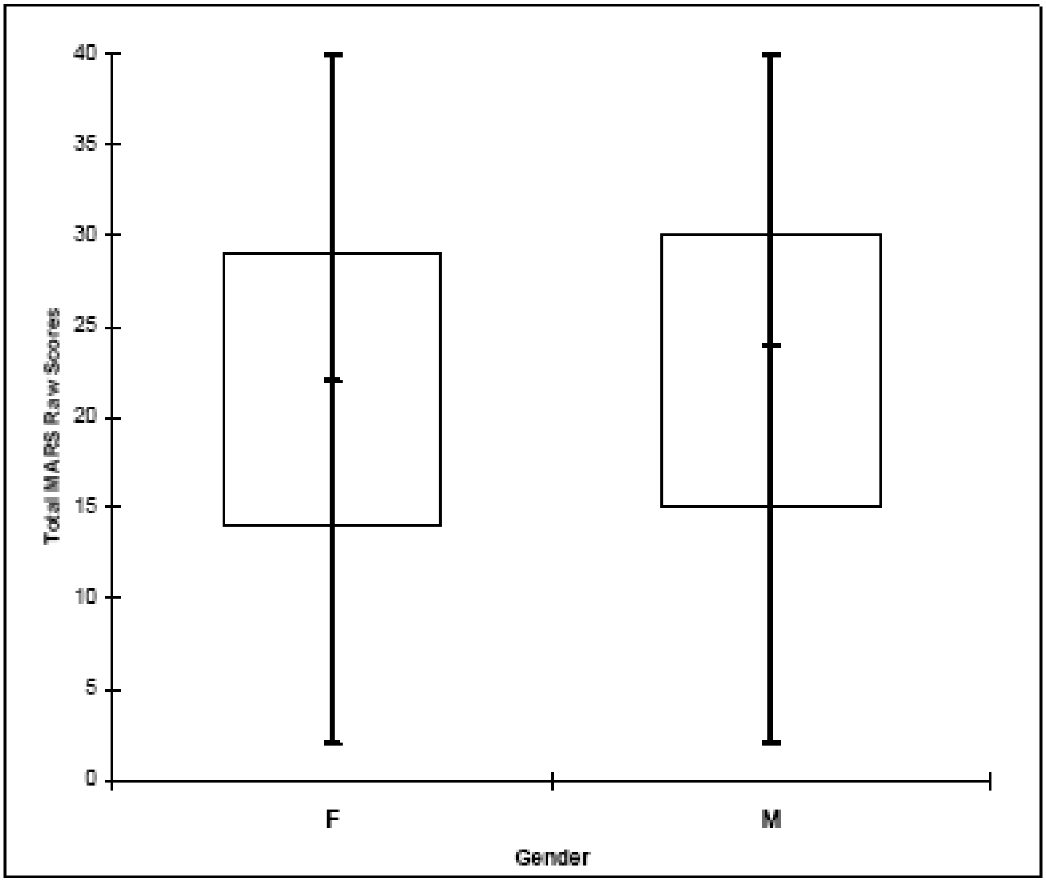


Table 9.4 Student count for Gender

Gender	Student Count
Female	312
Male	304

Figure 18.4 Distribution of sampling means by Gender

Course: 2

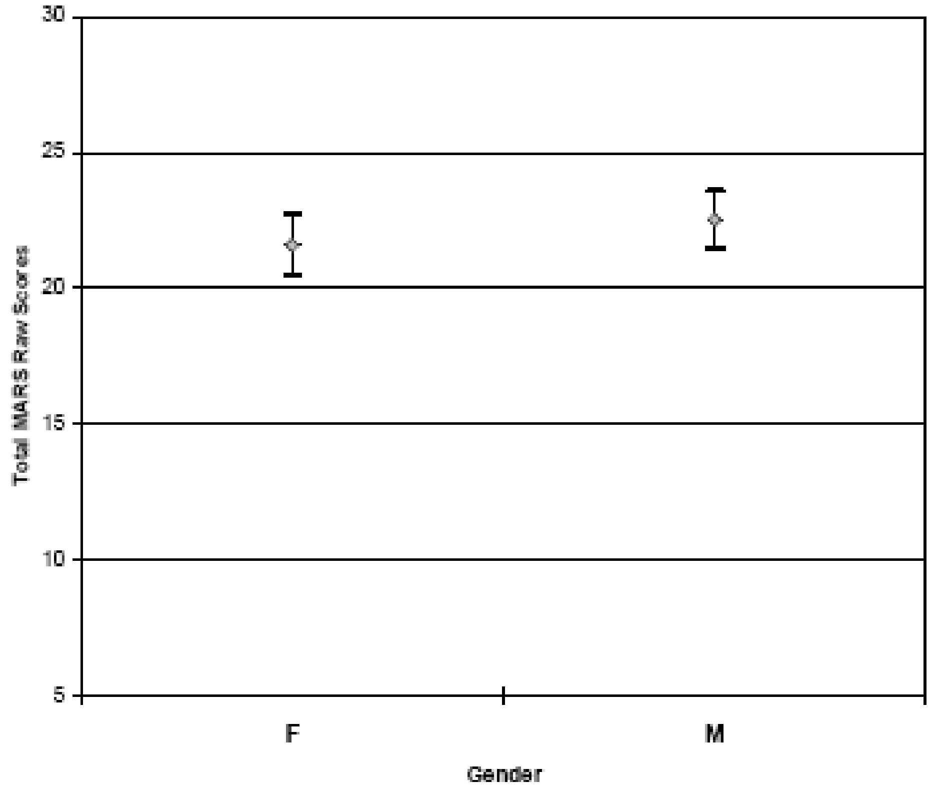


Table 18.4 Student count for Gender

Gender	Student Count
Female	312
Male	304

Distribution of sampling means
Course 2
Gender

In this section, test scores are compared across genders[4]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

The difference in mean scores for males and females is not statistically significant.

[4] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Figure 9.5 Box and whisker plot of Total MARS Raw Scores by Language Fluency

Course: 2

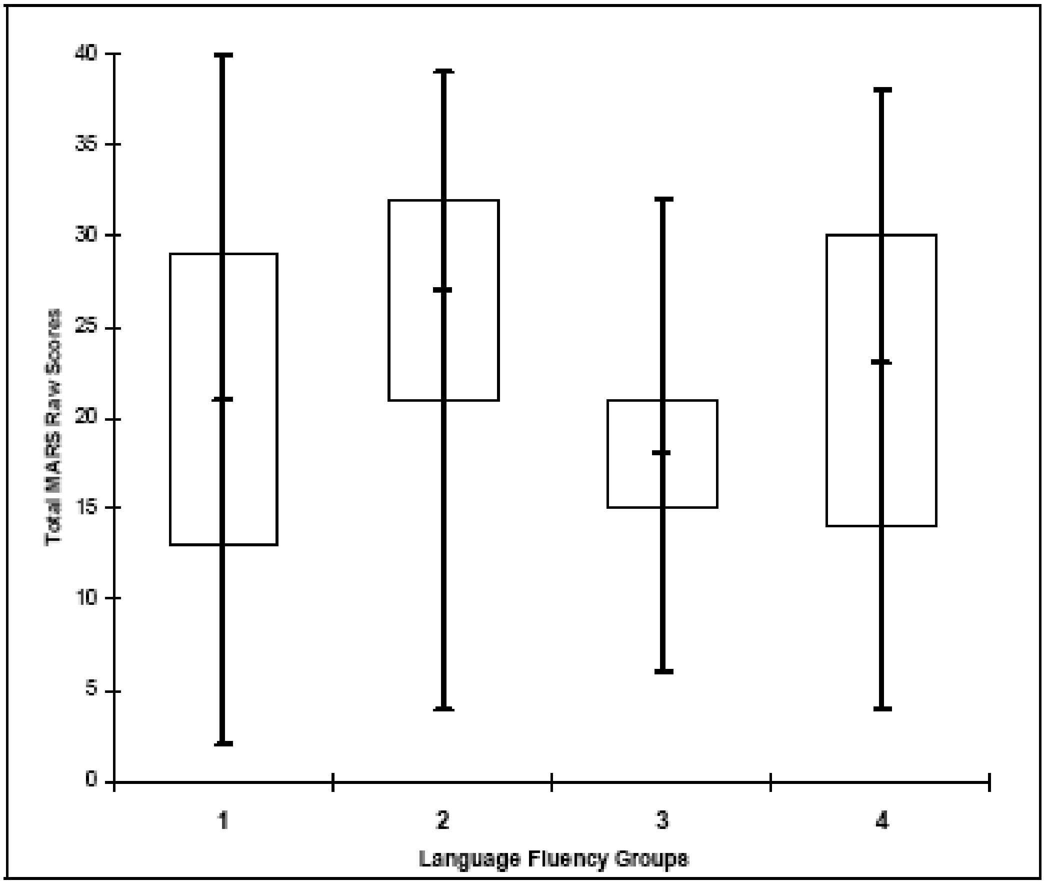
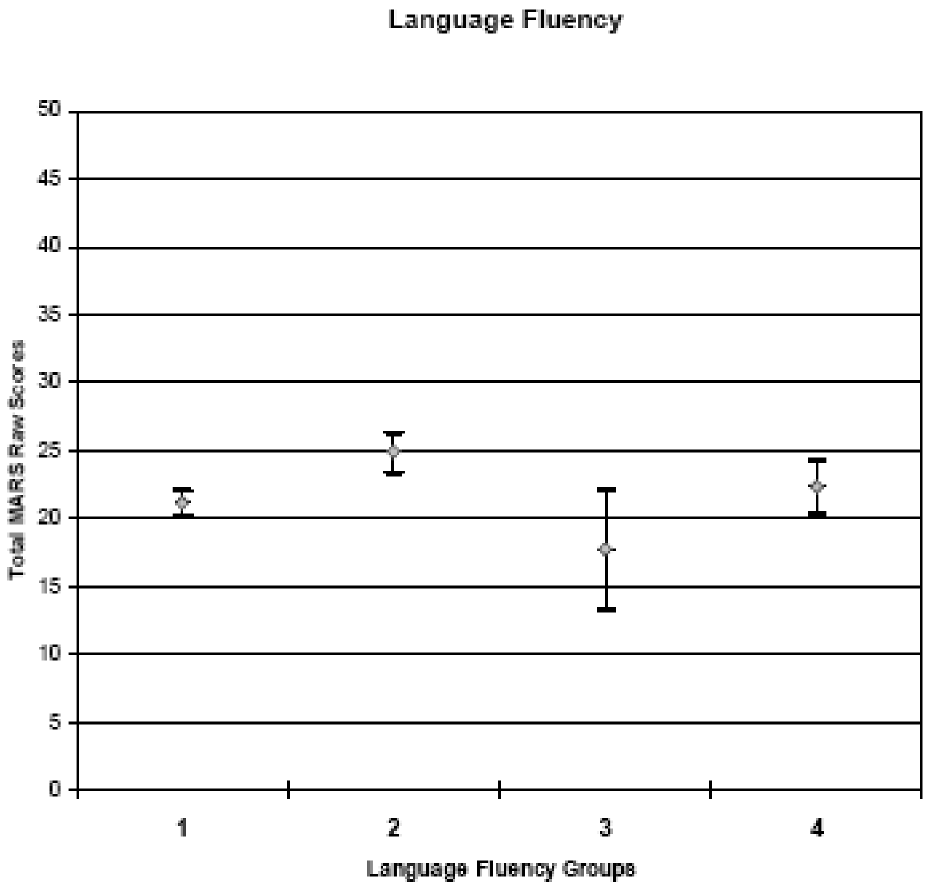


Table 9.5 Student count for Language Fluency

Language Fluency Group	Language Fluency	Student Count
1	English only	375
2	Initially Fluent (I-FEP)	134
3	English Learner	14
4	ReDesignated (R_FEP)	93

Figure 18.5 Distribution of sampling means by Language Fluency

Course: 2



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Language Fluency Group	Language Fluency	Student Count
1	English only	375
2	Initially Fluent (I-FEP)	134
3	English Learner	14
4	ReDesignated (R_FEP)	93

Distribution of sampling means
Course 2
Language Fluency

In this section, test scores are compared across different English language proficiency groups[5]. One way to look at the group differences is to study the graphs. If scores from group A are above and do not overlap scores from group B, then group A is significantly above group B. Conversely, if the scores from group A are below and do not overlap the scores from group B, then group A is significantly lower than group B. When the two scores overlap there is no significant difference between the groups.

The students classified as FEP have a significantly higher mean score than English only students and English learners but the scores are not statistically different from the mean score for R-FEP students. Indeed, the mean for R-FEP students is not significantly different from the mean of any other group.

[5] Overall comparisons were made using an Analysis of Variance (ANOVA) test. Comparisons between the groups were made using Tukey's honestly significant difference. All differences were significant at the .05 level.

Student Task	Find the lengths and speeds on a rotating wheel. Reason about the relationship between function of speed and its graph over time.
Geometry & Measurement	**Analyze characteristics and properties of two- and three-dimensional geometric shapes; develop mathematical arguments about geometric relationships; and apply appropriate techniques, tool, and formulas to determine measurements.**
Algebraic Properties and Representations	Recognize and use equivalent graphical and algebraic representations.

Implications for Instruction

Students at this grade level need more work with problems in context, where they need to reason about the information given and reason about which part of the geometrical figure relates to the solving the problem. It is one think to look at a problem in a text book about finding the circumference or 1/4 of the diameter, but the visualization to determine how far a rider is moving in terms of total distance and distance from the ground is quite different. Students need to be able to apply the mathematics they are learning in practical settings.

Students should be routinely using diagrams to help them make sense of what they know and what they need to find out. They need to be able to decompose shapes into relevant parts and how they correspond to the context of the problem. Other problems involving decomposing diagrams include: 2001 Course 2: Writing Desk and 2005 Course 2: Pipes.

Students at this grade level should be able to understand and use speed and time graphs. They should understand that the shape of the graph is not the same as the action in the context. Students should understand the relationship between slope and speed.

MARS Test Task 1 Frequency Distribution and Bar Graph, Course 2

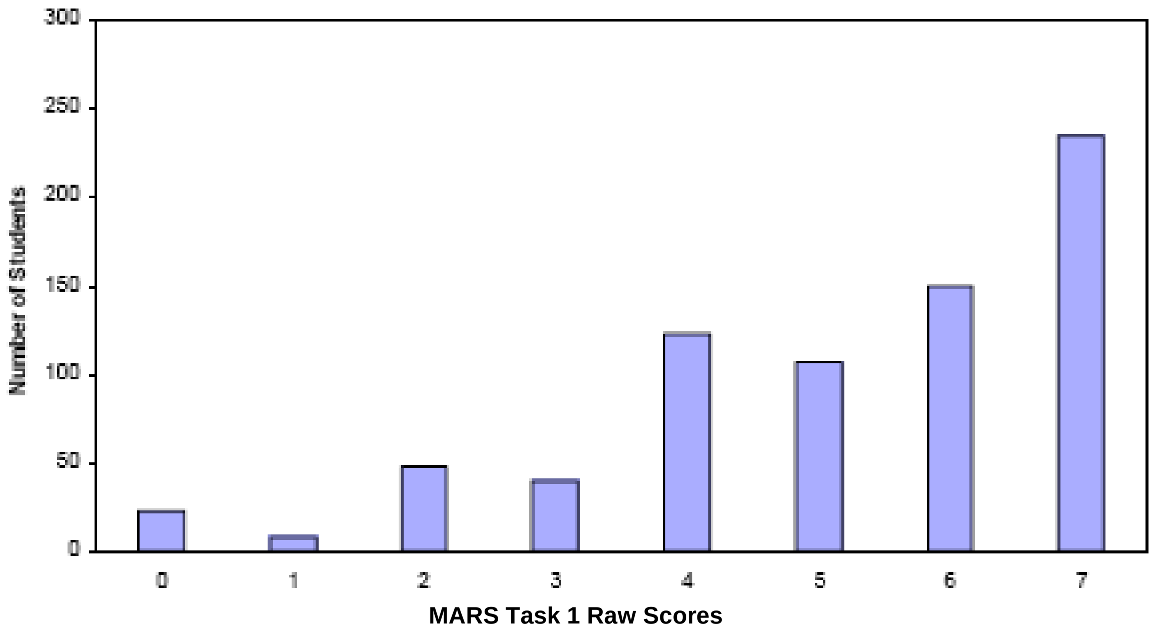
Task 1 – London Eye

Mean: 5.17 StdDev: 1.84

Table 50: Frequency Distribution of MARS Test Task 1, Course 2

Task 1 Scores	Student Count	% at or below	% at or above
0	23	3.1%	100.0%
1	8	4.2%	96.9%
2	48	10.8%	95.8%
3	40	16.3%	89.2%
4	122	33.0%	83.7%
5	106	47.5%	67.0%
6	150	68.0%	52.5%
7	234	100.0%	32.0%

Figure 59: Bar Graph of MARS Test Task 1 Raw Scores, Course 2



The maximum score available for this task is 7 points.
The minimum score for a level 3 response, meeting standards, is 4 points.

Most students, 95%, could find the circumference of the wheel and show their calculations. Many students, 84%, could find the circumference of the wheel and identify the graph that matched the speed and time of the London Eye, including an explanation for choosing the graph. More than half the students, (52%), could also calculate the speed of wheel. 32% of the students could meet all the demands of the task, including finding the height of the wheel after 1/4 of the ride had been completed. Only 3% of the students scored no points on the task. 75% of students with that score attempted the task.

Student Task	Work with the Pythagorean Rule, angles and similarity in given triangles. Write a justification for whether or not a triangle in a diagram has a right angle.
Core Idea 2 Mathematical Reasoning and Proof	**Employ forms of mathematical reasoning and proof appropriate to the solution of the problem, including deductive and inductive reasoning, making and testing conjectures and using counter examples and indirect proof.**
Core Idea 3 Geometry & Measurement	**Analyze characteristics and properties of two- and three-dimensional geometric shapes; develop mathematical arguments about geometric relationships; and apply appropriate techniques, tool, and formulas to determine measurements.**

Implications for Instruction

Students at this grade level should frequent opportunities to apply their knowledge to problem-solving situations. Students need opportunities to work with rich problems where they can pull from a variety of tools (in this case Pythagorean theorem and trig functions) to make justifications. Students should be given to share their and compare their justifications so they learn the logic of what makes a convincing argument. Students should see the variety of ways that a diagram can be used to helped track what is know and what needs to be calculated. In working with Pythagorean theorem, students need to understand not only how to use the formula, but connect the calculations to basic ideas such as the hypotenuse is the longest side of a right triangle.

Students need more work with similarity. Many are still using everyday definitions for similar, like one resembles or shares some characteristics with another. Students are not thinking about a more precise mathematical definition: same shape and proportional sides. Students need experiences that help them see that proportional sides means there is a multiplicative relationship rather than an additive relationship. Too often textbooks give examples where the scale factor is two. For these examples the student could add or multiply to get the next answer. There is no need to understand that both sides of the object are multiplied by 2. Students need to work with examples, such as stretching and shrinking shapes to see how addition distorts the shape of the object. (Look at MAC tasks like 7th grade 2001 – The Poster for proportional reasoning)

MARS Test Task 2 Frequency Distribution and Bar Graph, Course 2

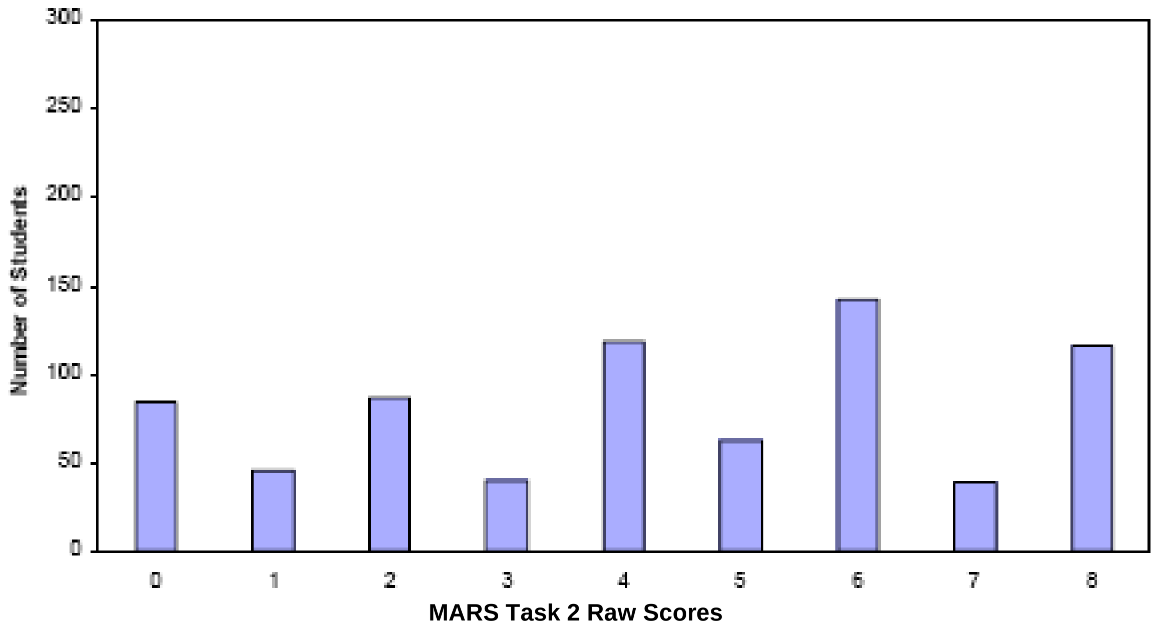
Task 2 – Hopewell Geometry

Mean: 4.33 StdDev: 2.59

Table 51: Frequency Distribution of MARS Test Task 2, Course 2

Task 2 Scores	Student Count	% at or below	% at or above
0	84	11.5%	100.0%
1	45	17.6%	88.5%
2	86	29.4%	82.4%
3	40	34.9%	70.6%
4	118	51.0%	65.1%
5	62	59.5%	49.0%
6	142	78.9%	40.5%
7	38	84.1%	21.1%
8	116	100.0%	15.9%

Figure 60: Bar Graph of MARS Test Task 2 Raw Scores, Course 2



The maximum score available for this task is 8 points.
The minimum score for a level 3 response, meeting standards, is 6 points.

Many students, about 82%, could find the length of the hypotenuse for H using Pythagorean theorem. More than half the students, 65%, could find the length of the hypotenuse for H and use proportional reasoning to find a triangle similar to triangle 1. Almost half the students, 40%, could find the hypotenuse, find a similar triangle, and also use trig or Pythagorean theorem to justify why the shaded triangle is not a right triangle. Almost 16% of the students could meet all the demands of the task including using trig functions to find the smallest angle in a right triangle. 11.5% of the students scored no points on this task. 77% of the students with this score attempted the task.

Student Task	Find graphical properties of a quadratic function given its formula.
Core Idea 1 Functions	**Understand patterns, relations, and functions.** • Understand and perform transformations on functions. • Understand properties of functions including quadratic functions.
Core Idea 2 Mathematical reasoning and proofs	Identify, formulate and confirm conjectures.

Implications for Instruction

Students need opportunities to practice algebraic skills. Providing situations, such as making justifications, can sharpen their algebraic skills and develop the logical thinking that is being promoted in the geometry course. Fostering Algebraic Thinking by Mark Driscoll provides an interesting variety of problems that build on algebraic skills and justification. For example:

Investigate and explain this pattern:
1/2 – 1/3 = 1/2 x 1/3
1/3 – 1/4 = 1/3 x 1/4
1/4 – 1/5 = 1/4 x 1/5, etc.
Why? Will this work for non-unit fractions. Why or why not?

Standard textbooks often routinely have sections for algebra review or make statements that could be turned into good problems. For example, in McDougall Littell Integrated Course 2, it tells students that the relationship of surface area for any two spheres is the ratio of their radius squared. This could be turned into an investigation about comparing different spheres and trying to find relationships that could be written in a generalized form.

Students should develop the habit of mind of showing their work and calculations. Too many students seemed to "guess" about whether the statements were true or false, without doing substitution to check or verify the truth of the statement. How do you help students develop productive habits of mind?

In Adding it Up, Helping Children Learn Mathematics, published by the National Research Council, it states that "All young Americans must learn to think mathematically, and the must think mathematically to learn." It analyses the mathematics to be learned as consisting of conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and *productive disposition*. Productive disposition is described as the habitual inclination to see mathematics as seeing mathematics as sensible, something that can be worked out, that is worthwhile, that requires persistence, and a belief in diligence and one's own efficacy.

How do we build that habit of testing ideas to see if they work, not taking things for granted or not guessing? How do we get students who want to "tinker" with mathematics to see what they can discover?

MARS Test Task 3 Frequency Distribution and Bar Graph, Course 2

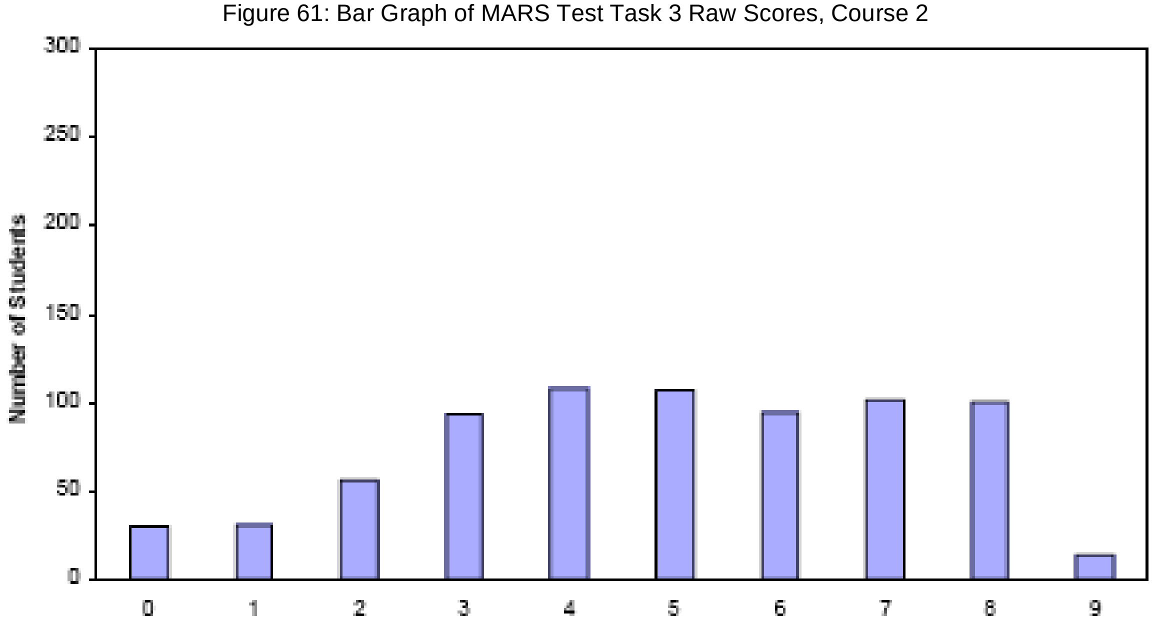
Task 3 – Quadratic

Mean: 4.89 StdDev: 2.29

Table 52: Frequency Distribution of MARS Test Task 3, Course 2

Task 3 Scores	Student Count	% at or below	% at or above
0	30	4.1%	100.0%
1	31	8.3%	95.9%
2	55	15.9%	91.7%
3	93	28.6%	84.1%
4	107	43.2%	71.4%
5	106	57.7%	56.8%
6	94	70.6%	42.3%
7	101	84.4%	29.4%
8	100	98.1%	15.6%
9	14	100.0%	1.9%

Figure 61: Bar Graph of MARS Test Task 3 Raw Scores, Course 2



The maximum score available on this task is 9 points.
The minimum score for a level 3 response, meeting standards, is 5 points.

Most students, 84%, could identify the coordinates of the point where a quadratic equation cuts the y-axis, understand this a quadratic has no maximum value, and knew that graph of an equation can be transformed into the graph of another by translations or stretches. More than half the students, 57%, could also factor a quadratic and make an inequality to describe when the quadratic was below the x-axis. Some students, 15.6%, could also use substitution to evaluate a quadratic, find the roots for the quadratic, and draw the shape of the graph. Less than 2% of the students could quantify a transformation. About 8% of the students scored no points on the task. None of the students with this score in sample attempted the task.

Geometry Task 4 How Compact?

Student task	Use a formula for a new concept. Calculate areas. Use the Pythagorean Theorem.
Core Idea 3 Algebraic Properties & Representations	**Represent and analyze mathematical situations and structures using algebraic symbols.** • Develop fluency in operations with real numbers. • Solve equations involving radicals and exponents in contextualized problems such as use of Pythagorean Theorem.
Core Idea 4 Geometry & Measurement	• Understand and use formulas for the area, surface area, and volume of geometric figures.

Implications for Instruction

Students need more practice with working problems in context and using diagrams. While many students could use Pythagorean theorem when it was laid out for them in textbook format with a right triangle, they obviously did not think about how the hypotenuse related to longest distance in a rectangle. Students need to be able to apply knowledge to unfamiliar situations and contexts.

Students also need to think about labelling diagrams. What is the longest distance for each of the three figures? What does that distance relate to mathematically? How can it be calculated? These types of self-questioning or internal dialogue are different from working problems as they appear in textbooks. How do you help students develop this internal dialogue?

While sometimes leaving expressions in unsimplified form is important for showing the assumptions behind a solution, at other times simplification can help lead to generalizations. Students need to have opportunities to discuss when simplification is important or useful and why. Students need to have exposure to many problems that allow them to build generalizations.

MARS Test Task 4 Frequency Distribution and Bar Graph, Course 2

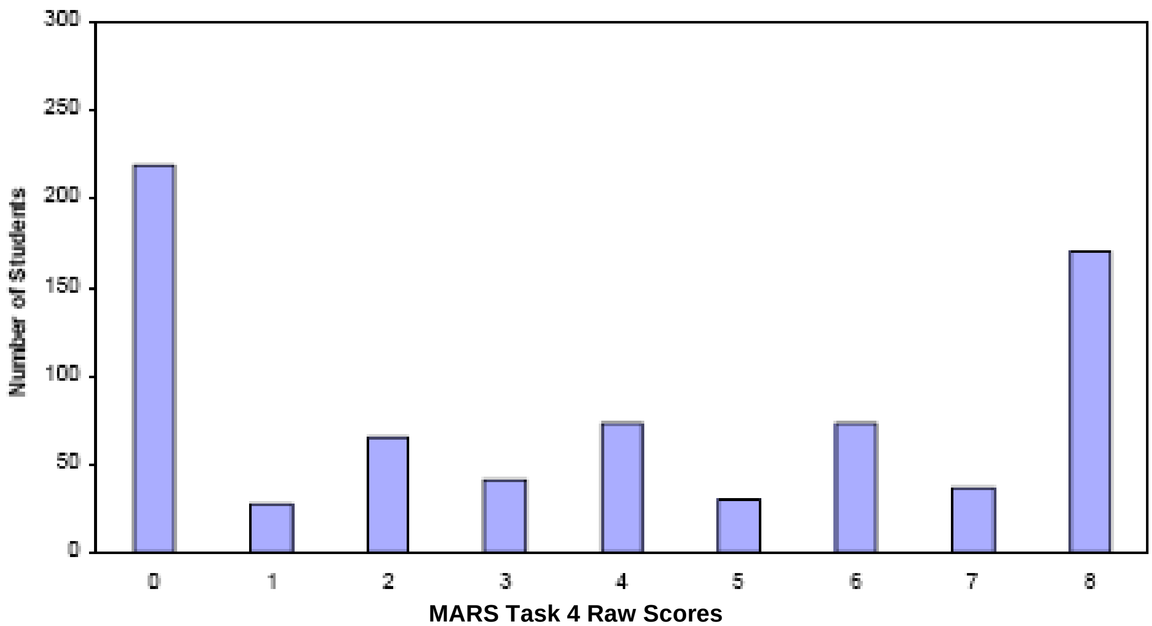
Task 4 – How Compact?

Mean: 3.78 StdDev: 3.18

Table 53: Frequency Distribution of MARS Test Task 4, Course 2

Task 4 Scores	Student Count	% at or below	% at or above
0	218	29.8%	100.0%
1	27	33.5%	70.2%
2	64	42.3%	66.5%
3	41	47.9%	57.7%
4	72	57.7%	52.1%
5	30	61.8%	42.3%
6	73	71.8%	38.2%
7	36	76.7%	28.2%
8	170	100.0%	23.3%

Figure 62: Bar Graph of MARS Test Task 4 Raw Scores, Course 2



The maximum score available on this task is 8 points.
The minimum score for a level 3 response, meeting standards, is 4 points.

Many students, about 67%, could either use the formula to find the compactness for either a triangle or a circle with a radius of 2. About half the students, 52%, could do both or work with the compactness of a specific and general circle, including finding the generalization that all circles have a compactness of 1. Almost 40% of the students could find the compactness of a triangle, circle, and make a generalization about a circle. 23% of the students could meet all the demands of the task including using the formula to calculate the compactness of a rectangle. Almost 30% of the students scored no points on this task. 95% of the students with this score attempted the task.

Geometry Task 5 Rhombuses

Student task	Use the properties of a rhombus. Use Pythagorean Theorem. Make a justification for similarity.
Core Idea 2 Mathematical Reasoning & proof	Employ forms of mathematical reason and proof appropriate to the solution of the problem at hand, including deductive and inductive reasoning, making and testing conjectures and using counter examples. • Explain the logic inherent in a solution process.
Core Idea 3 Geometry & Measurement	Analyze characteristics and properties of two and three-dimensional geometric shapes; develop mathematical arguments about geometric relationship; and apply appropriate techniques, tool, and formulas to determine measurements. • Understand and use formulas, including solving Pythagorean theorem and trig functions. • Make and test conjectures about geometric objects.

Implications for Instruction

Students seem to be unclear on the working definition for some geometric shapes, like rhombus, based on key attributes like equal sides. Students are also unclear about definition for similarity for rhombi. They don't understand what attributes must be proportional, what attributes must be the same. Why is it enough to show proportionality for the sides of two triangles or two rectangles, but not enough for a rhombus? What makes this shape unique?

MARS Test Task 5 Frequency Distribution and Bar Graph, Course 2

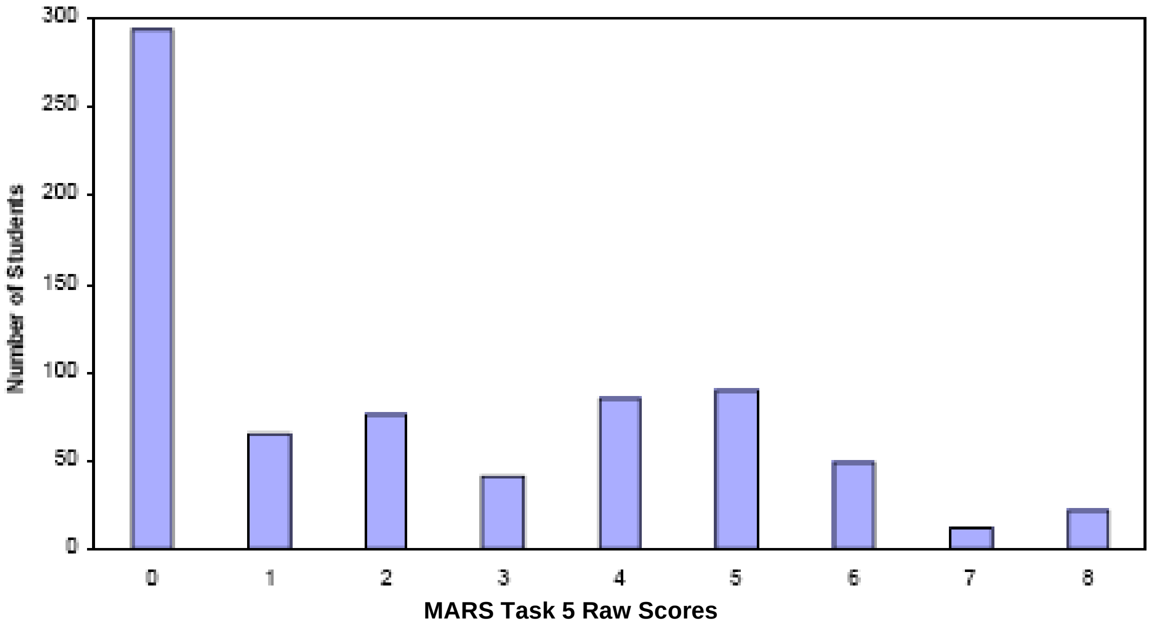
Task 5 – Rhombuses

Mean: 2.28 StdDev: 2.39

Table 54: Frequency Distribution of MARS Test Task 5, Course 2

Task 5 Scores	Student Count	% at or below	% at or above
0	293	40.1%	100.0%
1	65	49.0%	59.9%
2	76	59.4%	51.0%
3	41	65.0%	40.6%
4	85	76.6%	35.0%
5	90	88.9%	23.4%
6	49	95.6%	11.1%
7	11	97.1%	4.4%
8	21	100.0%	2.9%

Figure 63: Bar Graph of MARS Test Task 5 Raw Scores, Course 2



The maximum score available on this task is 8 points.
The minimum score needed for a level 3 response, meeting standards, is 3 points.

More than half, 59%, the students could use subtraction to find the side of the rhombus on the rectangle. About half the students could also use Pythagorean theorem to find the other side of the rhombus to prove that all sides were equal. About 1/3 of the students could also use Pythagorean theorem to find the size of the sides of the rhombus in part one of the task. Slightly more than10% could show that both figures were rhombi. About 3% could meet all the demands of the task including proving that the two rhombi were similar by proving that the angles were equal. 40% of the students scored no points on this task. 85% of the students with this score attempted the task.

Director's Note

The MAC Project is made possible through the generous contributions of the Robert Noyce Foundation. David Foster has been instrumental in his clear vision for mathematics, identifying the work of MARS and how it connects to that vision, and being able to pull together the diverse groups, which make up the Mathematics Assessment Collaborative. None of this would have materialized without his leverage and encouragement.

The Santa Clara Valley Mathematics Project, led by Dr. Joanne Rossi Becker, has been instrumental in the success of the Mathematics Assessment Collaborative. Dr. Becker and the Math Project provide support to MAC in various capacities. Dr. Becker serves on the M.A.C. Executive Committee and plays an important role in advising the director and membership on matters of mathematics education. In other roles, Dr. Becker helps the Collaborative keep focused on mathematics standards, provides mathematical expertise and helps to set performance level boundaries. The San Jose State University Foundation is the fiscal agent of M.A.C. Dr. Becker plays an essential role in overseeing the budget and expense payments. Dr. Becker assists with high school professional development and arranging the audit scoring sessions that employ San Jose State University students and are conducted in their Mathematics Department. In addition SCMVP and Dr. Becker provide ongoing professional development for the member districts through projects such as the Summer Lab Schools and the Summer Coaching Institutes. These grants and programs also provide support that allows participating teachers to attend the MAC professional development sessions.