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ABSTRACT

This document is the first volume of a two-volume study that explores the gender and racial/ethnic factors contributing to differential participation and performance in mathematics by elementary and secondary school students in the Montgomery County Public Schools (Maryland). This first volume contains an introduction and three major sections. Section I, "Conceptual Framework," comprises the following chapters: (1) "Review of the Literature"; and (2) "Methods." Section II, "Findings Related to Mathematics Participation and Achievement by Gender and Racial/Ethnic Group," comprises the following chapters: (1) "Mathematics Enrollment and Achievement at the High School Level"; and (2) "Progress and Performance in a K-8 Mathematics Curriculum." Section III, "Findings Related to Attitudes and Beliefs About Mathematics by Gender and Racial/Ethnic Group," comprises the following chapters: (1) "Students' Attitudes and Beliefs About Mathematics"; (2) "The Home Environment--Parental Attitudes, Beliefs, Expectations, and Support"; (3) "The School Environment: Teachers', Counselors', and Principals' Attitudes and Expectations Concerning Mathematics for Students"; and (4) "Summary and Recommendations." Statistical data are included on 72 tables and 7 graphs. The appendices include a list of 48 references, lists of mathematics curriculum objectives, copies of the data collection instruments, and the following statistical data: (1) course enrollment, grades, and California Achievement Test performance by gender and racial/ethnic group; (2) responses to student questionnaires; (3) responses to parent questionnaires; and (4) responses to teacher and counselor questionnaires. (FMW)

MONTGOMERY COUNTY PUBLIC SCHOOLS
ROCKVILLE, MARYLAND

Participation and Performance of Women and Minorities in Mathematics

A Project Supported by National Science Foundation Grant No: MDR-8470384 and the Montgomery County Public Schools

Volume I: Findings by Gender and Racial/Ethnic Group

July 1988

Harry Pitt
Superintendent of Schools

Prepared by the Department of Educational Accountability

MONTGOMERY COUNTY PUBLIC SCHOOLS
Carver Educational Services Center
Rockville, Maryland

PARTICIPATION AND PERFORMANCE OF WOMEN AND MINORITIES IN MATHEMATICS:

A PROJECT SPONSORED BY NATIONAL SCIENCE FOUNDATION GRANT NO. MDR-8470384
AND THE MONTGOMERY COUNTY PUBLIC SCHOOLS

VOLUME I: FINDINGS BY GENDER AND RACIAL/ETHNIC GROUP

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PARTICIPATION AND PERFORMANCE OF WOMEN AND MINORITIES IN MATHEMATICS

EXECUTIVE SUMMARY

BACKGROUND

For more than a decade, Montgomery County Public Schools (MCPS) has had priority goals for the education of female, Black, and Hispanic students in key academic areas such as mathematics. The school system has devoted a great deal of time, attention, and resources to the development of innovative curricula, staff awareness and sensitivity to cultural differences and sex role stereotypes, and staff training in promising practices and strategies such as differentiated instruction. The following are some of the major steps that have been taken:

- o MCPS led the nation in establishing a Board of Education policy in 1972 that mandated specific actions on the part of staff to address the problem of underachievement and underrepresentation of Black students in academic and extracurricular areas.

- o In the mid 1970's, MCPS conducted an institutional study required by Title IX, and designated a Title IX Coordinator in the Department of Human Relations. Annual conferences have been conducted by the Department of Human Relations and the Office of Instruction and Program Development, to provide staff with ways of fostering interest of female, Black, and Hispanic students in technical courses and careers.

- o The school system was the first in the greater Washington D.C. area to publish standardized test score results in 1978, showing differential performance by gender and racial/ethnic group.

- o Commitment to increasing Black and Hispanic students' achievement and participation was reiterated in 1983 when the Board of Education set the priority to:[1] "implement a special emphasis program that will result in substantial gains in a) the performance of minority students in the classroom and on standardized and criterion-referenced tests; b) the participation of minority students in programs for the gifted and talented, higher level academic courses, and extracurricular activities."

- o In 1985 MCPS adopted a policy on Women's Equity which stipulated actions that school and central office personnel must take to ensure equal opportunity and elimination of sex role stereotypes concerning student participation in courses, athletics, and other extracurricular activities, as well as staff employment opportunities.

- o In 1985 the MCPS Board of Education adopted the Initiatives for Sex Equity, which had several long-range goals: improvement of SAT scores for females, increased enrollment of females in computer science

1. <u>PRIORITIES: Montgomery County Board of Education</u>, Montgomery County Public Schools, September 1983.

courses and advanced courses in mathematics and science, and increased participation of women in nontraditional careers.

Such self-examination and leadership is essential to a vital school system.

In the last 10-12 years, substantial progress has been made toward these goals. For example, today, the performance of female, Black, and Hispanic students in the County far exceeds national levels of achievement for these groups. Within the state of Maryland as well, females, Blacks, and Hispanics outperform their peers in the other local school systems. This contrasts sharply with conditions in 1978 when Black students at all grade levels and Hispanic students in grades 7, 9, and 11 scored below national norms in mathematics achievement.

Despite these gains, the performance of female, Black, and Hispanic students continues to be a major concern. MCPS's proposal to the National Science Foundation (NSF) for funds to conduct a study of the participation and performance of female and minority students in mathematics is just one indicator of the continued interest in these areas. The unprecedented award by NSF to a school system rather than to an institution of higher education reflects NSF's judgment that MCPS is on the cutting edge of research, curriculum development, and student data management in these areas.

This document contains the findings of the NSF-funded study. The data show that, in many areas, MCPS has made great strides toward meeting the needs of its students in mathematics instruction. However, while the mathematics performance and participation of MCPS's female, Black, and Hispanic students has shown substantial improvement over the last decade, differences are still observed for students in different gender and racial/ethnic groups. This study represents one more step in MCPS's initiative in meeting the complex needs of all students in mathematics. Based on the findings in Montgomery County, it is likely that gender and racial/ethnic group performance and participation differences must be far greater in school systems that have not devoted similar time, attention, and resources to these issues.

Study Focus and Objectives

Over the last ten years or so, investigators have attempted to identify the factors that influence participation and success in mathematics for female, Black, and Hispanic students. In general, the research literature suggests that gender differences in mathematics participation do not emerge until senior high school, where mathematics course enrollment becomes optional after the completion of one or two years of required course-work. Females are less likely than males to enroll in elective and advanced mathematics courses and are less likely to pursue careers or fields of study that require heavy concentrations in mathematics. What few studies do address the mathematics experiences of minority students report large discrepancies in the performance of Black and Hispanic students when compared to White and Asian students at the elementary school level. These discrepancies continue to expand through the high school years.

This study of female, Black, and Hispanic students' mathematics participation and performance explored those factors which were believed to contribute to differential course-taking histories within the context of the elementary, junior high/middle, and high school environments. It was assumed that many of the decisions students make concerning high school mathematics participation have their roots in the elementary years. Thus, while a major focus of this study was the junior/high middle school and high school mathematics participation and performance of female, Black, and Hispanic students, the study also examined the mathematics participation[2] and performance of these groups of students in elementary school. Particular attention was devoted to those factors that might help explain the differential participation and performance of females compared to males, and Black and Hispanic male and female students compared to Asian and White males and females.

The overall goals of the study were threefold:

- to identify at what points, if any, in the educational process differences appear in the mathematics participation and performance of females compared to males, and Blacks and Hispanics compared to Asians and Whites, and to describe these differences

- to identify the factors in the school, home, and society that contribute to the differential mathematics participation of female, Black, and Hispanic students at the elementary, junior high/middle and senior high school levels

- to provide, where possible, the policy implications of the research and suggest alternatives or solutions which schools might wish to explore to increase the enrollment and achievement of females, Blacks, and Hispanics in mathematics.

While the primary focus of this research effort was to examine gender and racial/ethnic group differences, considerable attitudinal data were gathered from students and school staff, providing implications which bear upon mathematics instruction for students of both genders and all racial/ethnic groups. The bulk of this summary presents the major findings of the analyses concerning each of the three study goals listed above, and provides recommendations and conclusions that result from these findings. Additionally, this summary contains the major findings that resulted from an examination of the information obtained concerning mathematics instruction for all students.

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2. The word "participation" has two meanings in this report. At the high school level it refers to the highest level of mathematics instruction the students have completed (Geometry, Algebra 2, Calculus, etc.). At the elementary and junior high/middle school levels it refers to the student's placement in the K-8 mathematics curriculum. Students are placed in different levels (above, on, or below grade level) based on their rate of progress through the countywide mathematics curriculum objectives. Students who are in the same grade level are likely to be working on different curriculum objectives, or cover the same objectives in different levels of breadth and depth, if they are in different working level groups (above, on, or below level). Thus, they are viewed as "participating" in different mathematics experiences.

Organization of the Executive Summary

Findings from this study suggest that the factors contributing to participation and performance in mathematics are quite different for females than they are for Black and Hispanic students. Differences between female and male students do not appear until late in high school, when males enroll in advanced level mathematics classes in slightly larger numbers than females, and substantially outperform females on the mathematics section of the SAT. Differences in the performance of Blacks and Hispanics compared to Whites and Asians emerge very early in elementary school, and persist throughout the educational histories of these students. Therefore, the section that presents findings related to performance and participation is divided into a discussion of findings for female students, and a separate discussion of findings for Blacks and Hispanics. Similarly, recommendations are presented separately for females and Black and Hispanic students.

The following two sections present findings concerning the first two study goals shown above: identification of points in the educational process where differences in performance and participation emerge; and identification of factors in the school, home, and society that contribute to these differences. These sections are followed by the major findings related to the instruction of students as a whole. The final section presents recommendations and conclusions.

FINDINGS: AT WHAT POINT DO DIFFERENCES APPEAR?

Findings by Gender

Participation and Performance

The data show that participation and performance in the mathematics curriculum is fairly equal for male and female students from kindergarten through the first years of high school. It is only when the mathematics requirements for graduation and college admission are satisfied that gender differences emerge, with female students leaving high school with slightly less mathematics than males.

Achievement in mathematics was measured in the elementary and junior high/middle school grades by scores on the mathematics sections of the California Achievement Tests (CAT) and performance on locally-developed and calibrated criterion-referenced mathematics tests (CRT's). At the high school level, achievement was measured by the results of administration of the CAT in eleventh grade, and the Scholastic Aptitude Test (SAT) in eleventh and twelfth grades.

Both male and female students in Montgomery County performed better on the CAT and SAT than did comparable students nationwide (see Table E-1). Male and female students in the County performed equally as well on the CAT and the CRT's. However, surprisingly large differences emerged in SAT mathematics performance, with male students significantly outperforming females. This difference in SAT mathematics performance was observed regardless of the amount and complexity of mathematics and science courses taken by the students, and despite the fact that female students received higher grades than male students in all mathematics classes (see Table E-2).

TABLE E-1

SAT Score Means by Gender for Students in the Class of 1986
Who Took the SAT in Their Junior and/or Senior Years

Year of Test	All Students	Females	Males	Male/Female Difference
Montgomery County Means				
1985: Scores for Junior Year				
Verbal	477	466	489	23
Mathematics	530	505	561	56
Total Test	1007	971	1050	79
Number of Students	3155 *	1722	1433	
1985 or 1986: Highest Score Obtained in Junior and/or Senior Year				
Verbal	479	472	486	14
Mathematics	530	506	557	51
Total Test	1009	978	1043	65
Number of Students	4185 *	2273	1912	
United States Averages for Seniors **				
1985				
Verbal	431	425	437	12
Mathematics	475	452	499	47
Total Test	906	877	936	59
1986				
Verbal	431	426	437	11
Mathematics	475	451	501	50
Total Test	906	877	938	61

* Numbers and means are slightly different from overall Montgomery County figures since only those students who were enrolled in the County during their sophomore and junior years are included in the analysis.

** Students who take the SAT as seniors tend to average about 30 points lower, overall, than do juniors and seniors combined. This should be considered when making comparisons between seniors nationwide and Montgomery County juniors or juniors and seniors. Data source: Educational Testing Service.

TABLE E-2

Highest SAT Mathematics Score Obtained in Junior and/or Senior Year by Gender and Highest Mathematics Course Taken in High School

Highest Mathematics Course Taken	No. of Students		Average Score	Average Score		Average Male/Female Difference
	Fem.	Male	Total County	Female	Male	
Calculus	362	390	678	659	696	37
Pre-calculus	306	284	611	588	635	47
Advanced Alg.	520	396	529	511	552	41
Alg. 2 & Trig. (accelerated)	81	63	598	575	627	52
Trigonometry	96	89	513	494	533	39
Algebra 2	384	256	460	447	480	33
Geometry	224	167	409	391	433	42

NOTE: Separate analyses were conducted controlling both mathematics and science course enrollment, and very small, random changes in average male/female differences in SAT performance were observed. Thus, for simplicity of presentation, only differences in performance within level of mathematics course enrollment are presented in this report.

Attitudes and Beliefs About Mathematics

The results of surveys of samples of students in the fourth, sixth, eighth, and twelfth grades indicate that clear differences exist among groups of students in their levels of anxiety, confidence in, liking of, and perceived utility of mathematics. Female students seemed to be somewhat less confident in their abilities in mathematics than their male counterparts. They also turned to others for help more frequently than did males. A large group of males reported that males were better in mathematics than females. Additionally, male and female students alike reported that their mothers were not as good in mathematics as their fathers were.

Students' responses by gender indicate that there was little difference between males and females in the types of colleges they hoped to go to, and the number of years of college and graduate school that they planned on completing. Career aspirations, however, were quite different for these students. Males were more likely to aspire to careers in professional occupations utilizing mathematics or the physical sciences, or managerial occupations; females were more likely to want jobs that did not emphasize mathematics, and were less likely to view themselves as future managers. This difference in career objectives may have an influence on how much effort students are willing to take to understand the higher level mathematical concepts, and this, in turn, has an effect on SAT performance.

Supports for Mathematics in the Home and School

The data show that students' feelings about the utility of mathematics and the importance of doing well in school result in large part from parental expectations and pressures, and to a slightly lesser extent from the school environment. With the exceptions of only the very top female mathematics performers (those who finish high school mathematics with Calculus), female students receive less encouragement from the school, home, and society to pursue mathematics than male students receive.

Parents' responses to survey questions indicate that the students' mothers do not view themselves as competent in mathematics, and they communicate this message to their children. Fathers are more likely to help older children with their mathematics homework, whereas mothers are more likely to help children who are in the elementary grades and still dealing with elementary mathematical concepts. Moreover, while parents of today's students seem to be encouraging their daughters somewhat more than parents of the past did to take as much mathematics as possible, their goals for their children's future employment indicate that they still view mathematics and science careers as being primarily for men.

Principals' and counselors' responses suggest that many of them adhere to these views regarding gender and mathematics. More than 50 percent of the principals and about 60 percent of the counselors indicated that differences in the mathematics performance of males and females could be attributable to the following factors: females are not interested in mathematics, they feel they do not need mathematics for their careers, or they are not as competent in mathematics as are males. These views also appear to be reinforced by what students see in the classroom in terms of teacher competencies. In elementary school, where 90 percent of the classroom teachers are women, many teachers admit they are not comfortable teaching mathematics.

Findings by Racial/Ethnic Group

Participation and Performance

Racial/ethnic group differences in mathematics participation and performance were observed early in the students' educational history.[3] Asian and White

3. It is impossible to determine without further study whether students in all racial/ethnic groups actually start elementary school with similar mathematical skills, or whether many Asian and White students come to school already advanced, with skills that their peers do not have, and which are not assessed by the tests given in the early grades. This question cannot be resolved without extensive examination of children in the preschool years, an area which was outside the scope of the current research effort. It is an area, however, in which further study would provide useful data to school systems nationwide.

students made more progress in the K-8 mathematics curriculum than did Hispanic and Black students, and the pattern was observed early in the elementary school years. While it is assumed that all students start out equally in the mathematics curriculum in kindergarten and first grade, by the end of second grade, Black and Hispanic students tend to fall below grade level in their mastery of curriculum objectives in greater numbers than do Asian and White students, and Asian and White students begin to move ahead or accelerate in the curriculum in greater numbers than do Hispanic and Black students.

The evidence suggests that once a student falls below the standard level of performance in the curriculum for his/her grade level, he/she is not likely to ever again catch up to that grade level standard of performance. And, with each year in school, additional students either fall behind or move ahead, producing a difference in the progress of Black and Hispanic compared to Asian and White students that gets wider each successive year. Exhibits E-1, E-2, and E-3 illustrate the cumulative effect of differences in progress for each racial/ethnic group throughout the elementary school years.

The result of the cumulative differences between the groups is that, by the end of the elementary school years, as critical decisions are being made concerning class placement for seventh grade mathematics, as many as one-third to one-half of the Hispanic and Black students have fallen so far behind in the mathematics curriculum that there is little or no possibility of their being placed in a level of seventh grade mathematics that would allow them to be ready to take Algebra 1 in eighth or ninth grade.[4] It is no great surprise, then, to find that at the high school level, the most advanced mathematics courses (Pre-calculus and Calculus) are dominated by Asian and White students.

The pattern of performance on mathematics achievement measures by racial/ethnic group is comparable to the pattern observed for student progress and participation in the curriculum. Although students in each racial/ethnic group in Montgomery County performed better, on the average, than did comparable students nationwide on the standardized achievement measures, Asian and White students in the County outperformed Black and Hispanic students (see Table E-3). This pattern, which is comparable to what is observed nationally for the four racial/ethnic groups, was found as early as the third grade, the first time students are tested on the CAT, and continued through eleventh grade. Performance differences on the SAT were also large. Not only did Asian and White students outperform Hispanic and Black students on the test, but the proportions of each group who opted to take the test differed markedly as well: Asian and White students took the SAT in the largest numbers.

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4. Students who progress normally through the mathematics curriculum are expected to take Algebra 1 in the ninth grade, to complete mathematics courses at least through Algebra 2 or Advanced Algebra in high school. Accelerated students take Algebra 1 in the eighth grade, and can take Calculus if they remain in the accelerated mathematics courses throughout high school. Sixty percent of the Black students and 52 percent of the Hispanic students in this study left high school with Geometry, Algebra 1, or lower mathematics courses as the last course they completed. Figures for White and Asian students were 32 and 13 percent.

EXHIBIT E-1

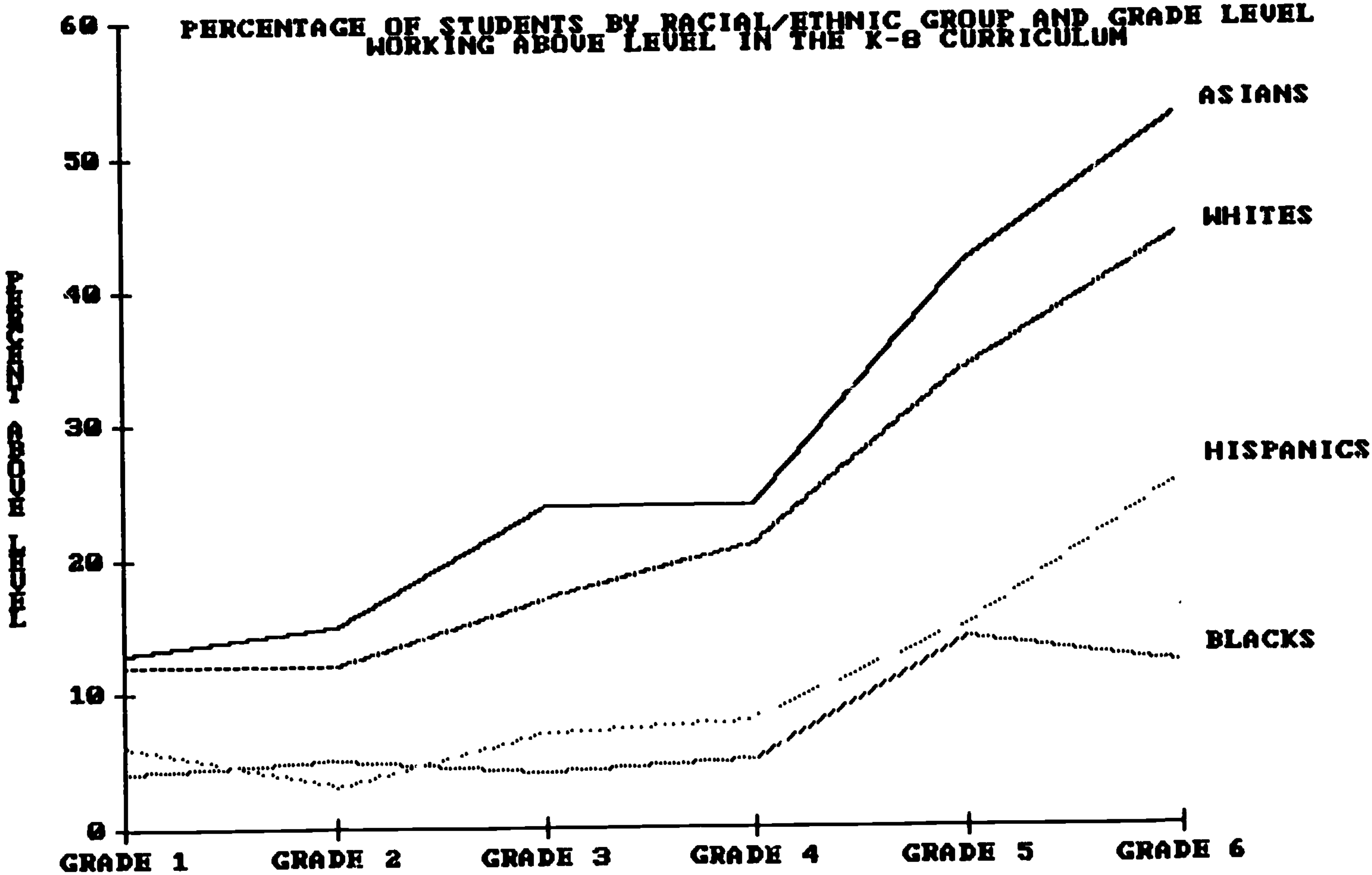

PERCENTAGE OF STUDENTS BY RACIAL/ETHNIC GROUP AND GRADE LEVEL
WORKING ABOVE LEVEL IN THE K-8 CURRICULUM
PERCENT ABOVE LEVEL
60
50
40
30
20
10
0
GRADE 1
GRADE 2
GRADE 3
GRADE 4
GRADE 5
GRADE 6
ASIANS
WHITES
HISPANICS
BLACKS

EXHIBIT E-2

PERCENTAGE OF STUDENTS BY RACIAL/ETHNIC GROUP AND GRADE LEVEL WORKING ON GRADE LEVEL IN THE K-8 CURRICULUM

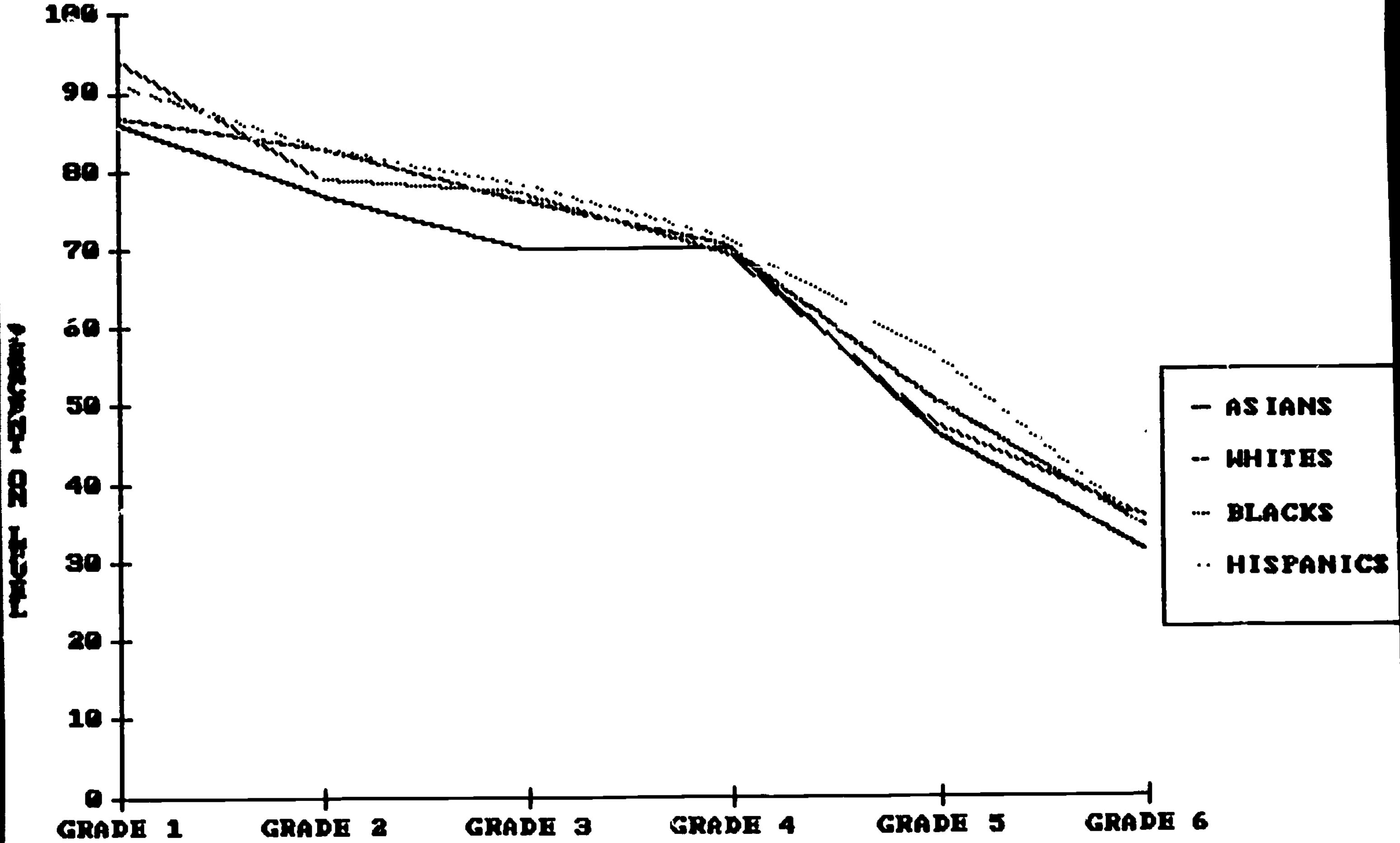


EXHIBIT E-3

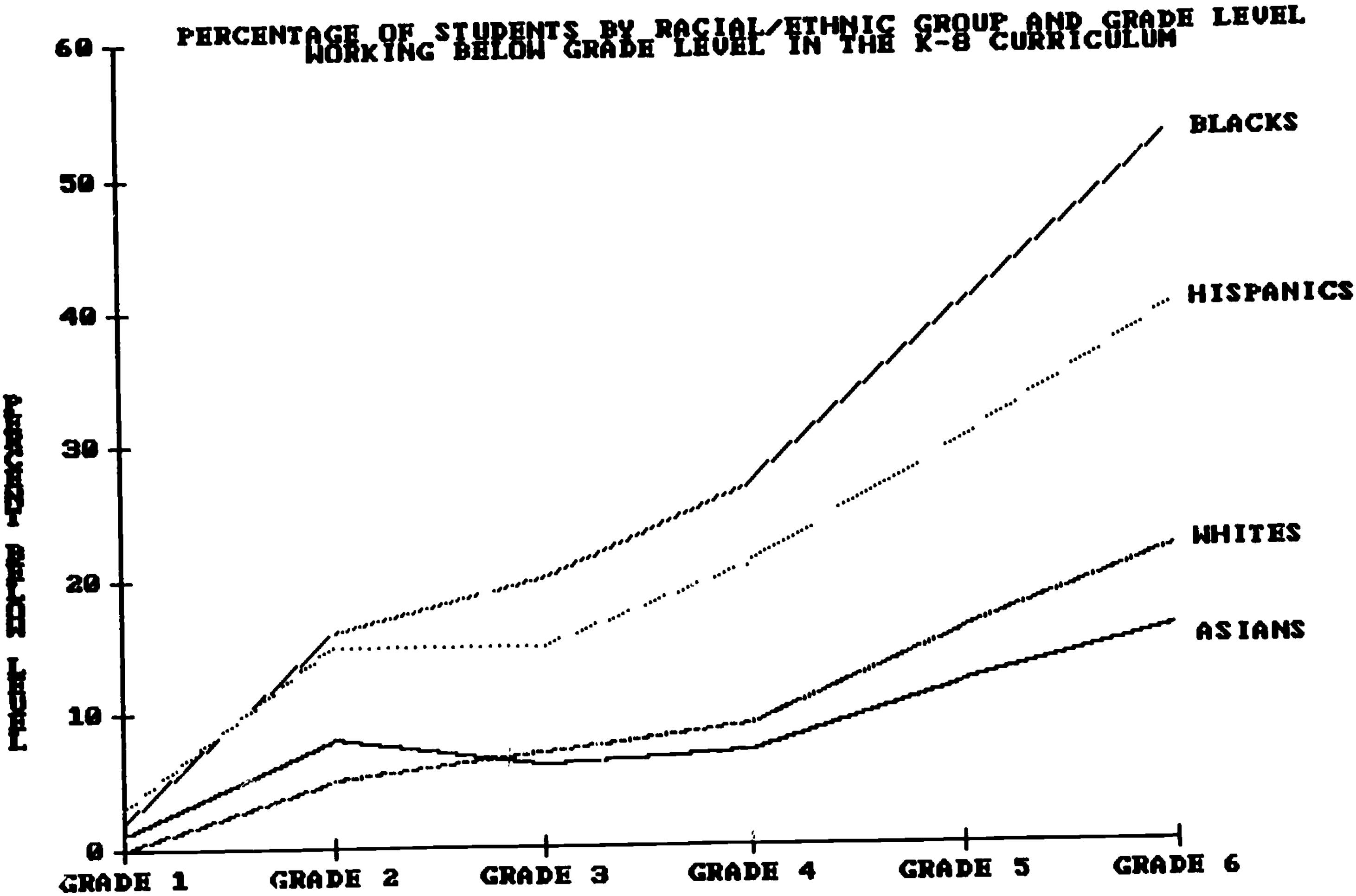

PERCENTAGE OF STUDENTS BY RACIAL/ETHNIC GROUP AND GRADE LEVEL
WORKING BELOW GRADE LEVEL IN THE K-8 CURRICULUM
60
50
40
30
20
10
0
PERCENT BELOW GRADE LEVEL
BLACKS
HISPANICS
WHITES
ASIANS
GRADE 1
GRADE 2
GRADE 3
GRADE 4
GRADE 5
GRADE 6

TABLE E-3

Stanine Scores of Students in the Class of 1986 on the Eleventh Grade CAT Mathematics Section by Racial/Ethnic Group

Stanine	% of Students Nationally in Each Stanine	% of All Asians in MCPS	% of All Whites in MCPS	% of All Blacks in MCPS	% of All Hispanics in MCPS
9 (highest)	4	37	20	4	11
8	7	12	12	3	6
7	12	15	19	11	10
6	17	16	24	21	19
5	20	11	15	23	25
4	17	7	8	25	17
3	12	2	2	11	8
2	7	0 *	0 *	1	2
1	4	0 *	0 *	1	1
Number of Students		499	5,313	857	280

* Percentage is less than half of one percent.

Further, while performance on standardized achievement tests of students in all gender and racial/ethnic groups appears to be related to level of participation in the mathematics curriculum, Black students, regardless of level of participation in the curriculum, consistently scored lower on the standardized tests than did their classmates who were in the other racial/ethnic groups. Even at the highest levels of participation (students enrolled in Algebra 2, Trigonometry, Advanced Algebra, Pre-calculus, or Calculus at the high school level), Black students did not perform on standardized tests at the same level as students from the other racial/ethnic groups (see Table E-4).

Attitudes and Beliefs About Mathematics

Few racial/ethnic group differences in attitudes toward mathematics were observed; the majority of the students and parents felt mathematics was necessary, and generally, students liked mathematics. High achieving Black students expressed a greater commitment to mathematics compared to what

TABLE E-4

Eleventh Grade CAT Performance of Students in the Class of 1986:
by Highest Mathematics Course Taken in High School and Racial/Ethnic Group

Highest Mathematics Course Taken and Racial/Ethnic Group		N	High * Sta. 9	8	7	Middle Stanine 4-6	Low Stanine 1-3
Calculus	Asian	155	79 %	14 %	7 %	1 %	0 %
	White	670	78	17	5	0 **	0
	Black	24	67	17	17	0	0
	Hispanic	16	75	19	6	0	0
Pre-calculus	Asian	93	41	18	33	8	0
	White	568	46	27	22	6	0
	Black	36	22	33	28	17	0
	Hispanic	23	52	30	13	4	0
Advanced Algebra	Asian	76	12	18	22	47	0
	White	923	12	19	41	28	0
	Black	99	4	3	41	52	0
	Hispanic	31	16	7	32	45	0
Algebra 2 with Trig.	Asian	16	31	19	13	38	0
	White	155	43	27	25	6	0
	Black	6	17	0	67	17	0
	Hispanic	7	29	14	43	14	0
Trigonometry	Asian	25	8	12	8	72	0
	White	189	13	21	32	34	0
	Black	26	8	0	35	58	0
	Hispanic	8	0	13	38	50	0
Algebra 2	Asian	48	6	4	17	71	2
	White	760	4	8	29	59	0 **
	Black	103	1	2	15	81	2
	Hispanic	[illegible]	0	7	17	76	0
Geometry	Asian	28	0	4	7	89	0
	White	564	1	4	13	82	0 **
	Black	121	0	2	4	93	2
	Hispanic	34	0	0	6	94	0
Algebra 1	Asian	22	0	0	0	82	18
	White	381	1	1	5	91	4
	Black	108	0	0	1	88	10
	Hispanic	30	0	0	0	83	17

* Stanines 9, 8, and 7 are shown separately to illustrate the differences among the racial/ethnic groups.

** Percentage is less than half of one percent.

students in other racial/ethnic groups showed. They expressed a desire to do well in mathematics so they could move on to good colleges and professional careers. This commitment was reinforced by their parents' feelings about the importance of mathematics.

Supports for Mathematics in the Home and School

Parents in general felt that mathematics was important in their children's futures. Parents of Black students were the most vocal in expressing this belief. They were significantly more likely to feel that all students needed as much mathematics as possible, and that their children should continue in mathematics even if their chances of receiving a grade of A or B were unlikely. Parents of Black students were also most vocal in expressing their willingness to interact with their children's teachers or other school staff if they felt their children were having problems in school.

Responses from students, teachers, counselors, and principals suggest that school staff have a different view of Black parents' commitment toward and support of their children's participation and performance in mathematics. Responses from students also indicate that Black students perceive differences in how they and other students are treated in class. High achieving Black students reported that they had to prove themselves to the teacher each time they entered a new mathematics class. They felt that teachers who had Black students in their honors or accelerated classes saw them as tokens, or as inferior to White students in the class. Black students felt a sense of isolation in these classes, especially in schools in which there might be only one or two Black students in each honors class.

These feelings articulated by high performing Black students were substantiated by teachers' assessments of students' performance in class. While students in the four racial/ethnic groups had fairly similar mathematics grades in early elementary school, in the later elementary and secondary years Black students consistently had the worst grades, even if they were working at accelerated levels in the curriculum. Hispanic students' grades were just slightly higher than those of Blacks. Whites and Asians had the best grades.

Survey responses indicate that many school staff feel educational problems begin in the home. Sixty-seven percent of the principals and 79 percent of the counselors felt that the differences in participation and performance in mathematics that are observed among different racial/ethnic groups stemmed from home variables. They viewed Asian and White students as coming from homes in which education is supported and participation in mathematics is encouraged. They cited economic factors and fragmentation of families as reasons for the lack of motivation and interest in mathematics they felt was dominant among Hispanic and Black students. While many school staffers felt that school systems needed to work hard to overcome these obstacles, some felt that these problems emanated from society and there was nothing that the schools could do until society changed.

Lastly, the data concerning personal characteristics of teachers indicate that there are few potential mentors or role models among the teaching staff for the three minority groups: Asians, Hispanics, and Blacks. Among counselors, there is also underrepresentation of Asians and Hispanics. Montgomery County is well aware of this problem, however, and is expending considerable effort and resources to recruit minority staff.

Several interpretations are possible for the discrepancy between the attitudes and beliefs of Black students and their parents toward education in general and mathematics in particular, and the degree of reinforcement these students receive through their test scores, class grades, and beliefs expressed by school staff. A cursory look at the data might suggest that there is a bias toward Black students that is expressed through these factors. However, it is also possible that the school system, in an effort to make advanced level classes more available to minority students, has placed some Black youngsters in classes above the level that their "paper credentials" would indicate to be appropriate. We cannot determine the real reason without more intensive data collection efforts than were possible in this study. However, if the latter interpretation were to be borne out, the fact that Black students can successfully complete these advanced level classes despite their lower test scores and report card grades would support the continuation of the practice of encouraging them to participate in higher level classes.

Overall, our findings suggest a different pattern of participation, performance, and rewards for performance of Black and Hispanic students compared to Asian and White students, and they corroborate the results of other research efforts. Further, the views of school staff and Black parents appear to differ regarding perceived parental support of their children's persistence in accelerated mathematics classes. Greater efforts to promote understanding between the school and the home would help in overcoming these differences.

FINDINGS: WHAT FACTORS CONTRIBUTE TO DIFFERENTIAL PERFORMANCE AND PARTICIPATION?

The findings presented above indicate that the pattern of participation and performance in mathematics differs markedly for females compared to Black and Hispanic students. While males and females participate and perform in mathematics at almost equal levels until the middle of their high school years, differences in the participation and performance of Black and Hispanic students compared to White and Asian students occur quite early in elementary school.

Results of statistical analyses of the available data suggest that attitudes and beliefs about mathematics, classroom participation, and test performance are highly related to each other. Generally, students who performed at higher levels in the curriculum felt less anxious, liked mathematics better, and saw a greater use for mathematics than did students who performed at lower levels. They also had a greater variety of strategies they could use to attack mathematics problems. Regardless of gender or racial/ethnic group membership, the more favorably students viewed the subject of mathematics, and themselves as competent mathematics performers, the more likely they were to persist in higher levels of the mathematics curriculum. Thus, attitudes about mathematics play an important part in shaping students' participation and performance in the mathematics curriculum.

Results of regression analyses show that participation and performance in the mathematics curriculum is strongly related to students' performance on achievement measures such as the CAT and SAT. Between two-thirds and three-fourths of the variation in how students perform on the achievement measures can be directly related to how well they have performed or to what extent they have participated in the mathematics curriculum. Moreover, doing well (getting good grades) in the curriculum enhances this relationship.

Those students who performed at accelerated levels in the curriculum produced the highest average scores on the standardized tests. Those students who performed at average levels in the curriculum performed better on the standardized tests than students who performed at lower levels in the curriculum. While it is conceivable that the relationship between performance in the curriculum and test performance is circular, with those who do well in class doing well on tests and thus being spurred on to continue to do well in class, etc., it seems likely that increasing students' opportunities to attain more curriculum objectives might have substantial payoffs in test performance down the road.

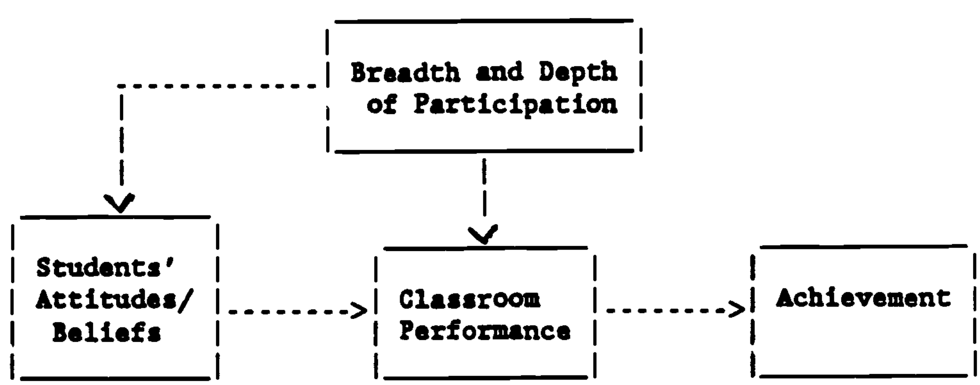
The fact that differences in the participation and performance of many Black and Hispanic students compared to Asians and Whites occur very early in the school years suggests that Black and Hispanic students do not cover the same breadth and depth in the curriculum as do Asian and White students. Thus, whereas for students, overall, a model linking attitudes, performance in the curriculum, and achievement might be formulated as follows:

> attitudes influence students' ability or willingness to perform in the curriculum, and performance and participation in the curriculum ultimately influence students' mathematics achievement,

the impact of the breadth and depth of participation in the curriculum must be considered when examining the ultimate performance and achievement of Black and Hispanic students. Thus, the model shown in Exhibit E-4 is suggested.

EXHIBIT E-4

Proposed Model of Factors Related to Mathematics Achievement



FINDINGS RELATED TO THE MATHEMATICS INSTRUCTION OF ALL STUDENTS

Students' Attitudes About Mathematics

Findings regarding attitudes and performance for all students mirror those reported above by gender and racial/ethnic group. In general, students who performed or participated at higher levels in the mathematics curriculum than their peers felt less anxious, liked mathematics better, and saw a greater use for mathematics than did students who performed at lower levels. They also had a greater variety of strategies they could use to attack mathematics problems. The findings presented in Volume I suggest that the more favorably students viewed the subject of mathematics, and themselves as competent mathematics performers, the more likely they were to persist in higher levels of the mathematics curriculum. The data reported in Volume II corroborate these findings.

Students' Feelings of Support in School and at Home

The Home

Comments from students isolate one variable above all others that they feel separates students who are good in mathematics or who pursue mathematics from those who are not good/do not pursue it. Students in the accelerated mathematics classes pointed to their parents as the primary force behind their interest in mathematics. They talked about the encouragement, interest in, and exposure to mathematics that their parents provided to them. These students also indicated that their parents expected them to take a lot of mathematics and do well.

Students in lower level mathematics classes did not seem to receive the same level of parental support for academics in general, let alone mathematics in particular as did those in accelerated classes. Comments from these students suggest that economic factors, i.e., whether they have to work after school, or whether their parents work more than one job, affects how much parental encouragement they receive. Moreover, the data suggest that, for about one-third to one-half of the students in secondary school, there is no one in the home who is capable of helping them with their mathematics homework.

The School

Junior high/middle and senior high school students were asked to reflect on their mathematics instruction, and the importance of mathematics teachers to them. The data suggest that students' feelings about their teachers can influence how much effort they are willing to put into the class. They also suggest that, in the absence of support from the home, teachers can play a critical role in shaping students' interest in mathematics. Over half the students in both groups felt that their mathematics teachers were good teachers. There was a tendency for the better mathematics students to feel more positively about their teachers and the poorer students to feel more negatively. However, there were many students working at lower levels in the mathematic curriculum who spoke favorably of mathematics teachers, and many students working at accelerated levels who made negative comments about mathematics teachers.

Feelings about their teachers, either positive or negative, ran very strong among the students. Students were very explicit about the characteristics of good (effective) and ineffective teachers. Students who were working at lower levels in the curriculum were more likely to report that they had had ineffective mathematics teachers than were students who participated in accelerated mathematics classes or groups.

According to the students, effective teachers took time with them, answered all questions patiently, nurtured students' feelings of confidence and competence, and instilled in students a sense of the importance of mathematics. Ineffective teachers, on the other hand, were perceived as being insensitive to students, particularly slower students. They were regarded by the students as more concerned with getting through the material than with making sure that all students understood. Ineffective teachers were seen as nasty, sarcastic, punitive, and not liking students. Moreover, these teachers were seen as doing nothing to make class interesting, and students often felt these teachers did not want to be in the classroom teaching them.

Teachers' Perceptions of Students

Accelerated students were viewed by teachers as significantly more capable and prepared for class than other students. They were viewed by their teachers as more studious, better behaved, and capable of going further in mathematics and in school in general than were students in other mathematics classes. Commensurate with their opinions about the students, teachers expected more of the accelerated students than they did of other students in their classes.

The data suggest that students who work at advanced or accelerated levels in the mathematics curriculum experience a mathematics education that is different in many ways from that provided to students who work below grade level in the curriculum. Students working above level in the curriculum are taught more complex mathematical concepts, and they are expected to produce more complete work and think at a higher level than their fellow students.

Instructional Opportunities

Montgomery County policy on the grading and reporting of student progress[5] states that:

> Students are expected to maintain at least a B average in honors level work ... When a student receives a grade of C ... he/she should be counseled about ways to improve. A student who receives a grade of D or E (failure) will be removed from honors level work in the designated course.

Indeed this policy appears to have had a substantial impact on students' opportunities in mathematics. In accordance with this policy, teachers,

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5. Montgomery County Public Schools' Administrative Regulation IKA-RA.

counselors, and principals indicate that accelerated mathematics is perceived by school staff as being appropriate content for only the most advanced or capable students. Teachers, guidance counselors, and school principals all indicated that only those students who are likely to receive A's or B's in the next mathematics course are typically recommended for accelerated or honors classes. This judgment is based on the student's performance in the prior mathematics class, and teacher recommendation. Thus, teachers have a large say in the future mathematics path of their students.

Opportunity to learn the mathematics content is significantly affected by the level of mathematics class into which the student is placed. Elementary school teachers reported that they have different expectations for students who are working above grade level in the curriculum than they do for students working on grade level. Similarly, they have different expectations for those working on grade level than they do for those working below grade level. Secondary school teachers indicated that they have different expectations for students who are in college preparatory mathematics classes than they do for general mathematics students.

Teachers expect students who are working at accelerated levels in the curriculum to be able to analyze, synthesize, and apply classroom knowledge to new situations. Students working below level in the curriculum are primarily exposed to rote learning, drill, and the simplest of mathematical problems and examples. Thus, students who are moved into lower mathematics classes or groups will likely fall behind those students who remain in the higher group, simply because of the difference in instruction they receive. This results in a situation whereby few students can move back up to a higher level group in mathematics without some assistance.

The study findings indicate that many students are sufficiently concerned about the potential impact on their grade point averages that participation in advanced level mathematics classes may have that they do not take these classes even when eligible to do so. Female, Black, and Hispanic students are more likely not to take these classes for fear of receiving lower grades than they would like to receive or are used to receiving. These findings suggest that these students and their parents need to be made more aware of the importance of accelerated mathematics courses, not only for career purposes, but also for the variety and depth of instruction to which they would be exposed.

POLICY IMPLICATIONS AND RECOMMENDATIONS

The findings from this study indicate that students in Montgomery County participate and achieve in mathematics at levels that are better than national averages. However, the study identified several areas in which MCPS students of different genders and/or racial/ethnic groups participated or achieved differently from each other.

Since students in Montgomery County receive educational services that are equal to or better than those provided elsewhere in the nation, we feel that these findings are especially significant. The fact that we have extensive data bases of student information, as well as procedures for monitoring the progress of students in the K-8 mathematics curriculum, places us ahead of most school districts in the country in terms of what we can provide to our students. Given these supports, the finding that differences exist here suggests that the problems with which we are dealing are deep-seated and difficult to address. Further, given the benefits of the Montgomery County education, we feel it likely that the status of female, Black, and Hispanic students in mathematics in school districts across the country might well be far worse than what we have observed here. Indeed, research studies conducted elsewhere suggest that these problems are widespread.

Based on our study findings a number of viable strategies emerge as ways of coping with these problem areas. The following sections contain recommendations that school systems can use to improve mathematics instruction and students' experiences in mathematics.

Participation and Performance by Gender

Attitudes and Beliefs

While differences in participation and performance in mathematics by gender do not emerge until the last year or two in high school, the findings from this study indicate that differences in attitudes and beliefs about mathematics start much earlier. The study has demonstrated the relationship between attitudes and beliefs and participation and performance in mathematics. Thus, these suggestions are intended to address the differences in attitudes and beliefs that are observed.

- o School systems should look for ways to communicate more strongly to female students and their parents the importance of mathematics for all students, and the viability of technical careers for females as well as males. And, since students' early attitudes and beliefs are largely developed at home, parent education should be a major focus of this effort.

- o School systems need to launch public relations campaigns to change the image of mathematics. Mathematics should be thought of as exciting, challenging, and desirable as opposed to necessary or a means to an end. Particularly at the junior/high middle school level, where students seem to be influenced most heavily by peer pressures, an effort should be made to try to staff mathematics classrooms with exciting, dynamic, and charismatic teachers, and to present material in a way that broadens students' understanding of the importance and relevance that mathematics has to a multitude of disciplines and careers.

- o If school systems truly want as many students as possible to enroll in more advanced mathematics courses, the notion that honors classes should be taken only if the student can be well assured of a grade of A or B should be reconsidered. It is likely that many students, particularly females, are reluctant to enroll in classes in which the prospect of a low grade carries such a stigma. Also, for some students, mathematics knowledge appears to be acquired in fits and spurts, with the student appearing to be stuck in a rut for a time, and then, almost overnight, having everything fall into place. Maintaining narrow performance standards could result in these students being unnecessarily eliminated from higher level mathematics classes. If anything, students who demonstrate that they are willing to aspire to higher standards by enrolling in these advanced level classes should be awarded some tangible or psychological reward for risking their good grade-point-averages in this way. Thus, the data suggest that the practice of weighted grades for honors or advanced level classes makes a lot of sense, and we suggest that school systems consider adopting this practice if they do not already do so. Additionally, school systems that compute weighted grades for honors level classes in which the students receive grades of A or B should consider expanding this policy to grades of A, B, or C.

Performance on the SAT

The solutions to the differential SAT mathematics performance by gender are not as readily apparent as are some of the other solutions suggested by this study. While we have moved somewhat closer than other research efforts have in examining this issue, large differences in performance still exist for which there are no definitive explanations. Further research is needed regarding the differential performance of females and males on the SAT. The following activities are recommended as starting points for this research:

- Intensive case studies of statistical outliers, e.g., those females who perform exceptionally well on the SAT mathematics section, should be conducted. Use of case studies rather than survey techniques would allow for greater in-depth examination of the attitudes, beliefs, and home and school factors that have surfaced in the current study as being important variables to consider.

- It would be useful and interesting to compare the performance of male and female students within the same school system on each item of the SAT mathematics section. Those items (if any) that appear to discriminate between females and males could be examined in relationship to course enrollments of the students and SAT verbal performance. Whereas ETS has conducted analyses of SAT performance and course enrollment data across various school systems where courses of the same name could differ substantially in content, Montgomery County has the benefit of its extensive historical computer data files for large groups of students who have taken the same course of study. Comparison of SAT performance for these students might yield some new information that was hidden in the analyses that were conducted by ETS across many school districts. Inclusion of SAT verbal performance in these analyses would enable us to examine whether differences that emerge are test-specific or mathematics-specific.

Progress and Performance of Black and Hispanic Students in the K-8 Mathematics Curriculum

The data from this study indicate that differences in student progress through the elementary school mathematics curriculum emerge as early as the first and second grade. Black and Hispanic students tend to fall behind in greater numbers than White and Asian students, and they do not accelerate above level in as great numbers either.

Suggestions for Remediation and Enrichment Programs

School systems must take extraordinary steps to ensure that students who fall below grade level in their progress through the mathematics curriculum in the early grades have every opportunity to be brought back up to grade level as soon as possible. The following steps could be taken to address this need:

- o Summer school programs could be designed and put into place for students in kindergarten, first, and second grades who are in danger of or who have already fallen below grade level in mathematics, or who did not come to school with the appropriate mathematics readiness skills. Parents must be made aware of why participation in these programs is essential for their children.

- o After school programs in mathematics could be established for students in grades 3-6 who need to be brought up to grade level in mathematics or who are in immediate danger of falling below level. Students in these grades could participate in both after school and summer school programs if needed. In school systems in which large numbers of students are bussed to school, transportation should be provided for the after school programs so that those students most in need of the services will be able to participate.

- o School systems should consider establishing mathematics resource teacher or mathematics specialist positions in elementary schools with large numbers of students in the early grades who need remediation in mathematics. These teachers could work with small groups of students, and also serve as resource people to the classroom teachers who are in need of assistance in teaching mathematics.

- o School systems should consider establishing after-school and/or summer school enrichment programs in mathematics especially geared for elementary school students who have the potential to be moved from on-level to above-level performance with a little assistance. Parents of Black and Hispanic students should be contacted directly by school staff and strongly encouraged to enroll their children in these programs. Transportation should be provided as part of this program.

Parental Support

We feel that school systems, parents, and other community members could work more closely together to meet the needs of the students. We suggest the following:

- o School systems should develop or adopt programs which foster support of the educational goals at home. These programs could include workshops for parents that give them the skills necessary to help their children with homework assignments. The workshops could be conducted either in group settings, or recorded on video tape so the parents could use them at home. MCPS currently uses parent awareness workshops for this purpose. The County has also endeavored to adopt and evaluate the success of programs developed outside the school system that foster parent involvement. The Family Math program, developed at the University of

California, Berkeley is an after school program designed to provide parents with hands-on experience working with their children in mathematics at home. It is currently being tried in several schools in Montgomery County. PIBS (Parent Involvement in Basic Skills) is another program supported by the school system to involve parents in their children's work. Additionally, MCPS conducts a homework hotline on local Cable TV. Responses to this program indicate that it may be an effective means of reaching students and parents in the home.

- A lending library of video tapes could be developed to be used by students and parents to learn essential mathematical concepts. These tapes could be made available in school and public libraries as well as in housing and recreation centers and day care centers.

- School systems could explore ways of obtaining cooperation from recreation centers and day care centers to provide tutoring services to students. The tutoring sessions could take place in the recreation centers and day care centers, and could be conducted by trained high school students or adult volunteers. MCPS recruits adult tutors through its connections with businesses and industry.

Teacher Training

The data indicate that elementary school teachers may not have the requisite training to be as comfortable teaching mathematics as they are teaching other subjects. Thus, students may not be receiving as complete instruction in mathematics as they do in reading, for example, in the early years. Or, teachers may not be as aware of the variety of ways mathematical concepts can be introduced to students who have different learning modalities. The following suggestions address these needs:

- School systems need to explore ways of retraining their pool of elementary school teachers. Montgomery County's Department of Quality Integrated Education, in cooperation with American University, sponsors a program in several County elementary schools which retrains classroom teachers in effective strategies for teaching science and mathematics. Montgomery County staff who have been involved in this program feel it has substantial benefits. The success of this program could be evaluated for potential dissemination to other school systems. Similar positive results have been obtained in elementary teacher training programs developed and conducted by MCPS, which were supported by Title II EESA funds.

- School systems or the NSF could consider developing a set of video tapes that could be used to train teachers in the most critical mathematical concepts or strategies that are deemed to be lacking. Teachers could borrow these tapes for self-instruction as needed.

- Montgomery County has retrained elementary school teachers who were interested in teaching junior high/middle school mathematics. Those who were involved in this effort felt it was an effective way to acquire staff in areas of great need. School systems could consider retraining some junior high/middle school mathematics teachers who would be interested in teaching mathematics in the elementary school.

- School systems should consider in-service training for junior and senior high school teachers in career awareness activities, and ways they can be more nurturing in the classroom and more sensitive to racial and sex role stereotypes.

Participation and Performance of Black and Hispanic Students in the Secondary School Curriculum

Large differences in participation and performance in the secondary school curriculum were observed by racial/ethnic group. A good part of the differences in participation that are observed at the secondary level are most likely a result of options being closed due to student differences in progress through the K-8 curriculum. Nevertheless, the study data suggest that many students leave the mathematics curriculum early or do not participate in the most advanced levels in the curriculum for other reasons. The following suggestions are aimed at keeping these students, for whom options have not been closed as a result of their progress in the K-8 curriculum, involved in the secondary school mathematics curriculum at the highest levels possible:

- School systems need to communicate more fully to students and their parents the importance of taking as much mathematics as possible in high school. Many parents are unaware of the importance to their children of staying in the mathematics curriculum after high school graduation requirements have been met. Responses from Black and Hispanic parents on the study surveys indicate that they would support the school system in its efforts to increase student enrollment in accelerated mathematics classes if they were made aware of the importance of these classes to their children's futures. School systems could use the resources of prominent community members from the same racial/ethnic group to assist in this communication process.

- Black and Hispanic parents need to be made more aware of the importance of SAT performance in their children's college plans. Parents should be instructed in the options available to students in preparing for the test, and the potential benefit to students of taking the test early in their high school years for practice purposes.

Mathematics Instruction of All Student

The findings presented above that discuss the mathematics instruction of all students suggest several areas in which changes could be made to the mathematics curriculum and how mathematics is presented in the classroom.

- Student responses suggest that those in the lower performing classes are suffering not only from an inability or lack of confidence in mathematics, but also from the perception, accurate or not, that their teachers do not want to be bothered by their "stupid" questions. School systems need to provide alternative classroom environments that are more encouraging and nurturing for these students.

- Students in the lower performing classes indicate that they receive the same or similar instruction year after year in repetitive content.

Teachers' responses suggest that this perception is accurate. It is recommended that school systems explore alternative methods and content of instruction for these students, so that these students can experience some of the fun aspects of mathematics.

- The data suggest that some students would be interested in taking mathematics beyond the level of Algebra 2 or Advanced Algebra if they had course options other than the traditional theoretically based Pre-calculus and Calculus courses. The possibility of developing an alternative course offering for these students might be considered by NSF and school systems. Such a course might include many of the Pre-calculus and Calculus concepts in an applied, rather than theoretical setting. The use of microcomputers to support this instruction also might be considered. MCPS has received some federal money to study the development of such a curriculum.

- The findings indicate that students in the accelerated mathematics classes receive instruction that includes considerably more analysis, synthesis, and other higher order thinking processes than the content presented in average or below level mathematics classes. Similarly, students in the average levels of instruction participate in higher level skills than do those in the below level classes. Thus, once placed in a lower level group, it is difficult for the student to move to a higher group. These findings suggest that caution be taken by teachers and principals before students are moved to lower groups, and that movement to lower groups be considered only after a variety of measures have been attempted to keep the student on the same level as his/her classmates or groupmates.

CONCLUSION

The findings presented in both volumes of this report show that, in many areas of mathematics instruction, MCPS is making great strides toward meeting the needs of its students. However, as is true in any large school system, there still remain areas in which improvement could be made. The findings also raise concerns which are generalizable to instruction and learning of mathematics nationwide.

It appears that the best way to be successful in mathematics is to have succeeded in mathematics in the past. Once a student experiences failure in mathematics or falls behind in completing the instructional objectives at his/her grade level, it is much more difficult to catch up. The data from this study show that this is more of a problem for Blacks and Hispanics than for Whites and Asians.

Montgomery County has been addressing the specific needs of its female, Black, and Hispanic students for more than a decade, and has expended substantial financial and staff resources on solutions to the problems. The finding that improvement is still needed only serves to illustrate the complexity of the issues with which we are dealing, and suggests what must be a bleak picture for these groups of students in school systems which have not yet fully focused on the problems.

SPECIAL THANKS

A special thank you must be given to Laure Sharp who served as consultant to this project. Laure brought her considerable knowledge, expertise, and sound judgment to the project when it was in a time of upheaval. She was a major contributor to this report, particularly to the sections dealing with gender differences on the SAT. Finally, the many conversations I had with Laure concerning data analysis and inferences that could be drawn from our many findings have served to make this report a much better document than it would have been otherwise.

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TABLE OF CONTENTS

Page

VOLUME I: FINDINGS BY GENDER AND RACIAL/ETHNIC GROUP

CHAPTER 1: INTRODUCTION

BACKGROUND 1-1
STUDY FOCUS AND OBJECTIVES 1-2
REPORT ORGANIZATION 1-4

SECTION I: CONCEPTUAL FRAMEWORK

CHAPTER 2: REVIEW OF THE LITERATURE

BACKGROUND 2-1
PATTERNS OF ENROLLMENT 2-1
Enrollment Findings by Gender 2-1
Enrollment Findings by Racial/Ethnic Group Membership 2-2
FACTORS INFLUENCING ENROLLMENT 2-2
Influences of Mathematics Achievement 2-3
Affective Factors 2-5
Social and School Factors 2-9

CHAPTER 3: METHODS

INTRODUCTION 3-1
KEY VARIABLES 3-1
Independent and Dependent Variables 3-1
Measures of Student Participation and Performance in Mathematics 3-2
Survey Data 3-4
DATA SOURCES AND SAMPLES 3-5
Computer Data Bases 3-5
Survey Data 3-5
DATA COLLECTION METHODOLOGIES 3-9
DATA ANALYSIS METHODOLOGIES 3-10

SECTION II: FINDINGS RELATED TO MATHEMATICS PARTICIPATION AND ACHIEVEMENT BY GENDER AND RACIAL/ETHNIC GROUP

CHAPTER 4: MATHEMATICS ENROLLMENT AND ACHIEVEMENT AT THE HIGH SCHOOL LEVEL: GENDER AND RACIAL/ETHNIC GROUP SIMILARITIES AND DIFFERENCES

OVERVIEW 4-1
Background 4-1
Mathematics Requirements for Graduation 4-2
Course Offerings 4-2
PARTICIPATION OF STUDENTS IN THE HIGH SCHOOL MATHEMATICS CURRICULUM 4-4

TABLE OF CONTENTS (Cont.)

Page

CHAPTER 4: MATHEMATICS ENROLLMENT AND ACHIEVEMENT AT THE HIGH SCHOOL LEVEL: GENDER AND RACIAL/ETHNIC GROUP SIMILARITIES AND DIFFERENCES (Cont.)

Participation for All Students 4-4
Differential Participation by Gender and Racial/Ethnic Group 4-5
MATHEMATICS ACHIEVEMENT OF HIGH SCHOOL STUDENTS: THE CALIFORNIA ACHIEVEMENT TESTS (CAT) 4-8
Overall Student Performance on the CAT 4-9
CAT Performance by Gender 4-9
CAT Performance by Racial/Ethnic Group 4-9
CAT Performance by Amount of Mathematics Taken in High School 4-11
Relationship of Attitudes, Beliefs, and Behaviors to CAT Performance 4-14
MATHEMATICS ACHIEVEMENT OF HIGH SCHOOL STUDENTS: THE SCHOLASTIC APTITUDE TEST (SAT) 4-18
SAT Results, Overall and by Gender 4-19
SAT Performance by Racial/Ethnic Group 4-29
Relationship of Attitudes, Beliefs, and Behaviors to SAT Performance 4-32
SUMMARY 4-35

CHAPTER 5: PROGRESS AND PERFORMANCE IN A K-8 MATHEMATICS CURRICULUM: GENDER AND RACIAL/ETHNIC GROUP SIMILARITIES AND DIFFERENCES

BACKGROUND 5-1
STUDENT PROGRESS IN THE K-8 MATHEMATICS PROGRAM 5-2
Number of ISM Objective and Problem-Solving Assessments Mastered 5-2
Performance Below, On, or Above Grade Level 5-4
Longitudinal Trends in Performance in the K-8 Curriculum 5-9
Problem-Solving Assessments 5-12
Grades Received in Mathematics Classes 5-15
PERFORMANCE AND ACHIEVEMENT IN MATHEMATICS 5-15
Performance on the CRT's 5-17
Performance on the California Achievement Tests (CAT) 5-20
RELATIONSHIP BETWEEN ACHIEVEMENT AND OTHER VARIABLES 5-26
Relationship Between Achievement and Performance in the K-8 Curriculum 5-26
Relationship Between Achievement, Performance in the Curriculum, and Other Variables 5-28
SUMMARY 5-29

TABLE OF CONTENTS (Cont.)

Page

SECTION III: FINDINGS RELATED TO ATTITUDES AND BELIEFS ABOUT MATHEMATICS BY GENDER AND RACIAL/ETHNIC GROUP

CHAPTER 6: STUDENTS' ATTITUDES AND BELIEFS ABOUT MATHEMATICS: THE RELATIONSHIP TO PARTICIPATION AND PERFORMANCE BY GENDER AND RACIAL/ETHNIC GROUP

BACKGROUND 6-1
FINDINGS BY GENDER 6-2
Competence in Mathematics 6-2
Utility of Mathematics 6-4
Mathematics As A Male Domain 6-4
Participation in "Male" or "Female" Activities 6-4
Supports for Mathematics in School 6-6
Supports for Mathematics in the Home 6-6
FINDINGS BY RACIAL/ETHNIC GROUP 6-7
Liking of Mathematics 6-7
Supports (or Lack Thereof) for Mathematics in the School 6-8
Support (or Lack Thereof) for Mathematics from Peers 6-9
SUMMARY 6-9

CHAPTER 7: THE HOME ENVIRONMENT - PARENTAL ATTITUDES, BELIEFS, EXPECTATIONS, AND SUPPORT: ITS EFFECT ON STUDENTS' PARTICIPATION AND PERFORMANCE BY GENDER AND RACIAL/ETHNIC GROUP

BACKGROUND 7-1
FINDINGS RELATED TO GENDER DIFFERENCES 7-1
Mathematics As A Male Domain 7-2
Parents' Perceptions of Their Children's Early Interest in Mathematics 7-2
Parents' Perceptions of Their Own Competence in Mathematics 7-3
Parents' Reports of Who Helps Student with Homework 7-3
Parents' Educational Goals for Their Children 7-4
Employment Goals 7-4
FINDINGS BY RACIAL/ETHNIC GROUP 7-5
Students' Need to Persist in High Level Mathematics 7-5
Mathematics As A Male Domain 7-6
Perceptions of Mathematics Teachers 7-7
Parents' Perceptions of Children's Early Interest in Mathematics 7-9
SUMMARY 7-11

CHAPTER 8: THE SCHOOL ENVIRONMENT: TEACHERS', COUNSELORS', AND PRINCIPALS' ATTITUDES AND EXPECTATIONS CONCERNING MATHEMATICS FOR STUDENTS BY GENDER AND RACIAL/ETHNIC GROUP

BACKGROUND 8-1

TABLE OF CONTENTS (Cont.)

Page

CHAPTER 8: THE SCHOOL ENVIRONMENT: TEACHERS', COUNSELORS', AND PRINCIPALS' ATTITUDES AND EXPECTATIONS CONCERNING MATHEMATICS FOR STUDENTS BY GENDER AND RACIAL/ETHNIC GROUP (Cont.)

ATTITUDES AND BELIEFS ABOUT MATHEMATICS FOR STUDENTS BY GENDER 8-1
Teachers' Attitudes 8-2
Counselors' Attitudes and Beliefs 8-2
Principals' Attitudes 8-3
ATTITUDES AND BELIEFS REGARDING RACIAL/ETHNIC GROUP DIFFERENCES IN MATHEMATICS 8-3
Counselors' Perceptions 8-4
Principals' Perceptions 8-4
TEACHERS' RATINGS OF STUDENTS' PERFORMANCE IN MATHEMATICS BY GENDER AND RACIAL/ETHNIC GROUP 8-5
Differences in Teacher Ratings by Students' Gender 8-6
Differences in Teacher Ratings by Students' Racial/Ethnic Group 8-6
SUMMARY 8-7

CHAPTER 9: SUMMARY AND RECOMMENDATIONS

OVERVIEW 9-1
Background 9-1
Study Focus and Objectives 9-1
FINDINGS: AT WHAT POINT DO DIFFERENCES APPEAR? 9-3
Findings by Gender 9-3
Findings by Racial/Ethnic Group 9-6
FINDINGS: WHAT FACTORS CONTRIBUTE TO DIFFERENTIAL PERFORMANCE AND PARTICIPATION? 9-14
POLICY IMPLICATIONS AND RECOMMENDATIONS 9-16
Participation and Performance by Gender 9-16
Progress and Performance of Black and Hispanic Students in the K-8 Mathematics Curriculum 9-18
Participation and Performance of Black and Hispnaic Students in the Secondary School Curriculum 9-20

APPENDICES

APPENDIX TO CHAPTER 2: References A.2-1

APPENDIX TO CHAPTER 3: ISM Objectives and Data Collection Instruments A.3-1
ISM Objectives A.3-1
4th and 6th Grade Student Questionnaire A.3-19
K-8 Parent Questionnaire A.3-24
4th and 6th Grade Teacher Questionnaire: Section 1 A.3-34

TABLE OF CONTENTS (Cont.)

	Page
APPENDIX TO CHAPTER 3: ISM Objectives and Data Collection Instruments (Cont.)	
4th and 6th Grade Teacher Questionnaire: Section 2	A.3-39
8th and 12th Grade Student Questionnaire	A.3-41
9-12 Parent Questionnaire	A.3-52
8th and 12th Grade Teacher Questionnaire: Section 1	A.3-63
8th and 12th Grade Teacher Questionnaire: Section 2	A.3-69
Mathematics Report Card Grade and ISM Working Level Abstract Form	A.3-72
Counselor Questionnaire	A.3-73
Principal Questionnaire	A.3-77
Agendas for Focus Group Sessions	A.3-82
APPENDIX TO CHAPTER 4: Course Enrollment, Grades, and CAT Performance by Gender and Racial/ Ethnic Group	A.4-1
APPENDIX TO CHAPTER 6: Responses to Student Questionnaires	A.6-1
APPENDIX TO CHAPTER 7: Responses to Parent Questionnaires	A.7-1
APPENDIX TO CHAPTER 8: Responses to Teacher and Counselor Questionnaires	A.8-1

TABLE OF TABLES

Page

CHAPTER 3: METHODS

TABLE 3.1: Survey/Interview Samples for Students in Grades 4, 6, and 8 3-7
TABLE 3.2: Survey/Interview Samples for Students in Twelfth Grade 3-8
TABLE 3.3: Summary of the Types and Sources of the Data Collected by Respondent Type 3-9

CHAPTER 4: MATHEMATICS ENROLLMENT AND ACHIEVEMENT AT THE HIGH SCHOOL LEVEL: GENDER AND RACIAL/ETHNIC GROUP SIMILARITIES AND DIFFERENCES

TABLE 4.1: Highest Course Taken by Students in the Class of 1986: Overall and by Gender 4-4
TABLE 4.2: Highest Course Taken by Students in the Class of 1986: by Racial/Ethnic Group 4-6
TABLE 4.3: Average Course Grades for Students in the Class of 1986: Overall and by Gender 4-7
TABLE 4.4: Grade in Highest Course Taken by Students in the Class of 1986: by Racial/Ethnic Group 4-8
TABLE 4.5: Stanine Scores of Students in the Class of 1986 on the Eleventh Grade CAT Mathematics Section: Overall and by Gender 4-10
TABLE 4.6: Stanine Scores of Students in the Class of 1986 on the Eleventh Grade CAT Mathematics Section by Racial/Ethnic Group 4-11
TABLE 4.7: Correlations Between CAT Mathematics NCE Scores and Mathematics Courses Taken 4-12
TABLE 4.8: Eleventh Grade CAT Performance of Students in the Class of 1986: by Highest Mathematics Course Taken in High School and Gender 4-13
TABLE 4.9: Eleventh Grade CAT Performance of Students in the Class of 1986: by Highest Mathematics Course Taken in High School and Racial/Ethnic Group 4-15
TABLE 4.10: Amount of Variation in CAT Mathematics Scores Explained Through Regression Analysis on Several Variables: by Gender and Overall 4-17
TABLE 4.11: Amount of Variation in CAT Mathematics Scores Explained Through Regression Analysis on Several Variables: by Racial/Ethnic Group 4-19
TABLE 4.12: SAT Score Means by Gender for Students in the Class of 1986 Who Took the SAT in Their Junior and/or Senior Years 4-20
TABLE 4.13: Eleventh Grade SAT Mathematics Score Means by Gender for Students Who Completed Various Mathematics Courses by the End of Their Junior Year 4-22
TABLE 4.14: Highest SAT Mathematics Score Obtained in Junior and/or Senior Year by Gender and Highest Mathematics Course Taken in High School 4-23
TABLE 4.15: Career Aspirations of Students by Gender and Participation in Mathematics 4-25

Page

CHAPTER 4: MATHEMATICS ENROLLMENT AND ACHIEVEMENT AT THE HIGH SCHOOL LEVEL: GENDER AND RACIAL/ETHNIC GROUP SIMILARITIES AND DIFFERENCES (Cont.)

TABLE 4.16: Gender Differences in Need for Help with Mathematics Homework by Level of Participation in the Curriculum 4-26
TABLE 4.17: Gender Differences in Preparation for the SAT . 4-27
TABLE 4.18: Average Junior Year SAT Performance by Gender: Aggregated Within SAT Mathematics Score Ranges 4-28
TABLE 4.19: Proportion of Students by Racial/Ethnic Group Who Took the SAT in Their Junior and/or Senior Year 4-29
TABLE 4.20: SAT Score Means by Racial/Ethnic Group for Students in the Class of 1986 Who Took the SAT in Their Junior and/or Senior Years 4-30
TABLE 4.21: Eleventh Grade SAT Mathematics Score by Racial/Ethnic Group for Students Who Completed Various Mathematics Courses by the End of Their Junior Year 4-31
TABLE 4.22: Highest SAT Mathematics Sc Mathematics Courses by the End of Their Junior Year 4-31
TABLE 4.22: Highest SAT Mathematics Score Obtained in Junior and/ or Senior Year: by Racial/Ethnic Group and Highest Mathematics Course Taken in High School 4-32
TABLE 4.23: Amount of Variation in SAT Mathematics Scores Explained Through Regression Analysis on Several Variables: by Gender and Overall 4-35
TABLE 4.24: Amount of Variation in SAT Mathematics Scores Explained Through Regression Analysis on Several Variables: by Racial/Ethnic Group 4-36

CHAPTER 5: PROGRESS AND PERFORMANCE IN A K-8 MATHEMATICS CURRICULUM: GENDER AND RACIAL/ETHNIC GROUP SIMILARITIES AND DIFFERENCES

TABLE 5.1: Average Number of ISM Objective and Problem-Solving Assessments Mastered by Grade: Countywide and by Gender 5-3
TABLE 5.2: Average Number of ISM Objective and Problem-Solving Assessments Mastered by Grade and Racial/Ethnic Group 5-4
TABLE 5.3: Average Number of ISM Objective and Problem-Solving Assessments Mastered by Grade and Racial/Ethnic Group: Expressed As A Percentage of White Students' Progress 5-5
TABLE 5.4: Ranges of Mastery of Objective and Problem-Solving Assessments That Classify Students as Working On Grade Level 5-6
TABLE 5.5: Percentage of Students Working Below, On, or Above the Grade Level Standard: Countywide and by Gender 5-7
TABLE 5.6: Percentage of Students Working Below, On, or Above Grade Level Standard: by Grade and Racial/Ethnic Group 5-8

Page

CHAPTER 5: PROGRESS AND PERFORMANCE IN A K-8 MATHEMATICS CURRICULUM: GENDER AND RACIAL/ETHNIC GROUP SIMILARITIES AND DIFFERENCES (Cont.)

TABLE 5.7: Predicted Status of Students by Racial/Ethnic Group Based on First Grade Performance in the K-8 Curriculum 5-12
TABLE 5.8: Average Number of Problem-Solving Points Attained by Students in the K-8 Curriculum: Overall and by Gender 5-13
TABLE 5.9: Average Number of Problem-Solving Points Attained by Students in the K-8 Curriculum by Racial/Ethnic Group 5-14
TABLE 5.10: Mathematics Grades Received by Students in Their Prior Three Years of School: by Grade Level and Gender 5-16
TABLE 5.11: Mathematics Grades Received by Students in Their Prior Three Years of School: by Grade Level and Racial/Ethnic Group 5-17
TABLE 5.12: CRT Mathematics Performance of Third, Fifth, and Seventh Grade Students: Countywide and by Gender 5-18
TABLE 5.13: CRT Mathematics Performance of Third, Fifth, and Seventh Grade Students by Racial/Ethnic Group 5-19
TABLE 5.14: CRT Mathematics Performance of Students by Grade Level, Racial/Ethnic Group, and Level of Performance in the Curriculum 5-19
TABLE 5.15: CAT Mathematics Performance of Students by Grade Level: Countywide and by Gender 5-21
TABLE 5.16: Performance on the CAT Controlling for Performance in the K-8 Curriculum: Third, Fifth, and Seventh Grade Students 5-22
TABLE 5.17: Stanine Distribution by Gender on the CAT Total Mathematics Subtest 5-22
TABLE 5.18: CAT Mathematics Performance of Students by Grade Level and Racial/Ethnic Group 5-23
TABLE 5.19: Stanine Distribution by Racial/Ethnic Group: CAT Total Mathematics Score 5-24
TABLE 5.20: Performance on the CAT Controlling for Performance in the K-8 Curriculum: Third and Fifth Grade Students by Racial/Ethnic Group 5-25
TABLE 5.21: Performance on the CAT Controlling for Performance in the K-8 Curriculum: Seventh Grade Students by Racial/Ethnic Group 5-26
TABLE 5.22: Correlations Between Participation and Performance Variables 5-27
TABLE 5.23: Amount of Variation in CAT Mathematics Scores Explained Through Regression Analysis on Several Variables: by Gender and Overall, Grades 4 and 6 5-30
TABLE 5.24: Amount of Variation in CAT Mathematics Scores Explained Through Regression Analysis on Several Variables: by Racial/Ethnic Group, Grades 4 and 6 5-31

TABLE OF TABLES (Cont.)

Page

CHAPTER 6: STUDENTS' ATTITUDES AND BELIEFS ABOUT MATHEMATICS: THE RELATIONSHIP TO PARTICIPATION AND PERFORMANCE BY GENDER AND RACIAL/ETHNIC GROUP

TABLE 6.1: Students' Feelings Concerning Whether or Not They Had A Good Mind for Mathematics by Gender: Students in Grades 4, 6, 8, and 12 6-3

TABLE 6.2: Gender Differences in Perceptions of Mathematics As A Male Domain: Students in Grades 4, 6, 8, and 12 6-5

TABLE 6.3: Racial/Ethnic Group Differences in the Liking of Mathematics: Students in Grades 4, 6, 8, and 12 6-8

CHAPTER 7: THE HOME ENVIRONMENT - PARENTAL ATTITUDES, BELIEFS, EXPECTATIONS, AND SUPPORT: ITS EFFECT ON STUDENTS' PARTICIPATION AND PERFORMANCE BY GENDER AND RACIAL/ETHNIC GROUP

TABLE 7.1: Parents' Perceptions of Students' Early Interest in Mathematics, Computers, and Mechanics: by Grade Level and Gender 7-2

TABLE 7.2: Parents' Reports of Who Helps Student with Homework and Why: Grades 4, 6, 8, and 12 7-3

TABLE 7.3: Fourth Grade Parents' Educational Goals for Their Children by Gender 7-4

TABLE 7.4: Parents' Employment Goals for Their Children by Gender: Grades 4, 6, 8, and 12 7-5

TABLE 7.5: Parents' Perceptions of Students' Need to Persist in Mathematics: by Students' Grade Level and Racial/Ethnic Group 7-6

TABLE 7.6: Parents' Perceptions of Mathematics As A Male Domain: by Students' Grade Level and Racial/Ethnic Group 7-7

TABLE 7.7: Parents' Perceptions of Mathematics Teachers Their Children Had: by Students' Grade Level and Racial/Ethnic Group 7-8

TABLE 7.8: Parents' Inclinations Towards Questioning Their Children's Mathematics Teachers If They Disagreed with the Teacher's Assessment of the Student: by Students' Grade Level and Racial/Ethnic Group 7-9

TABLE 7.9: Parents' Perceptions of Students' Early Interest in Mathematics, Computers, and Mechanics: by Grade Level and Racial/Ethnic Group 7-10

TABLE 7.10: Parents' Perceptions of Students' Early Interest in Mathematics, Computers, and Mechanics: by Grade Level, Gender and Racial/Ethnic Group 7-10

TABLE OF TABLES (Cont.)

Page

CHAPTER 8: THE SCHOOL ENVIRONMENT: TEACHERS', COUNSELORS', AND PRINCIPALS' ATTITUDES AND EXPECTATIONS CONCERNING MATHEMATICS FOR STUDENTS BY GENDER AND RACIAL/ETHNIC GROUP (Cont.)

TABLE 8.1: Percentage of Students by Racial/Ethnic Group Reported to be Careful in Mathematics Class by Their Teachers: Grades 4 and 6 ... 8-6

TABLE 8.2: Percentage of Students by Racial/Ethnic Group Reported to be Studious in Mathematics Class by Their Teachers: Grades 4, 6, 8, and 12 ... 8-7

TABLE 8.3: Teachers' Ratings of Students' Overall Ability by Racial/Ethnic Group: Grades 4, 6, 8, and 12 ... 8-8

CHAPTER 9: SUMMARY AND RECOMMENDATIONS

TABLE 9.1: SAT Score Means by Gender for Students in the Class of 1986 Who Took the SAT in Their Junior and/or Senior Years ... 9-4

TABLE 9.2: Highest SAT Mathematics Score Obtained in Junior and/or Senior Year by Gender and Highest Mathematics Course Taken in High School ... 9-5

TABLE 9.3: Stanine Scores of Students in the Class of 1986 on the Eleventh Grade CAT Mathematics Section by Racial/Ethnic Group ... 9-11

TABLE 9.4: Eleventh Grade CAT Performance of Students in the Class of 1986: by Highest Mathematics Course Taken in High School and Racial/Ethnic Group ... 9-12

TABLE OF EXHIBITS

	Page
CHAPTER 4: MATHEMATICS ENROLLMENT AND ACHIEVEMENT AT THE HIGH SCHOOL LEVEL: GENDER AND RACIAL/ETHNIC GROUP SIMILARITIES AND DIFFERENCES	
EXHIBIT 4.1: Model Illustrating the Relationship Among Attitudes, Course Participation, and SAT Performance	4-34
CHAPTER 5: PROGRESS AND PERFORMANCE IN A K-8 MATHEMATICS CURRICULUM: GENDER AND RACIAL/ETHNIC GROUP SIMILARITIES AND DIFFERENCES	
EXHIBIT 5.1: Longitudinal History of Performance in the K-8 Curriculum for Three Samples of Students	5-10
CHAPTER 7: THE HOME ENVIRONMENT - PARENTAL ATTITUDES, BELIEFS, EXPECTATIONS, AND SUPPORT: ITS EFFECT ON STUDENTS' PARTICIPATION AND PERFORMANCE BY GENDER AND RACIAL/ETHNIC GROUP	
EXHIBIT 7.1: Stereotypical Representation of Women in Mathematics by the Media	7-12
CHAPTER 9: SUMMARY AND RECOMMENDATIONS	
EXHIBIT 9.1: Percentage of Students by Racial/Ethnic Group and Grade Level Working Above Grade Level in the K-8 Curriculum	9-8
EXHIBIT 9.2: Percentage of Students by Racial/Ethnic Group and Grade Level Working On Grade Level in the K-8 Curriculum	9-9
EXHIBIT 9.3: Percentage of Students by Racial/Ethnic Group and Grade Level Working Below Grade Level in the K-8 Curriculum	9-10
EXHIBIT 9.4: Proposed Model of Factors Related to Mathematics Achievement	9-15

FACT SHEET

PARTICIPATION AND PERFORMANCE OF WOMEN AND MINORITIES IN MATHEMATICS

What was the purpose of the study?

This study explored those factors which were believed to contribute to differential participation and performance in mathematics of students in different gender and racial/ethnic groups. Participation and performance were examined within the context of the elementary, junior high/middle, and high school environments. The overall goals of the study were threefold:

- to identify at what points, if any, in the educational process differences appear in the mathematics participation and performance of females compared to males, and Blacks and Hispanics compared to Asians and Whites, and to describe these differences
- to identify the factors in the school, home, and society that contribute to the differential mathematics participation of female, Black, and Hispanic students at the elementary, junior high/middle and senior high school levels
- to provide, where possible, the policy implications of the research and suggest alternatives or solutions which schools might wish to explore to increase the enrollment and achievement of females, Blacks, and Hispanics in mathematics.

What data were gathered and/or utilized in the study?

The following performance and participation data were gathered for this study:

- progress of students in the K-8 mathematics curriculum (ISM) - about 3,000 students per grade level for grades 1-6, and 2,000 students per grade level for grades 7 and 8 (computerized records were available for students in schools with computer-assisted assessment)
- student enrollment in high school mathematics courses - more than 6,000 high school seniors
- students' report card grades in mathematics - more than 6,000 high school seniors, and approximately 300 students each from grades 4, 6, and 8
- performance on the County-developed criterion-referenced tests in mathematics (CRT's) - approximately 6,000 students per grade level, grades 3-8
- performance on the mathematics subtests of the California Achievement Tests (CAT) - approximately 6,000 students per grade level, grades 3, 5, 8, and 11
- performance on the mathematics and verbal sections of the Scholastic Aptitude Test (SAT) - approximately 4,000 students

Students had to be enrolled in MCPS for at least two years prior to the study to be included in the analyses.

Information concerning attitudes and beliefs about mathematics was collected from the following sources:

- o student responses to questionnaire items designed to measure such concepts as confidence in mathematics, interest in mathematics, perceptions of the utility of mathematics, and postsecondary aspirations - approximately 300 students each from grades 4, 6, and 8, and more than 500 students in grade 12
- o information gathered through focus group discussions with students in grades 8, 11, and 12 (small group guided discussions with same-gender, same-racial/ethnic group, and same-achievement level students) to obtain information on the factors that influenced their participation in mathematics and their success or lack of success in mathematics - 16 groups of approximately 10 students each
- o parent responses to questionnaire items concerning their attitudes and beliefs about mathematics, and their perceptions of and educational and career goals for their children - between 100 and 200 parents of students in each of the student samples above for grades 4, 6, 8, and more than 200 parents of 12th graders
- o surveys of mathematics teachers of students in the samples regarding their perceptions of the sample students and their attitudes and beliefs about mathematics instruction - more than 80 teachers each in grades 4 and 6, approximately 40 for grade 8, and more than 160 for grade 12
- o surveys of a sample of junior high/middle and high school guidance counselors of sample students, regarding their attitudes and beliefs about mathematics - 82 counselors
- o surveys of elementary and junior high/middle school principals of students in the samples, regarding their attitudes and beliefs about mathematics - 48 principals

How were participants selected for each sample?

Students were selected from three levels of performance in the K-8 mathematics curriculum (those working above, on, or below grade level) and from three levels of performance on the SAT mathematics section (650 and above, 520-640, and below 520). The samples were balanced as evenly as possible, so there would be similar numbers of Asians, Blacks, Hispanics, and Whites, as well as males and females in each performance level. Students included in the study were enrolled in MCPS for a minimum of two years prior to data collection.

Parents, teachers, and counselors of half the students in the student samples were selected at random. Principals of all elementary and junior high/middle schools that had students in the study samples were interviewed.

INTRODUCTION

BACKGROUND

For more than a decade, Montgomery County Public Schools (MCPS) has had priority goals for the education of female, Black, and Hispanic students in key academic areas such as mathematics. The school system has devoted a great deal of time, attention, and resources to the development of innovative curricula, staff awareness and sensitivity to cultural differences and sex role stereotypes, and staff training in promising practices and strategies such as differentiated instruction. The following are some of the major steps that have been taken:

- MCPS led the nation in establishing a Board of Education policy in 1972 that mandated specific actions on the part of staff to address the problem of underachievement and underrepresentation of Black students in academic and extracurricular areas.

- In the mid 1970's, MCPS conducted an institutional study required by Title IX, and designated a Title IX Coordinator in the Department of Human Relations. Annual conferences have been conducted by the Department of Human Relations and the Office of Instruction and Program Development, to provide staff with ways of fostering interest of female, Black, and Hispanic students in technical courses and careers.

- The school system was the first in the greater Washington D.C. area to publish standardized test score results in 1978, showing differential performance by gender and racial/ethnic group.

- Commitment to increasing Black and Hispanic students' achievement and participation was reiterated in 1983 when the Board of Education set the priority to:[1] "implement a special emphasis program that will result in substantial gains in a) the performance of minority students in the classroom and on standardized and criterion-referenced tests; b) the participation of minority students in programs for the gifted and talented, higher level academic courses, and extracurricular activities."

- In 1985 MCPS adopted a policy on Women's Equity which stipulated actions that school and central office personnel must take to ensure equal opportunity and elimination of sex role stereotypes concerning student participation in courses, athletics, and other extracurricular activities, as well as staff employment opportunities.

- In 1985 the MCPS Board of Education adopted the Initiatives for Sex Equity, which had several long-range goals: improvement of SAT scores for females, increased enrollment of females in computer science courses and advanced courses in mathematics and science, and increased

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1. PRIORITIES: Montgomery County Board of Education, Montgomery County Public Schools, September 1983.

participation of women in nontraditional careers.

Such self-examination and leadership is essential to a vital school system.

In the last 10-12 years, substantial progress has been made toward these goals. For example, today, the performance of female, Black, and Hispanic students in the County far exceeds national levels of achievement for these groups. Within the state of Maryland as well, females, Blacks, and Hispanics outperform their peers in the other local school systems. This contrasts sharply with conditions in 1978 when Black students at all grade levels and Hispanic students in grades 7, 9, and 11 scored below national norms in mathematics achievement.

Despite these gains, the performance of female, Black, and Hispanic students continues to be a major concern. MCPS's proposal to the National Science Foundation (NSF) for funds to conduct a study of the participation and performance of female and minority[2] students in mathematics is just one indicator of the continued interest in these areas. The unprecedented award by NSF to a school system rather than to an institution of higher education reflects NSF's judgment that MCPS is on the cutting edge of research, curriculum development, and student data management in these areas.

This document contains the findings of the NSF-funded study. The data show that, in many areas, MCPS has made great strides toward meeting the needs of its students in mathematics instruction. However, while the mathematics performance and participation of MCPS's female, Black, and Hispanic students has shown substantial improvement over the last decade, differences are still observed for students in different gender and racial/ethnic groups. This study represents one more step in MCPS's initiative in meeting the complex needs of all students in mathematics. Based on the findings in Montgomery County, it is likely that gender and racial/ethnic group performance and participation differences must be far greater in school systems that have not devoted similar time, attention, and resources to these issues.

STUDY FOCUS AND OBJECTIVES

While the vast majority of research on the performance and participation of female and minority students in mathematics has concentrated on the junior and senior high school years, many educators and researchers have hypothesized that differential participation in mathematics, while perhaps most clearly identified in the latter years of high school, actually has its roots in the earlier years, probably as early as in the primary elementary school grades. Clearly, those factors identified as being critical -- confidence in mathematics, perceived utility of mathematics vis-a-vis later life and career decisions, and parental expectations -- develop and have their impacts over a long period of time. Alexander and Cook (1982) stated:

> We must return to what we take to be the most striking and perhaps far-reaching implications of these analyses: that so many of the influences upon senior high school outcomes are already well

2. In this report "minority" refers to Black and Hispanic students.

established before students even enter high school. It seems clear to us that those who share our interest not only in organizational differentiation within schools but also in school achievement processes generally, would be well advised to turn their attention to the academic experiences in the early grade levels, for this seems to be where much of what is observed at the "input end" is actually set into motion.

However, data on the effects of the earlier mathematics experiences of females are fragmentary and have not been systematically linked to the later enrollment patterns of these students. Similarly, there is a dearth of research on the early mathematics experiences of minority students.

The present MCPS study of female and minority students' mathematics participation and performance follows the lead of researchers such as Alexander and Cook with its emphasis on the total school experience. It explores further those factors which are believed to contribute to differential course-taking histories within the context of the elementary, junior high/middle school and high school environments.

The study assumes that many of the decisions students make concerning high school mathematics participation have their roots in the elementary years. Thus, it examines the mathematics performance of elementary school children and the factors that may help explain the differential elementary school experiences of female and male and majority[3] and minority students. For the study to focus only on the elementary school years would be as misplaced as prior studies' exclusive focus on the senior high school years. Therefore, the study not only examines the elementary school mathematics experiences of students but also those occurring at the junior high/middle and senior high school levels.

The study further assumes that the factors that contribute to differential mathematics participation[4] and achievement among males/females and minority/majority students in elementary, junior high/middle and senior high school are not necessarily the same, nor are the influences of specific variables likely to be constant over time. For example, it is probable that peer group influences may play a role in mathematics course-taking at the senior high level but not at the early elementary level. Similarly, students' perceptions of the utility of mathematics and the effects of these percep-

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3. In this report "majority" refers to White and Asian students.

4. The word "participation" has two meanings in this report. At the high school level it refers to the highest level of mathematics instruction the students have completed (Geometry, Algebra 2, Calculus, etc.). At the elementary and junior high/middle school levels it refers to the student's placement in the K-8 mathematics curriculum. Students are placed in different levels (above, on, or below grade level) based on their rate of progress through the countywide mathematics curriculum objectives. Students who are in the same grade level are likely to be working on different curriculum objectives, or cover the same objectives in different levels of breadth and depth, if they are in different working level groups (above, on, or below level). Thus, they are viewed as "participating" in different mathematics experiences.

tions on mathematics decision-making and course-taking may be expected to increase as the student approaches graduation.

The research of which this report is a part seeks to analyze the processes which lead to differential enrollment and achievement in mathematics, with the primary focus being on female and minority students. The overall goals of the research are threefold:

- to identify at what points, if any, in the educational process differences appear in the mathematics participation and performance of females and minorities relative to that of males and majority students, and to describe these differences

- to identify the factors in the school, home, and society that contribute to the differential mathematics participation of female and minority students at the elementary, junior high/middle and senior high school levels

- to provide, where possible, the policy implications of the research and suggest alternatives or solutions which schools might wish to explore in increasing the enrollment and achievement of females and minorities in mathematics.

This report summarizes the findings of the analyses we have performed to address each of these goals.

REPORT ORGANIZATION

It is recognized that the participation and achievement of female and minority students must be viewed in the broader context of the school's instructional climate, and the mathematics-related attitudes and behaviors of these students must be considered in relation to the attitudes and behaviors that prevail among all students. While this study was not designed to address these broader issues in depth (to do so would have required an enormous data collection effort), relevant data relating to the mathematics experiences of the student body as a whole were acquired. Volume I of this report presents the major study findings as they relate to gender and racial/ethnic group differences, and Volume II presents the findings related to mathematics instruction for the student body as a whole.

Volume I is organized into nine chapters. These chapters form three major sections. The first section, containing Chapters 2 and 3, presents the conceptual framework of the study. Chapter 2 presents a review of the literature pertaining to racial/ethnic group and gender differences in mathematics participation, performance, and achievement. In Chapter 3 we summarize the methods used for the conduct of our study. In this chapter we describe the data sources on which our analyses are based, and define key study concepts.

The second major section of Volume I contains Chapters 4 and 5, and presents the major study findings related to participation and performance in mathematics by gender and racial/ethnic group membership. Chapter 4 examines racial/ethnic group and gender differences in mathematics course-taking and achievement at the senior high school level. The findings reported in this chapter document the patterns of participation and achievement that are observed, and link these patterns to students' attitudinal and background data.

Chapter 5 presents the results of our analyses of student progress and performance in mathematics at the elementary school level. The extent to which students from different racial/ethnic groups and genders differ in their progress through a K-8 mathematics curriculum is investigated. The relationships between performance in the K-8 curriculum and mathematics achievement are explored across grade levels.

The third major section of Volume I addresses students', parents', and school staffs' attitudes and beliefs concerning mathematics and mathematics education as they relate to students' gender and racial/ethnic group membership. Chapter 6 presents the attitudes and behaviors of students. It focuses on the extent to which students who have exhibited various patterns of performance and participation in mathematics differ with respect to their attitudes and beliefs, and whether these differences are related to gender or racial/ethnic group membership. Chapter 6 also presents a discussion of the supports in mathematics students report they receive at home. It seeks to determine whether the type and level of support and assistance students receive from their parents/other adults is different for students who have exhibited different levels of participation and achievement in mathematics.

Chapter 7 presents parental attitudes and beliefs about mathematics. The degree of consistency between students' and their parents' attitudes toward mathematics and the mathematics education they have received is examined relative to student participation and achievement in mathematics. Chapter 7 also explores the extent to which home support in mathematics is provided by male versus female household members, and examines the educational and mathematics backgrounds of these household members.

Chapter 8 explores the influence of the school on mathematics participation and achievement for students by gender and racial/ethnic group. This chapter presents the attitudes, beliefs, and opinions about mathematics held by elementary and secondary school mathematics teachers, and junior high/middle and high school guidance counselors. It also presents relevant comments made by principals as they discussed their schools' philosophies for mathematics instruction with our researchers. A special focus of this chapter is the perceptions principals and counselors have of the underlying causes of racial/ethnic and gender discrepancies in mathematics participation and performance, and the solutions these respondents would suggest for eliminating these differences.

Chapter 9, the summary chapter for Volume I, summarizes and integrates the key findings contained in the second and third sections of this volume. The findings of our analyses are discussed both in terms of findings related to students' gender and racial/ethnic group membership. Specifically, Chapter 9 integrates the study findings as they relate to the research goals identified earlier in this chapter:

- When, in the educational process, do differences in performance and participation begin to emerge?

- o What factors appear to contribute most substantially to gender and racial/ethnic group differences?

Finally, Chapter 9 presents policy implications of the study findings and suggests, where possible, alternatives or solutions schools might wish to explore to enhance the participation and performance of female and minority students in mathematics.

Volume II of this report is a much shorter volume, and addresses findings related to the larger context of mathematics instruction and experiences for all students, regardless of gender or racial/ethnic group membership. This volume focuses on two discussions: the perceptions of students regarding mathematics and the instructional environment in which mathematics is presented; and the perceptions of teachers and other school staff concerning students' performance in mathematics, instructional goals for various groups of students, and the decision processes whereby students are selected for or placed into various levels of mathematics instruction.

Volume II is organized into four chapters. Chapter 1 presents a short introduction. Chapter 2 presents students' perceptions of mathematics and mathematics instruction. A special focus of this chapter is a description of students' perceptions of "good" and "poor" mathematics teachers.

Chapter 3 presents the perceptions of school staff regarding mathematics and mathematics instruction. A special focus of this chapter is a description of the goals teachers set for remedial and advanced level mathematics students. The chapter reports the findings of our analyses of teacher evaluations and expectations of low, middle, and high achieving mathematics performers. Teachers' ratings of student performance, mathematics ability, and student characteristics (e.g., degree of preparation, care in doing work, etc.) are examined relative to the mathematics performance levels of the students being assessed.

Chapter 4 summarizes the findings of Volume II. It integrates the perceptions of students and school staff concerning mathematics and mathematics education. Finally, this chapter contains implications of these findings and recommendations for improvement of the quality of mathematics instruction for those students whose mathematics achievement is at or below the level of average students in their grade.

SECTION I:

CONCEPTUAL FRAMEWORK

REVIEW OF THE LITERATURE

BACKGROUND

A review of the literature was conducted in order to determine what is presently known about the participation of female and minority[1] students in mathematics. In particular, this review sought to establish the differential rates of participation of these students in comparison with male and White and Asian students, and to identify the factors that have been studied as possible contributors to these rates.

For the most part, studies of differential mathematics enrollment concentrate on the discrepancies between males and females. Studies on minority student participation are relatively sparse. In fact, it is clear from our review that research on factors affecting minority participation in mathematics is sadly lacking and that a definite need for attention to this area exists.

PATTERNS OF ENROLLMENT

Enrollment Findings by Gender

Many studies have shown that women are substantially underrepresented in senior high school mathematics courses.

- In the 1960 Project Talent sample, only 9 percent of the females were taking four years of high school mathematics as compared with 33 percent of the males (Wise et al., 1979).

- Of the students entering Berkeley in 1972, 57 percent of the males had taken four years of high school mathematics as compared with only 8 percent of the entering females (Sells, 1973).

- According to College Entrance Examination Board data, there was a consistent difference by gender in the number of years of high school mathematics studied, with males being twice as likely as females to report taking five or more years of mathematics. (This pattern was observed for the years 1973 through 1981.)

- By way of explanation for these findings, Fauth and Jacobs (1980) have suggested that female students drop mathematics as soon as they fulfill the basic requirements for high school graduation or college admission.

Several more recent studies have indicated that the gap between male and female mathematics course enrollment may be closing, however.

- Chipman et al. (1985) reported that enrollment in advanced mathematics was about 60 percent male and 40 percent female. Moreover, they re-

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1. In this report "minority" refers to Black and Hispanic students.

ported that about 40 percent of those persons who approached college with a standard level of mathematics preparation were female, and that about 40 percent of the females who entered college had taken the standard four years of high school mathematics.

- West et al. (1985) found that males and females were about equally likely to have concentrated in mathematics in high school and to have enrolled in a college preparatory mathematics course sequence. In this study, mathematics concentration was defined as having earned four or more credits in mathematics with at least one credit being earned in Calculus, Elementary Functions and Analysis, or other advanced level mathematics courses.

- A number of studies have found that males and females were equally likely to enroll in less advanced mathematics courses (Armstrong, 1981; Fennema and Carpenter, 1981; West et al., 1985).

Enrollment Findings by Racial/Ethnic Group Membership

The findings of studies examining racial/ethnic group differences in advanced mathematics participation have been more consistent, albeit dismal. Research findings indicate that Black students are far behind White students in their level of high school mathematics participation.

- According to West et al. (1985), Black students were significantly less likely to have concentrated in mathematics over their high school career (3.3 percent) or to have earned credit in a standard set of college preparatory mathematics courses (25 percent) than their White counterparts (10 percent and 41 percent, respectively). Moreover, the percentages of mathematics concentrators and four-year college-bound mathematics students who were Black were less than would be expected, given their representation in the high school student population.

- Data from the National Assessment of Educational Progress (1979) show that only 24 percent of the 17 year-old Black students had taken Algebra 2 as compared with 38 percent of their White counterparts.

- Additionally, several studies found higher concentrations of Black students than White students in lower level mathematics courses (Marrett, 1981; Jackson, 1982; West et al., 1985).

FACTORS INFLUENCING ENROLLMENT

Researchers have examined a wide range of factors in order to determine their effect on differential participation and achievement in mathematics. In addition to such factors as students' racial/ethnic group, gender, and socioeconomic status (SES), studies have investigated many other student, parent, and school variables. Overall, the findings of studies linking these variables to female mathematics participation are mixed, and studies of minority participation are relatively few in number. Nevertheless, the literature summarizing these studies does suggest some important variables that should be considered when attempting to explain differential mathematics participation among female and minority students.

Influences of Mathematics Achievement

Perhaps the most consistent and strongest predictor of mathematics participation is a student's prior achievement in mathematics. Conversely, the best predictor of mathematics achievement appears to be the number and type of mathematics courses a student has taken (Brush, 1980; Chipman et al., 1985; Lee and Ware, 1986). With few exceptions (Fox, 1977; Parsons, 1980), prior research has shown a strong positive relationship between mathematics achievement and participation in mathematics.

- In the Project TALENT sample, the correlation between ninth grade mathematics achievement and later high school mathematics course participation was 0.62 (Wise et al., 1979).

- West et al. (1985) found that 83 percent of the students who had concentrated in mathematics over their high school careers had composite vocabulary, verbal, and mathematics test scores that fell in the highest quartile range. In contrast, only 10 percent of those students who had earned fewer than 2 credits in college preparatory mathematics (i.e., general mathematics students) had scores that fell in the highest quartile.

Influences of Achievement by Gender

Differences are found by students' gender in the relationship between mathematics achievement scores and the intention to study mathematics. Differences in the mathematics achievement of males and females have been found to be closely tied to the age of the students tested. Studies of gender and achievement have usually shown few differences before grade 9, but by the end of the twelfth grade, on the average, males outperformed females.

- Boswell (1980) found strong positive correlations between mathematics achievement scores and the intention to study mathematics (0.55 for males and 0.51 for females in the ninth grade and 0.72 for males and 0.61 for females in the eleventh grade).

- There was a strong relationship between a student's last grade in mathematics and persistence. When students' last grades in mathematics courses were lower than their overall mathematics GPA, they were less likely to take the next mathematics course in the sequence. This finding was especially true for females (Lee and Ware, 1986).

- The Second International Mathematics Study Summary Report for the U.S. reported that there were no strong differences in mathematics achievement for eighth grade males and females, but that twelfth grade males outperformed twelfth grade females. Such differences were usually explained by male and female course-taking histories: males were more likely than females to have enrolled in the highest level mathematics courses (International Association for the Evaluation of Educational Achievement, 1985).

- Wise et al. (1979) found that differences in average mathematics achievement increased sharply after tenth grade, with males outperforming females by a full .6 of a standard deviation.

Examination of standardized test scores clearly confirms this age-related pattern.

- o The scores of Scholastic Aptitude Test (SAT) test-takers show that differences in performance exist for the older students. Data reported by the College Entrance Examination Board for the years 1972 through 1985 show that there has persisted a difference of 40 to 50 points on the quantitative portion of the SAT, with males consistently outperforming females.

- o ETS reports that this difference is even greater for students in the top tenth of their high school class -- 67 points. This picture of increased differences between the most able males and females is further reinforced by their performance on the Mathematics Level I and II examinations. In 1979, 6 percent of the males, as compared with 2 percent of the females, achieved a score of 700 or above on the Level I test. On the Level II test, the comparable figures were 38 percent and 22 percent, respectively.

Other research has challenged the conclusion that differences between the sexes emerge only after grade 9.

- o Benbow and Stanley (1980) reported differences in mathematics reasoning ability between gifted males and females by the seventh grade. They also found that these differences were not attributable to differential course-taking, but to superior male ability in spatial tasks.

- o Peterson and Fennema (1985) confirmed that male superiority in mathematics is seen as early as the upper elementary years and noted that the largest differences between males and females existed as early as the fourth grade in tasks of high level cognitive complexity.

- o Maccoby and Jacklin (1974) found that males and females achieve at relatively similar rates through the fifth grade; marked differences in achievement begin in the middle school years and increase year by year.

- o In a study of seventh and eighth graders, Webb (1984) found that regardless of ability level, males outperformed females on achievement tests. This was attributed to teachers interacting differently with their male and female students, with males being more likely than females to receive explanations to their mathematics questions when they requested them.

- o In Armstrong's 1978 Women and Mathematics National Survey, 13 year-old females performed significantly better than males on a test of mathematics computation and performed equally well on tests of problem-solving and algebra, as well as on tests of overall mathematics achievement. Moreover, females performed significantly better than did males on tests of spatial visualization at age 13. Findings from the National Assessment of Educational Progress II (1977-78) generally confirmed Armstrong's findings but claimed that 13 year-old males performed slightly better than did females on problem-solving items.

Influences of Achievement by Racial/Ethnic Group

While the differences in the mathematics achievement of males and females usually do not seem to surface until the junior high/middle or high school years, a lower level of achievement for non-Asian minorities is usually observed in the elementary grades.

- Data provided by McGraw-Hill, the publisher of the California Achievement Tests, show that by grade 3, the difference in performance between Black and "other" students ("other" includes White and Asian students) was 18 Normal Curve Equivalent (NCE)[2] points for the norm sample. For Hispanic students, the difference in performance from "other" students was 11 NCEs.

- Holmes (1982) found that by age 9, the performance of Black students was about 20 percent below the national average.

- In reporting the analyses of the second mathematics assessment of the NAEP II, Anick et al. (1981) found that Black students were 11 percentage points below the national average at age 9, 15 percentage points below at age 13, and 17 percentage points below at age 17.

- Matthews (1983) reported that there were significant differences in mathematics achievement after age 9 and that these differences continued to grow over students' educational careers.

- Olstad et al. (1981) reported that between grades 9 and 12 Black, Puerto Rican, and to a lesser extent, Mexican American students, showed little improvement in their mathematics abilities.

- Differences have also been detected in the mathematics SAT scores of students from different racial/ethnic groups. In 1982, the SAT scores in mathematics averaged 514 for Asian students, 484 for White students, 369 for Black students, and 410 for Hispanic students.

Precisely how early racial/ethnic differences in mathematics achievement develop is not known. A study by Ginsberg and Russell (1981) suggested, however, that these differences are not evident between Black and White students during the preschool and kindergarten years. This may be interpreted as suggesting that experiences during the school years are associated with emerging differences in mathematics achievement.

Affective Factors

Studies of mathematics participation have looked at how different attitudes and beliefs affect achievement and enrollment in mathematics. Factors that have been examined in order to determine their impact on differential participation in mathematics include students':

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2. NCE scores are standardized scores that range between 1 and 99. Intervals of the same size between pairs of scores are equal, regardless of where in the score range they occur.

- interest in and liking of mathematics

- confidence in their mathematics ability, level of mathematics anxiety, mathematics self-concept, and academic self-concept

- perceptions concerning the educational and practical utility of mathematics

- perceptions of mathematicians and of themselves as mathematicians

- perceptions of the difficulty of mathematics and their responses to difficult tasks

- causal attributions for success and failure

- career versus family orientation

- perceptions of what constitutes quality mathematics instruction.

The findings from research relating these variables to mathematics enrollment and achievement are mixed. However, in general, the research does suggest that most of these factors contribute to differential participation and performance in mathematics, particularly as they relate to gender. The role these factors play in explaining racial/ethnic differences in mathematics participation has received less attention by educational researchers. Some of the findings from these studies are highlighted below.

Confidence in Mathematics/Mathematics Anxiety/Mathematics Self-Concept

A number of studies examined such factors as confidence in mathematics, mathematics self-concept, and mathematics anxiety with respect to their effect on differential enrollment and achievement in mathematics. Confidence in mathematics seems to be strongly related to mathematics enrollment and achievement.

- Medin (1985) found that there was a significant relationship between test anxiety and the mathematics achievement of seventh and eighth graders, with achievement decreasing as anxiety increased.

- Lantz and Smith (1980) reported that the degree of mathematics confidence differentiated those who actually enrolled in advanced mathematics courses from those who did not. This finding was supported by a number of researchers (Casserly and Rock, 1979; Parsons 1980) who found that the decision to enroll in mathematics was strongly linked to one's expectations for success.

- Fennema and Sherman (1977) and Parsons (1980) reported correlations between confidence and mathematics achievement of between 0.30 and 0.40.

- By age 12, males have more confidence in their mathematics ability than do females (Armstrong, 1979; Fennema and Sherman, 1979; Parsons et al., 1982). Conversely, by seventh grade, females have lower expectations for future success in mathematics than do males (Eccles, 1986).

Males' expectations regarding mathematics grades are more positive than are those of females (Lantz and Smith, 1980), and more females than males report mathematics as being difficult (Brush, 1979, 1980).

- With respect to race, many minority females who were high achievers in mathematics in elementary school demonstrated low mathematics self-concepts at the junior high/middle school level and later chose not to pursue mathematics courses (Beane, 1985).

Liking of Mathematics

There is some evidence that age-related differences with respect to liking of mathematics exist.

- Chipman et al. (1985) reported a positive relationship between liking of mathematics and mathematics enrollment in higher level courses.

- In students' ranking of the importance of various factors in influencing their decision to study mathematics, liking for mathematics ranked fairly low (Parsons, 1980; Lantz, 1980). However, liking of mathematics may be more important for older students: at grade 7 it was ranked sixth of nine factors and at grade 12 it was ranked third (Armstrong, 1979).

- Brush (1979, 1980) reported that between grades 6 and 12 there was a sharp decline in the liking of mathematics for all students.

- Surprisingly, there seems to be little evidence that strong sex differences in liking of mathematics exist. However, Berryman (1983) suggested that junior high school females were less likely than their male counterparts to like mathematics and to choose mathematics-related careers.

- Although Black elementary school students scored lower on achievement tests than did White students, they liked mathematics, found it interesting, had little mathematics anxiety, and would like to study more mathematics (Beane, 1985; Johnson and Prom, 1984). However, research by Thomas (1986) indicated that Black high school students were less interested in mathematics than were White students.

Sex/Race Stereotyping of Mathematics

Studies of stereotyping mathematics as a male domain have produced contradictory findings.

- While female students saw mathematics as a male profession, this perception did not seem to influence their enrollment in mathematics (Brush, 1979, 1980; Lantz and Smith, 1980), nor did it preclude some women from pursuing mathematics careers (Boswell, 1980, 1985).

- Beane (1985) reported that some Black students perceived mathematics as a White activity and found that there was a lack of minority role models in mathematics. Moreover, some minorities viewed mathematicians as highly intellectual, inflexible, and socially isolated -- traits which are not valued in their cultures.

Perceived Utility of Mathematics

A number of studies have found that the perceived utility of mathematics is strongly related to mathematics enrollment.

- The perceived utility of mathematics is considered a dominant influence on mathematics enrollment (Lantz and Smith, 1980). Moreover, the perceived utility of mathematics, both in daily life and in relation to educational and career plans, was significantly related to the amount of mathematics students had taken (Armstrong, 1979).

- According to Wise et al. (1979), males may be more aware of the utility of mathematics than females, and this may help explain sex differences in mathematics participation and performance.

- Differences in the perceived utility of mathematics reflect differences in the career orientations of males and females (Fox, 1979). When females planned to pursue a career rather than become a homemaker, mathematics took on an increased importance. Females who continued to study mathematics were found to be more attuned to career plans than were those who did not continue (Stallings, 1979).

- Black students were less likely to understand the ways in which mathematics would be useful to them in the future. They tended to see mathematics as a classroom exercise that was unrelated to their everyday lives (Beane, 1985; Matthews, 1982).

Locus of Control

Students differ in their perceptions regarding whether they, themselves, or events outside themselves control their performance in school. This perception, or locus of control, has been found to contribute to mathematics achievement.

- Males were more likely than females to attribute their success in mathematics to their own ability whereas females were more likely to attribute success to effort or luck (Meyer, 1985).

- There is a significant interaction between locus of control and mathematics achievement level placement (i.e., above, on, or below grade level) among seventh and eighth graders. Mathematics achievement for internally-oriented students is consistently and significantly higher than for externally-oriented students (Medin, 1985).

Family versus Career Orientation

A student's orientation toward family versus a career has also been linked to mathematics participation.

- Female high school seniors who expressed a strong concern for family and their personal lives were less likely to choose college majors requiring heavy mathematics concentrations (Lee and Ware, 1986).

Summary of Affective Factors

For the most part, research on student's attitudes and perceptions as factors contributing to the differential mathematics participation of males and females has examined these factors independently of one another. That is, the interrelatedness of these variables has often been overlooked. Given the level of correlation typically reported between any one of these characteristics and mathematics enrollment, it is likely that they interact or otherwise combine with one another to influence male and female participation in mathematics.

For example, while stereotyping mathematics as a male domain does not in and of itself appear to be an important predictor of male and female differences, it is possible that this variable is correlated with others that seem to influence male and female decisions to study mathematics (e.g., confidence in one's mathematics ability, perceived utility of mathematics, and mathematics anxiety).

Similarly, locus of control may combine with other affective variables, such as the perception of mathematics as a White profession, to influence the decisions of minority students. The interrelatedness of these variables is examined in later chapters of this report.

Social and School Factors

Studies have examined the extent to which "critical others" affect the decision to enroll in mathematics courses, suggesting that there are gender differences in the types of communication students receive about continuing in mathematics. Such studies have looked at the effects parents, peers, teachers, and counselors have on students' decisions to enroll in mathematics courses and on their career choices. Generally, consistent and strong effects have been found for the influence of parents, with the role of teachers and peers receiving mixed support.

- Lantz and Smith (1980) reported that students were influenced most by parents, followed by teachers and peers. They noted that students rated mothers more important than fathers as influences upon enrollment decisions. The findings of Bloom and Sosniak (1981) and Berryman (personal communication) supported the importance of parental influence relative to that of teachers and peers.

- Research on the role of teachers has shown that teachers play a very positive role in encouraging students to continue in mathematics (Remick and Miller, 1977; Parsons et al., 1982). Moreover, their influence becomes increasingly important as the child gets older (Parsons et al., 1982).

Social and School Factors by Gender

How parents and others influence students is not entirely clear, but it appears that it is more through the transmittal of expectations than through any kind of role modeling. The establishment of expectations is important for both males and females, but it appears that differences in expectations favoring males arise after the elementary years.

- Parents believe that males do better than females in advanced mathematics courses (Jacobs and Eccles, 1985) and feel that mathematics is harder for adolescent females than males, despite the fact that male and female students actually do not differ in terms of grades or achievement test scores in mathematics (Parsons et al., 1982).

- Parents of sons generally indicated that they felt mathematics to be more important/useful for their children than did parents of daughters (Jacobs and Eccles, 1985).

- In one of the few studies relating mathematics participation to counseling, Lantz and Smith (1980) found that students who did not continue in mathematics stated that the school counselor was important in influencing this choice. Similarly, Casserly (1975) found that counselors discouraged females from taking mathematics during their senior year because it might interfere with their extra-curricular activities.

Social and School Factors by Racial/Ethnic Group Membership

Analyses of factors affecting the career choices of minority students indicate that parental expectations are important for understanding racial/ethnic mathematics enrollment differences.

- The postsecondary experiences of non-Asian minority parents had very strong effects on the mathematics participation and career choices of their children. Parental education was found to affect the choice of quantitative majors through its effects on high school performance and postsecondary education plans. Differences in the choices of mathematics and science majors between non-Asian minority and White majority college freshmen were not observed when students had even one parent who had attended college (Berryman, 1983).

Research has also suggested that teachers' expectations of Black and White students' mathematics abilities may be different and that this may help explain mathematics participation and performance discrepancies.

- When teachers negatively influence students, it is primarily in the expectation of failure which they communicate, especially to Black students (Rowe, 1977).

- Teacher expectations of students and their achievement potential were lower when the student was a member of a minority group (Olstad et al., 1981).

- Beane (1985) suggested that even when performance was the same, teachers tended to see minority students as low achievers and majority students as high achievers. Moreover, he suggested that White students were given more praise and encouragement and that this pattern was found regardless of the teacher's race.

- Beane (1985) stated that students who, as early as fifth grade, are discouraged from preparing for Algebra and Geometry are being handicapped in terms of later educational and occupational opportunities. He went on to suggest that counselors who promote the early entry of minorities into general, vocational, and remedial programs are projecting low expectations to students, teachers, and parents.

A variety of other school factors have been suggested as possible contributors to gender and/or racial differences in mathematics participation, including:

- the availability of mathematics clubs and other mathematics-related extracurricular activities and student participation in these activities (Thomas, 1986)

- the gender and racial/ethnic composition of the faculty and student body (Matthews, 1983)

- class size (Matthews, 1983)

- teachers' attitudes and feelings about mathematics (Beane, 1985).

Many studies have suggested that schools can help students keep their options open by requiring students to take more courses in mathematics at the senior high school level rather than allowing for mathematics electives. For example, Berryman stated:

> Ironically, the high school tradition of offering more advanced mathematics as electives interacts with women's lesser interests in mathematics-related activities to foreclose these options to them. Removing the choice during high school would preserve it after high school.

Summary of Social and School Factors

The studies highlighted here have shown that parents, teachers, and counselors have a major influence on students' decisions to enroll in mathematics courses as well as on their career choices. The studies have suggested that there are differences in the types of messages and expectations these parties transmit to students with respect to mathematics performance and continued mathematics participation, with males and White students receiving more encouragement than females and Black students. It seems reasonable to hypothesize that these differences in messages and in expectations affect both student attitudes toward mathematics and their perceptions of their mathematics abilities and that these, in turn, affect student participation and performance in mathematics.

3

METHODS

INTRODUCTION

This chapter describes the methods used in the conduct of the study. It details the key variables, data sources, samples, and data collection methodologies. It also lays out the relationships between key variables that were considered for statistical analyses.

KEY VARIABLES

Independent and Dependent Variables

Independent Variables

The major independent variables considered in this study are students' gender and racial/ethnic group membership. For most analyses performed in the study, analyses by gender and racial/ethnic group are conducted as well. Thus, gender and racial/ethnic group membership may be considered the key design or blocking variables for the study.

Additional variables are included in the independent variable set. Surveys and interviews were used to gather information from students, parents, teachers, and guidance counselors. These respondents provided attitudinal data regarding students' capabilities in mathematics, perceived utility of mathematics, gender or racial/ethnic stereotypes regarding mathematics, as well as the several other attitudinal areas discussed in the literature review. Statistical analyses of the relationship of the attitudinal variables with the study's dependent variables are performed in an effort to determine the extent to which differences in attitudes explain differences that are observed in the dependent variables.

Dependent Variables

Two groups of variables comprise the set of dependent variables that are used for the analyses discussed in this report. The first set of variables consists of all measures of student performance in mathematics that could be gathered from County computer data bases, as well as data that were gathered by hand from student records. These data include scores from norm-referenced and criterion-referenced tests.

The second set of variables considered for the purposes of this study comprises those variables that describe student participation in mathematics, namely, the types of mathematics courses in which students were enrolled, grades in these courses, and whether students were deemed to be working at a level above, on, or below other students in their class or grade.

Participation in mathematics is considered a dependent variable because of the interest, nationally, in participation rates of various gender and racial/ethnic groups. It is recognized, however, that participation in mathematics probably plays a large part in the ability of students to perform well on the types of measures that are considered in this study. Therefore, participation in mathematics also serves as an independent variable for many analyses presented herein.

Measures of Student Participation and Performance in Mathematics

Three sources of data are used in this study as measures of student participation and performance in mathematics: 1) progress through Montgomery County's K-8 mathematics curriculum; 2) senior high school course enrollments; and 3) performance on tests of mathematics achievement.

Student Participation in the K-8 Mathematics Curriculum

The mathematics curriculum for all County students in grades K-6 and for students in grades 7 and 8 who have not yet completed all pre-algebra instructional content is a criterion-referenced instructional program called the Instructional System in Mathematics (ISM). This program, which was developed by Montgomery County Public Schools, is designed to allow students to progress individually through a set of approximately 375 performance-based objectives. The objectives cover several general topics in mathematics and are arranged over 18 different levels of achievement which theoretically span the 18 semesters of schooling students complete from the beginning of kindergarten through the end of grade 8. The curriculum includes basic instruction in computations with whole numbers and fractions, as well as topics such as geometry and measurement, exponents, factors and multiples, and statistics. The Appendix to Chapter 3 contains a complete listing of the objectives covered in the ISM curriculum.

County-developed and validated mastery assessments are given to students throughout the school year to determine whether or not mastery of individual objectives has been attained. A subset of 171 of the ISM program objectives, which have been designated as "key" objectives, are assessed between kindergarten and grade 8, with an average of 20 such assessments taking place yearly. For example, first grade key objectives include: ordering sets, writing numerals 0-9, reading and demonstrating with objects addition and subtraction sentences (sums to 10), and using the symbol for cent.

The cumulative records of students' mastery of the ISM objectives provide the basis for determining their progress in the K-8 mathematics curriculum and for speaking of differential levels of performance in this curriculum. From the data on the objectives passed by each student, it is possible to provide a "pseudo" course-taking history for the elementary grades. For example, if one third grade student has passed only objectives in addition and subtraction and another third grade student has also passed multiplication and division objectives, the two students can be thought of as working at different levels in the mathematics curriculum, even though technically they both were enrolled in grade 3 mathematics.

For the analyses presented in this report, a student's level of performance in the ISM program is stated either in terms of the total number of objectives mastered by the student, or in terms of his or her ISM working level. In the first case, students may demonstrate mastery on 0 to 199 assessments.[1] The higher the number of assessments mastered, the closer the student comes to completing the K-8 mathematics curriculum.

The student's ISM working level is defined by a grade level standard consisting of a number of objectives he or she is expected to have mastered by the end of each grade. Depending upon the number of objectives a student has mastered relative to this county-established standard, a student's performance in mathematics in elementary school is defined as being below, on, or above grade level. For example, by the end of the third grade, a student is expected to have mastered roughly[2] 58 to 88 key objective and problem-solving assessments. Mastery of fewer than 58 key objective and problem-solving assessments results in the student being classified as working below grade level, while mastery of more than 88 results in the student being classified as working above grade level. By the end of the fifth grade, the expected number of key objective and problem-solving assessments a student should have mastered in order to be considered working on grade level increases to between 116 and 142, and by the end of seventh grade it increases to between 158 and 190.

Student Participation in High School Mathematics

Participation in high school mathematics is defined and classified in terms of the specific courses taken by students. Data contained in Montgomery County's computerized report card files are used to define the mathematics course-taking histories of high school students. From the information stored in these files, it is possible to identify the individual courses taken by students in grades 9 through 12.

The summary measures of students' high school course-taking history that are used in many of the analyses presented in the later chapters of this report are the highest level mathematics course in which students have enrolled and the grades received in these courses. Given the finite number of mathematics course offerings available to students and the prerequisites attached to many of these offerings, knowledge of the highest (most advanced) course in which students have enrolled provides a great deal of information about the students' secondary mathematics experience.

The highest level course students in Montgomery County can take in mathematics is Calculus. About one-sixth of the County students leave high school having taken mathematics through Calculus. A substantial number manage to complete mathematics through Pre-calculus (Elementary Functions and Analytic Geometry) while in high school. As will be shown in Chapter 4, there is a small group of County students, nonetheless, who take only the most basic of mathematics courses while in high school.

1. The difference between the 199 assessments mastered and the 171 key objectives identified earlier is a function of two points being assigned to each of 14 problem-solving assessments.

2. The word "roughly" is used because each problem-solving assessment carries two points, while the key objective assessments carry one point. Thus, the number of assessments actually mastered can vary among students.

Mathematics Achievement

K-8 student achievement in mathematics is assessed both in terms of performance in the ISM program and standing on a nationally normed achievement test. Achievement in the ISM program is assessed by County-developed criterion-referenced tests (CRT's), while overall mathematics achievement is assessed by performance on the California Achievement Tests (CAT), a norm-referenced test.

The two measures of mathematics achievement provide different information on the performance levels of K-8 students. Scores on the CAT are given interpretable meaning by their being compared with the scores of other students: a nationwide sample on whom the test was normed in the 1976-77 school year. The CRT's, on the other hand, assess the performance of students in relation to a locally-accepted standard of performance. They measure student achievement and retention of the materials covered in grades 3-8 of the ISM curriculum, rather than the more general skills measured by the CAT.[3] The tests are administered at the end of the school year. Despite their differences, the two measures of mathematics achievement -- CAT and CRT's -- are expected to be highly correlated with one another.

Mathematics achievement for secondary school students is measured using two normed tests of mathematics. The CAT is administered to all eleventh grade students. Additionally, mathematics achievement of college-bound students is measured by performance on the mathematics portion of the Scholastic Aptitude Test (SAT). SAT data are available for most students who are college-bound, especially those students who have enrolled in the higher levels of mathematics courses.

Survey Data

Survey and interview data were collected for samples of students to augment the information available from computer files. These data contain indicators of factors believed to influence student mathematics participation and achievement. The data include:

- student responses to questionnaire items designed to measure such concepts as confidence in mathematics, interest in mathematics, perceptions of the utility of mathematics, and postsecondary aspirations

- information gathered through focus group discussions with selected students in grades 8, 11, and 12 to obtain information on the factors that influenced their participation in mathematics and their success or lack of success in mathematics. This includes discussions of such variables as postsecondary goals and plans, attitudes toward courses in general and toward mathematics in particular, perceptions of the characteristics of a good mathematics performer, and influences by "significant others" (e.g., family, teachers, counselors, and peers) with respect to mathematics participation and performance

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3. There is one CRT for each grade level from third to eighth grade.

- telephone interview data on parent characteristics (e.g., education, income, and occupation), and on such variables as their expectations regarding their child's future education and occupation, attitudes toward mathematics, perceptions of the utility of mathematics, and liking of mathematics

- teacher and counselor responses to questionnaire items designed to obtain information on such variables as attitudes toward mathematics, the goals of mathematics instruction, and perceptions concerning the causes of and solutions to gender and racial/ethnic group differences in student mathematics participation and achievement.

DATA SOURCES AND SAMPLES

The analyses of student participation and achievement in mathematics are based on data from two primary sources: 1) the computer data bases regularly maintained by Montgomery County; and 2) data which were gathered via surveys and interviews of students and their parents, teachers, and counselors during the Spring and early Summer of 1986. In addition, the student records maintained by the schools were tapped in order to obtain information on students' mathematics grades and current ISM working level. Finally, focus group discussions with students (small group guided discussions with same-gender, same-racial/ethnic group, and same-achievement level students) proved to be another rich source of data.

Computer Data Bases

Historical data on students' mastery of the objectives in the ISM program, secondary mathematics courses taken, and their CRT, CAT, and SAT scores came from the County's computer data bases. For the most part, analyses of these data are restricted to students who had at least a two-year history in Montgomery County.

CRT, CAT, and SAT data were available for all students in the respective grade levels who took the tests: over 6,000 per grade level for the CRT's and CAT, and between 3,000 and 4,000 for the SAT. ISM program data were based on the performance of students in County elementary schools that had computer capabilities for monitoring assessment data. About half the elementary schools had computer-assisted assessment capabilities. Approximately 3,000 students per grade level were included in these analyses for grades 1-6, and about 2,000 per grade level for grades 7 and 8.

Survey Data

Students in Grades K-8

Because the study focused on the K-12 mathematics experiences of MCPS students, and because it was presumed that the factors affecting mathematics participation and performance come from a variety of sources, it was necessary to select several different samples for the survey/interview process. Three separate student samples were drawn to study the mathematics experiences of K-8 students: students in grades 4, 6, and 8. Since the data were collected during the school year, the primary focus was a retrospective look as of the end of their third, fifth, and seventh grade mathematics experiences.

Every effort was made to ensure that within students' gender and racial/ ethnic group membership, all levels of mathematics achievement and performance were represented. The intent was to sample at least 30 students for each of the 12 cells representing racial/ethnic group membership (4 groups) and ISM working level (3 groups -- below, on, or above grade level).[4] Within each cell there would be approximately equal numbers of males and females.

In some instances a cell size of 30 was unobtainable, as in the case of above grade level Black students, because fewer than 30 students in the population of students had the targeted characteristics. Other causes of reduced cell size were students leaving the school system after data collection began, or students who were absent for extended periods of time. Thus, the final sample sizes in the three grades were 277, 326, and 319, respectively. These data were augmented by information gathered from the students' parents, teachers, and counselors. Table 3.1 provides the sample numbers for students in grades 4, 6, and 8.

Students in Grade 12

The analyses of mathematics participation and achievement in high school were supported by survey data from two samples of twelfth grade students. One of these samples was based on the performance of male and female students on the SAT. Approximately equal numbers of male and female students were chosen for this sample. They were drawn uniformly from three levels of performance on the SAT mathematics section as eleventh graders: 650 or above, 520-640, and below 520. Because the majority of SAT-takers in Montgomery County are White, students from minority racial/ethnic groups were underrepresented in this analysis despite attempts to fill all cells uniformly. There were 164 students in the original sample of students who took the SAT in eleventh grade. However, when eleventh and twelfth grade SAT takers were combined, 331 students were included in the SAT sample. Table 3.2 presents this sample.

4. For the eighth grade sample, students in the above grade level category represented those students enrolled in Algebra 1 as eighth graders. Students enrolled in this course were stratified by racial/ethnic group and gender, and selected at random within each stratum. Unfortunately, either due to this separate selection of Algebra 1 students or for some other unforseen reason, the eighth grade sample turned out to contain somewhat higher functioning students, on the average, than the other samples. This difference in level of functioning has caused the eighth grade sample to appear different from the other groups in many of the analyses that are presented in this report. The reader should bear this in mind when drawing inferences from the data as presented.

TABLE 3.1

Survey/Interview Samples for Students in Grades 4, 6, and 8

Grade/ Gender/ Ethnicity	Number of Students Surveyed	Number of Parents Surveyed *	No. Students With Teacher Surveys **	Number of Teachers Surveyed **	Number of Counselors Surveyed ***
Grade 4	277	136	158	85	--
Females	136	66	79		
Males	141	70	79		
Asians	65	34	37		
Whites	86	42	43		
Blacks	67	29	36		
Hisp.	59	31	42		
Grade 6	326	126	160	86	--
Females	168	59	80		
Males	158	67	80		
Asians	84	31	40		
Whites	86	38	42		
Blacks	83	29	40		
Hisp.	73	28	38		
Grade 8	319	133	147	37	14
Females	164	71	81		
Males	155	62	66		
Asians	82	33	43		
Whites	82	41	36		
Blacks	91	33	38		
Hisp.	64	26	30		

* Parents of approximately half the students were interviewed. Every effort was made to interview as many male parents/guardians as female parents/guardians, although the ratio of males to females is approximately 1:2.

** Teachers of approximately half the students were surveyed. An attempt was made to obtain information from the last two mathematics teachers of these students, but for many students only the most recent teacher responded. Since teachers of mathematics at the junior high level teach multiple preparations of the same course, individual teachers responded for as few as one and as many as 17 students.

*** Guidance counselors in the junior high/middle school level often serve an entire grade level. Thus, only one or two guidance counselors per school were surveyed, on the average.

TABLE 3.2

Survey/Interview Samples for Students in Twelfth Grade

Sample/ Gender/ Ethnicity	Number of Students Surveyed	Number of Parents Surveyed	No. Students With Teacher Surveys	Number of Teachers Surveyed	Number of Counselors Surveyed
SAT Sample	331 *	145 *	164 *		
Females	171	79	82		
Males	160	66	82		
Asians	68	28	41		
Whites	151	68	70		
Blacks	68	32	29		
Hisp.	44	17	24		
All 12th Graders	584 *	237 *	267 *	166	68
Females	287	122	128		
Males	297	115	139		
Asians	108	46	54		
Whites	210	96	93		
Blacks	134	50	59		
Hisp.	132	45	61		

* Students in the SAT sample and the course-taking sample were combined for parent, teacher, and counselor interviews and surveys. Also, the 331 students in the SAT sample are included in the larger sample of students.

The second twelfth grade sample was based on the course-taking histories of majority and minority students. Students from each level of course-taking participation were included in this sample, again with an attempt to find equal proportions of students from each racial/ethnic group and gender to fill each cell of the design. There were 584 students in this sample (see Table 3.2).[5]

As with the K-8 student samples, the data collected from the members of these two samples were augmented by data obtained from samples of school staff and parents. Samples of parents and teachers were drawn from the combined sample of 584 students.

5. This sample includes the 331 students in the SAT sample.

DATA COLLECTION METHODOLOGIES

An assortment of data collection methodologies were employed to obtain information on or from the members of the study samples. These methodologies included record reviews and extractions of data, focus group sessions. self-administered surveys, and structured telephone interviews. The choice of a particular methodology or set of methodologies was based on the type of information that was needed and on the characteristics of the individuals on or from whom the information was to be sought. Table 3.3 summarizes the types and sources of the data collected for each group of respondents. A complete set of the data collection instruments is contained in the Appendix to Chapter 3.

TABLE 3.3

Summary of the Types and Sources of the Data Collected by Respondent Type

Respondent	Type of Data	Source of Information
Students	Report card data (e.g., mathematics grades, ISM working level)	Record reviews
	ISM program history, CAT and CRT data	MCPS data bases
	Attitudes toward, perceptions of, and beliefs about mathematics experiences and post-secondary plans and aspirations	Student Questionnaire (group administration) Focus groups
Teachers	General attitudes and beliefs about mathematics and mathematics instruction, assessments of specific students	Teacher questionnaire (mail survey)
Counselors	General attitudes and beliefs about mathematics and reasons underlying racial and gender patterns of mathematics participation	Counselor questionnaire (mail survey)
Parents	Attitudes toward, perceptions of, and beliefs about mathematics, mathematics experiences of respondent and child, and educational and occupational expectations for child	Parent questionnaire (phone interviews)

DATA ANALYSIS METHODOLOGIES

Several data analysis techniques were used in this study. Basic survey data were tabulated and aggregated for students in the same gender, racial/ethnic group, and level of performance or participation in the curriculum. Chi-square statistics were computed to investigate significant differences among groups. Factor Analysis was used to reduce the large set of attitudinal items on the student surveys into a small number of meaningful scales. Correlation and Regression Analysis were used to determine the strength of association between independent and dependent variables. And, Analysis of Covariance was used to investigate whether teachers perceive students of different gender and/or racial/ethnic groups differently, regardless of their level of performance or participation in the curriculum.

The remainder of this document presents the results of these analyses.

SECTION II:

FINDINGS RELATED TO MATHEMATICS PARTICIPATION AND ACHIEVEMENT
BY GENDER AND RACIAL/ETHNIC GROUP

MATHEMATICS ENROLLMENT AND ACHIEVEMENT AT THE HIGH SCHOOL LEVEL: GENDER AND RACIAL/ETHNIC GROUP SIMILARITIES AND DIFFERENCES

OVERVIEW

Background

For more than thirty years high school students in Montgomery County Public Schools have placed near the top in national rankings of academic achievement, as shown by nationally normed tests such as the California Achievement Tests (CAT) and the Scholastic Aptitude Test (SAT). It is generally believed that the high academic achievement of Montgomery County high school students is attributable not only to the high educational level and economic affluence of a large segment of the parent population, but also to the wide range and high caliber of course offerings in the Montgomery County high schools and the availability of well-equipped support facilities such as libraries and laboratories. It is also testimony to the time, attention, and resources that have been devoted in the last decade to the mathematics education of all MCPS students, regardless of gender or racial/ethnic group membership.

Montgomery County high school students rank high in all the subject matter areas measured by the CAT and SAT. Data for the past several school years, comparing CAT scores of Montgomery County students in grade 11 with national norms, have consistently shown that County students score at or above the national level i reading, language, and mathematics achievement. The SAT scores of Montgomery County students are also consistently above the national average. In 1986 the national average was 432 on the SAT verbal section and 475 for the mathematics section, for a combined SAT score of 906. Comparable figures for Montgomery County were 466 and 517, for a combined total of 983, the highest of any school system in the greater Washington metropolitan area.

The majority of Montgomery County's students are college bound and participate in a rigorous academic program while in high school. It is not unusual for students to take three or more years of mathematics, science, and foreign language while in high school. Nonetheless, there is a small proportion of County students who are not as academically oriented. For these students, their high school diploma will probably be a terminal degree.

This chapter examines the participation of Montgomery County high school students in mathematics courses, and the performance of these students on standardized tests of mathematics achievement. Participation and performance are analyzed for male and female students, as well as for students from different racial/ethnic groups. The data show that, although there is a strong link between the level of participation in mathematics courses and mathematics achievement, large gender and racial/ethnic differences persist.

The discussion in this chapter also focuses on the extent to which attitudes, beliefs, and behaviors influence students' participation and performance in mathematics. The relationship of variables such as students' liking of mathematics, students' feelings of competence in mathematics, and supports for mathematics at school and in the home are examined. The study findings indicate that there is a relationship between these variables and participation and performance differences.

Mathematics Requirements for Graduation

Completion of three years of high school mathematics courses and demonstrated proficiency in mathematics (by passing the Maryland Functional Mathematics Test in grade 9 or later) are the current graduation requirements in the State of Maryland. As will be shown in the next section, there is a great deal of latitude with respect to the content and the level of difficulty of the courses which students can take to satisfy the graduation requirements.[1]

The statewide functional mathematics test is administered in the ninth grade and does not require higher level mathematics skills. While this test was not a graduation requirement for students in this study (it became a requirement for the class of 1987), 83 percent of all ninth graders in Montgomery County passed the test in 1985, and 86 percent passed in 1986. In 1985 there were a total of 600 eleventh graders in County schools who had not passed the functional mathematics test; most of these had failed on several previous attempts. However, the vast majority of these students ultimately passed the test and were able to be graduated with their senior class.

While the passing rates for male and female students on the functional mathematics test have been practically identical for the past two years, racial/ethnic group differences are quite marked: in 1986 the percentages of ninth graders who passed the test ranged from a high of 93 percent for Asians and 91 percent for Whites to 67 percent for Blacks and 64 percent for Hispanics.[2]

Course Offerings

Math 9 is the lowest level course in which a student may enroll in high school and satisfy part of the three-year graduation requirement in mathematics. Math 9 is a year-long general mathematics course which does not cover much algebra or geometry. Four other courses which do not introduce concepts in algebra or geometry are also available (Business Mathematics, Applications of Mathematics, Related Mathematics, and Consumer Mathematics). Students may take a full year of each of these courses. Thus, it is conceivable that a student can satisfy the graduation requirement in mathe-

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1. For students sampled in this study only two years of mathematics were required for graduation.

2. It should be noted that three percent more of the White and Asian students passed the Maryland Functional Mathematics Test in 1986 than did so in 1985. Corresponding increases for Hispanic and Black students were only 2 percent.

matics without becoming acquainted with algebra or other higher level mathematical concepts. In fact, as will be shown below, this is the case for a small proportion of the Montgomery County high school student body.

Montgomery County also offers a two year Introduction to Algebra course for students who cannot master the Algebra 1 course content in one year. This course covers the Algebra 1 material over a two year span, and although students receive two year's course credit toward high school graduation, they earn only one year's credit in Algebra. A small proportion of the students in Montgomery County enroll in this course.

While Montgomery County offers mathematics courses which will satisfy the graduation requirements for students who do not seek to acquire higher level mathematics skills or who do not have the ability to do so, the bulk of the curriculum is aimed at students who will need to satisfy college admissions requirements[3] or who have the ability and interest to pursue a rigorous high school mathematics program. For example, Algebra 1 is offered as an advanced level course in the eighth grade and the normal mathematics course in ninth grade. Students who start with Algebra 1 in the eighth grade may finish their high school mathematics with Calculus. Students who enroll in Calculus are eligible to take the advanced placement examination, whereby they may qualify for college credit or advanced standing from the university in which they subsequently enroll.

The mathematics curriculum is largely built on a hierarchical sequence, with Algebra 2 and Trigonometry the prerequisites for higher level courses such as Pre-calculus and Calculus. Thus, a student who has a slow start will not be able to enroll in the complete sequence of advanced mathematics courses offered by the school system. A student who takes Algebra 1 as a ninth grader may complete high school mathematics at the level of Advanced Algebra or possibly Pre-calculus. Accelerated students who take Algebra 1 as eighth graders may finish high school mathematics with Calculus if they remain in accelerated levels throughout high school.

Of course, the student who starts out in the freshman year with Math 9 or the first half of the two year Introduction to Algebra course is not likely to become eligible for enrollment in the higher level courses, should this student subsequently display the interest or ability to do so. It may be noted that a small number of students do manage to complete mathematics through Calculus in Montgomery County by taking two mathematics courses in one year to offset a slow start in Algebra 1. However, this is the exception rather than the rule, and as illustrated in Volume II of this report, school staffs traditionally discourage all but the brightest students from doubling up on mathematics courses or taking mathematics in summer school as ways of moving ahead.

The relationship of course-taking patterns to gender, racial/ethnic group membership, and test results (CAT and SAT mathematics scores) are examined in the next sections of this chapter.

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3. To be admitted to one of the colleges in the Maryland state system, satisfactory completion of mathematics through Algebra 2 is required.

PARTICIPATION OF STUDENTS IN THE HIGH SCHOOL MATHEMATICS CURRICULUM

Participation for All Students

The mathematics enrollment data contained in Table 4.1 represent the highest mathematics courses completed by graduates of the class of 1986. Only those students in the class of 1986 who had been enrolled in Montgomery County for at least their sophomore and junior years in high school were included in the analysis. There were 6,969 students who met this criterion.

TABLE 4.1

Highest Course Taken by Students in the Class of 1986: Overall and by Gender

Highest Mathematics Course Taken	Overall		Females		Males	
	N	%	N	%	N	%
Calculus	874	14	409	12	465	15
Elementary Functions and Analytic Geometry	725	11	368	11	357	12
Advanced Algebra	1,145	18	638	19	507	17
Algebra 2 with Trigonometry (accelerated)	186	3	98	3	88	3
Trigonometry	252	4	124	4	128	4
Algebra 2	962	15	546	16	416	14
Geometry	766	12	388	12	378	12
Algebra 1	566	9	324	10	242	8
Algebra 1, Part 1 (first year of slow-paced course)	62	1	25	1	37	1
General Mathematics *	871	14	433	13	438	14
Number of Students	6,409 **		3,353		3,056	

* Consists of Math 9, Business Mathematics, Applications of Mathematics, Consumer Mathematics, and Related Mathematics.

** Due to some incomplete report card files, 560 students are missing from this analysis.

The data show that two-thirds of the students took at least three years of mathematics while in high school, which for these students was at least one year more than was required for graduation. Additionally, one-fourth of the students had completed Calculus or Elementary Functions (Pre-calculus) while in high school. At the other end of the continuum, however, there exists a surprisingly large group (one-fourth of the students) who left high school with only the basic algebra skills or no experience at all in algebra.

Differential Participation by Gender and Racial/Ethnic Group

Course Enrollment

Table 4.1 also presents the mathematics enrollment data by gender. The table shows that, for the most part, there were few gender differences in mathematics course enrollment. The largest difference observed is that males were more likely than females to have enrolled in Calculus and Pre-calculus, while females were more likely to cease taking mathematics after completing Advanced Algebra or Algebra 2.

Racial/ethnic group differences in mathematics course enrollments were substantially more pronounced than were gender differences (see Table 4.2). While 86 percent of the Asian students and 68 percent of the White students had completed mathematics at least through Algebra 2 by the end of twelfth grade, 49 percent of the Hispanic students and 40 percent of the Black students had taken courses at this level. Additionally, examination of the most accelerated levels of mathematics courses shows White students to be three times as likely as Black students to be availing themselves of the maximum mathematics course offerings in the County, and Hispanic students to be twice as likely as Black students to be taking these most advanced courses. On the other hand, Hispanic students were twice as likely as White students to have taken no more than the first part of Algebra 1 or just general mathematics (Math 9, Business Mathematics, Consumer Mathematics, etc.) in their high school careers, and Black students were over twice as likely as Whites to have ceased taking mathematics at this level.

Grades Received in Courses

Examination of Tables 4.3 and 4.4 reveals the dramatic difference in classroom grades received by students, and the potential effect these grades seem to be having on mathematics course enrollment. By gender, as well as for the students as a whole, the pattern is clearly linear. That is, students who continue in mathematics through the accelerated courses are those who continue to receive the better grades. Female students, nonetheless, receive higher grades than male students do regardless of the level of the last mathematics course taken.

The linear pattern of increasing mathematics grades as courses become more difficult is observed among students of the four racial/ethnic groups as well. However, there are large differences in the grades received by students in the four groups. For most levels of mathematics examined here, Black students were graded lower than their peers in class. Since movement into the next level of mathematics instruction is based in part on the grade the student received in the prerequisite course, the lower grades received

TABLE 4.2

Highest Course Taken by Students in the Class of 1986:
by Racial/Ethnic Group

Highest Mathematics Course Taken	% of All Asians	% of All Whites	% of All Blacks	% of All Hispanics
Calculus	32	14	3	7
Elementary Functions and Analytic Geometry	20	12	5	10
Advanced Algebra	16	19	13	13
Algebra 2 with Trigonometry (accelerated)	3	3	1	3
Trigonometry	5	4	4	3
Algebra 2	10	16	14	13
Geometry	6	12	16	15
Algebra 1	5	8	15	13
Algebra 1, Part 1 (first year of slow-paced course)	0 *	1	2	1
General Mathematics	2	12	27	23
Number of Students	484	4,920	744	242

* Percentage is less than half of one percent.

by Black students could well be contributing to their disproportionately low enrollment in accelerated mathematics courses.

When both gender and racial/ethnic group are examined jointly, it is observed that the rates of male and female enrollment in mathematics for Asian and White students generally parallel the pattern observed overall for males and females: males enrolled at a slightly higher level in the top mathematics courses. However, marked differences by gender were found for Hispanic students. Hispanic males were twice as likely as Hispanic females to enroll in Calculus or Pre-calculus (see Table A-4.1 of the Appendix to Chapter 4). At the low end of the continuum, Black and Hispanic males were more likely than their female counterparts to take only general mathematics courses in high school. In grades earned (see Table A-4.2 of the Appendix), females of all racial/ethnic groups received higher grades than did their male counterparts, although for Black students this pattern is observed mainly in the higher level courses.

TABLE 4.3

Average Course Grades for Students in the Class of 1986: Overall and by Gender

Highest Mathematics Course Taken	Average Grade, Overall	Average Grade, Females	Average Grade, Males
Calculus	2.78 *	2.88 *	2.70 *
Elementary Functions and Analytic Geometry	2.40	2.52	2.28
Advanced Algebra	2.21	2.31	2.08
Algebra 2 with Trigonometry (accelerated)	2.05	2.14	1.95
Trigonometry	1.69	1.81	1.57
Algebra 2	1.74	1.84	1.61
Geometry	1.49	1.49	1.49
Algebra 1	1.60	1.64	1.55
Algebra 1, Part 1 (first year of slow-paced course)	1.31	1.16	1.41
General Mathematics	1.95	2.02	1.88
Number of Students	6,409	3,353	3,056

* Average grades based on A = 4, B = 3, C = 2, etc.

TABLE 4.4

Grade in Highest Course Taken by Students in the Class of 1986: by Racial/Ethnic Group

Highest Mathematics Course Taken	Avg. Grade, Asians	Avg. Grade, Whites	Avg. Grade, Blacks	Avg. Grade, Hispanics
Calculus	2.91	2.77	2.62	2.66
Elementary Functions and Analytic Geometry	2.34	2.43	2.25	2.28
Advanced Algebra	2.03	2.25	1.94	2.16
Algebra 2 with Trigonometry (accelerated)	2.25	2.05	1.67	2.00
Trigonometry	1.65	1.72	1.62	1.38
Algebra 2	1.84	1.78	1.43	1.81
Geometry	1.62	1.52	1.36	1.26
Algebra 1	2.00	1.61	1.49	1.66
Algebra 1, Part 1 (first year of slow-paced course)	*	1.33	1.31	*
General Mathematics	1.82	2.02	1.80	1.80
Number of Students	484	4,920	744	242

* Number of students in this group is less than 5. Average grade is not printed due to the instability of this number as an estimate for the population it represents.

MATHEMATICS ACHIEVEMENT OF HIGH SCHOOL STUDENTS: THE CALIFORNIA ACHIEVEMENT TESTS (CAT)

In addition to student participation in mathematics, the present study is interested in student achievement as it relates to gender and racial/ethnic group membership. Given that mathematics achievement is, in general, strongly associated with the level of student participation in mathematics, it would be expected that racial/ethnic group and gender variations in mathematics achievement would coincide with the differences observed with respect to mathematics enrollment and course-taking histories. That is, the mathematics achievement of male and female students should be similar, reflecting their similar course-taking patterns, however, there should be large discrepancies in the mathematics achievement of Asian and White students compared to that of Black and Hispanic students, reflecting their dramatically different course-taking histories. The following sections will show that this hypothesis is generally upheld for performance on the CAT.

Overall Student Performance on the CAT

Montgomery County Public Schools administers the CAT in the third, fifth, eighth, and eleventh grades to all students. Subtests of the CAT assess students' performance on key skills such as reading, language usage, spelling, mathematics, and reference skills. County students have consistently placed very high on this test battery in comparison to national norms. Seventy-nine percent of the eleventh grade students who were tested scored above the national average for the total battery in 1985, and 78 percent scored above the national average in 1986. In both years, 80 percent of the students scored above the national average on the mathematics section of the test.

CAT Performance by Gender

In 1985, the year the students in this study took the test as eleventh graders, female students outperformed male students by as much as 6 normal curve equivalent (NCE) points in the total language score (67 vs. 61), and scored slightly better than males on the overall CAT battery (68 vs. 65). However, while the NCE scores for the total mathematics section were identical for male and female students (66 NCE), females performed slightly better than males in mathematics computation, whereas males performed slightly better than females in mathematics concepts and applications.

Table 4.5 contains the stanine distribution for the total mathematics section of the CAT, by gender and for County students, overall. Analysis of the data by the 9 stanine groups brings out a slight difference between male and female students that is masked when only average NCE scores are compared. Four percent more males than females attained a stanine score of 9, the highest stanine category.

CAT Performance by Racial/Ethnic Group

Whereas CAT performance is fairly similar for male and female students, marked differences among the four racial/ethnic groups are found in all subject areas covered by the test battery: scores of Asian and White students greatly exceed those of Hispanic and Black students. While Black and Hispanic students perform, on the average, similarly to average students nationwide, Asian and White students perform better than approximately four-fifths of the nation's high school students. Table 4.6 illustrates the differential performance of students by racial/ethnic group.

TABLE 4.5

Stanine Scores of Students in the Class of 1986 on the Eleventh Grade CAT Mathematics Section: Overall and by Gender

Stanine	National %	% of Females in MCPS	% of Males in MCPS	% of All MCPS Students
9 (highest)	4	17	21	19
8	7	11	10	11
7	12	18	17	18
6	17	23	22	23
5	20	17	15	16
4	17	10	11	10
3	12	3	3	3
2	7	1	1	1
1 (lowest)	4	0 *	1	0 *
Number of Students		3,622	3,347	6,969

* Percentage is less than half of one percent.

The data in Table 4.6 show that in Montgomery County White students are twice as likely as Hispanic students to be working in the top two stanine levels in mathematics by the time they are ready to depart from the public educational system, and they are over four times as likely as Black students to be working at these levels. Asian students are almost three times as likely as Hispanic students, seven times as likely as Black students, and 1.5 times as likely as White students to be working at the top two levels. This pattern is reversed at the lower stanine levels. Black students achieve just slightly lower than eleventh graders nationally, and the three other racial/ethnic groups outperform students nationally.

Examination of the data by gender and racial/ethnic group combined does not reveal any great surprises. Within each racial/ethnic group, male students are more likely to attain the highest stanine scores on the CAT mathematics section, while female students are more likely to fall in the middle stanine categories. This finding is especially noticeable for Hispanic males and females (see Table A-4.3 of the Appendix).

TABLE 4.6

Stanine Scores of Students in the Class of 1986 on the Eleventh Grade CAT Mathematics Section by Racial/Ethnic Group

Stanine	National Percent	% of Asians in MCPS	% of Whites in MCPS	% of Blacks in MCPS	% of Hispanics in MCPS
9 (highest)	4	37	20	4	11
8	7	12	12	3	6
7	12	15	19	11	10
6	17	16	24	21	19
5	20	11	15	23	25
4	17	7	8	25	17
3	12	2	2	11	8
2	7	0 *	0 *	1	2
1	4	0 *	0 *	1	1
Number of Students		499	5,313	857	280

* Percentage is less than half of one percent.

CAT Performance by Amount of Mathematics Taken in High School

Analysis of the relationship of CAT performance and highest level of mathematics taken in high school shows a strong correlation between the two variables.[4] Table 4.7 presents the correlations between CAT mathematics

4. Correlations range in value from -1.0 to +1.0. If the correlation between two variables is either -1.0 or +1.0, there is a direct relationship between the two variables. That is, for a correlation of +1.0, a student who has the highest score in the group of mathematics NCE scores will also have participated most fully in the mathematics curriculum. Conversely, a student who has the lowest score in the group, would also have the lowest level of participation. A correlation of -1.0 also indicates a direct relationship between two variables, however, as the score in one variable increases, the value of the other variable decreases. A correlation of 0.0 indicates there is no relationship between the two variables in question.

stanine scores and mathematics participation for students overall, by gender, and by racial/ethnic group. Overall, a correlation of about 0.82 was observed between CAT mathematics performance and prior history of mathematics course enrollment. The strength of this relationship is observed for students of each gender and racial/ethnic group.

If the correlation coefficient is squared in value (multiplied by itself), the resulting number shows how much of the variance or variation in the students' performance on one variable is directly related to the variation in students' performance on the other variable. For students in this study, course-taking history accounts for two-thirds of the variance in CAT performance, or, conversely, CAT performance accounts for two-thirds of the variance in course-taking history. The correlation coefficient does not indicate which variable is the causal variable and which is the effect, but minimally, it can be said that there is a substantial relationship between performance on the CAT and the level of mathematics courses the students have taken.

TABLE 4.7

Correlations Between CAT Mathematics NCE Scores and Mathematics Courses Taken

	Overall	Females	Males	Asians	Whites	Blacks	Hispanics
Correlation	.82	.81	.83	.80	.81	.78	.82
Significance	.000	.000	.000	.000	.000	.000	.000
% variance in CAT score attributable to different course-taking patterns and vice versa	67	66	69	64	66	61	67

Table 4.8 presents a more detailed analysis of the relationship of course-taking history to CAT mathematics performance for County students overall, and by gender. To simplify the presentation, the CAT stanine distribution has been condensed into three major categories: high (stanines 7 through 9), middle (stanines 4 through 6), and low (stanines 1 through 3). Within the high category, students scoring at stanines 7, 8, and 9 are displayed separately to show differences that exist at the highest achievement levels. The data show that the relationship between courses taken and CAT performance is very similar for male and female students, and, excepting students who took mathematics through Algebra 2 with Trigonometry, CAT performance clearly increases as students enroll in higher level courses.

TABLE 4.8

Eleventh Grade CAT Performance of Students in the Class of 1986: by Highest Mathematics Course Taken in High School and Gender

Highest Mathematics Course Taken and Gender		N	High			Middle	Low
			Sta. 9	8	7	Stanine 4-6	Stanine 1-3
Calculus	Female	405	75 %	19 %	5 %	1 %	0 %
	Male	462	80	14	6	0 *	0
	Total	867	78	16	5	0 *	0
Pre-calculus	Female	365	43	27	25	5	0
	Male	357	47	25	22	7	0
	Total	722	45	26	23	6	0
Advanced Algebra	Female	630	9	18	39	34	0
	Male	500	15	17	39	29	0
	Total	1130	12	17	39	32	0
Algebra 2 with Trig.	Female	98	38	33	24	6	0
	Male	86	43	16	28	13	0
	Total	184	40	25	26	9	0
Trigonometry	Female	124	11	19	30	40	0
	Male	125	11	18	30	42	0
	Total	249	11	18	30	41	0
Algebra 2	Female	536	3	8	27	62	0 *
	Male	408	4	6	25	65	0
	Total	944	4	7	26	63	0 *
Geometry	Female	377	1	3	11	85	1
	Male	373	1	4	11	84	1
	Total	750	1	3	11	85	1
Algebra 1	Female	307	0 *	0 *	2	92	6
	Male	236	0 *	1	5	87	7
	Total	543	0 *	1	3	90	6
Algebra 1, Part 1	Female	23	0	0	0	91	9
	Male	36	0	0	0	97	3
	Total	59	0	0	0	95	5
General Mathematics	Female	416	0	1	3	77	20
	Male	409	0	1	3	72	24
	Total	825	0	1	3	75	22

* Percentage is less than half of one percent.

It will be observed in several tables in this chapter that the students who ceased taking mathematics after completing Algebra 2 with Trigonometry performed better on standardized achievement tests than did students who ceased taking mathematics after completing Advanced Algebra. This apparent reversal in performance is probably indicative of the difference in abilities of these two groups. Algebra 2 with Trigonometry is the accelerated class which allows students to complete the algebra 2 and trigonometry content in one year rather than 1 1/2 years. Students typically take this course in their sophomore or junior year in high school, and go on to Elementary Functions and Analytic Geometry (the Pre-calculus course) and possibly Calculus as juniors and seniors. Students who complete Advanced Algebra have typically taken Algebra 2 as high school juniors, and Trigonometry and Advanced Algebra in their senior year. A worthy activity for future research would be to conduct case studies of those students who drop out of the mathematics curriculum after Algebra 2 and Trigonometry. Since these students have the potential of high participation in the mathematics curriculum, their reasons for leaving the curriculum at this early stage might prove to be of substantial interest.

Table 4.9 contains the course-taking history and CAT performance of students by racial/ethnic group. The data indicate that CAT performance is related to course enrollment for all racial/ethnic groups. However, Black students, regardless of course-taking history, do not attain the same level of performance on the CAT mathematics section as do students in the other racial/ethnic groups. This finding is also true to some extent for Hispanics.

Relationship of Attitudes, Beliefs, and Behaviors to CAT Performance

Findings from current research in the field of mathematics learning suggest a strong link between students' participation and performance in mathematics on the one hand, and how students feel about themselves and mathematics on the other hand. As part of this study, voluminous data were gathered from samples of students in various grade levels. These data describe how students feel about mathematics as a discipline and themselves as mathematics performers, and their perceptions of the supports they receive from home and the school in helping them to do well in mathematics.

The results of this survey effort are described in greater detail Chapters 6-8 of this volume and in Volume II. In this section, key attitudinal and behavioral characteristics of the students are linked to their performance on the CAT. The data that form the basis of this analysis were derived from the responses of 584 high school seniors who comprised the twelfth grade sample cohort. In the remainder of this section, survey responses of these twelfth grade students are linked to their eleventh grade performance on the CAT.

Statistically, the relationships between attitudes, home variables, and achievement can be demonstrated or refuted through the use of a computational procedure known as Regression Analysis. This technique was used to determine the strength of statistical association between several attitudinal and behavioral variables and performance on the CAT. The analysis was conducted in stages The first stage in the analysis required the reduction of all the attitude questions on the student surveys into some manageable subset of variables that would make interpretation of the results easier.

The set of 30 attitude questions was rearranged into several clusters, or scales, using a statistical procedure called Factor Analysis.

TABLE 4.9

Eleventh Grade CAT Performance of Students in the Class of 1986:
by Highest Mathematics Course Taken in High School and Racial/Ethnic Group

Highest Mathematics Course Taken and Racial/Ethnic Group		N	High			Middle	Low
			Sta. 9	8	7	Stanine 4-6	Stanine 1-3
Calculus	Asian	155	79 %	14 %	7 %	1 %	0 %
	White	670	78	17	5	0 *	0
	Black	24	67	17	17	0	0
	Hispanic	16	75	19	6	0	0
Elem. Func. & Analytic Geometry	Asian	93	41	18	33	8	0
	White	568	46	27	22	6	0
	Black	36	22	33	28	17	0
	Hispanic	23	52	30	13	4	0
Advanced Algebra	Asian	76	12	18	22	47	0
	White	923	12	19	41	28	0
	Black	99	4	3	41	52	0
	Hispanic	31	16	7	32	45	0
Algebra 2 with Trig.	Asian	16	31	19	13	38	0
	White	155	43	27	25	6	0
	Black	6	17	0	67	17	0
	Hispanic	7	29	14	43	14	0
Trigonometry	Asian	25	8	12	8	72	0
	White	189	13	21	32	34	0
	Black	26	8	0	35	58	0
	Hispanic	8	0	13	38	50	0
Algebra 2	Asian	48	6	4	17	71	2
	White	760	4	8	29	59	0 *
	Black	103	1	2	15	81	2
	Hispanic	29	0	7	17	76	0
Geometry	Asian	28	0	4	7	89	0
	White	564	1	4	13	82	0 *
	Black	121	0	2	4	93	2
	Hispanic	34	0	0	6	94	0

* Percentage is less than half of one percent.

TABLE 4.9 (Cont.)

Eleventh Grade CAT Performance of Students in the Class of 1986: by Highest Mathematics Course Taken in High School and Racial/Ethnic Group

Highest Mathematics Course Taken and Racial/Ethnic Group		N	High Sta. 9	8	7	Middle Stanine 4-6	Low Stanine 1-3
Algebra 1	Asian	22	0	0	0	82	18
	White	381	1	1	5	91	4
	Black	108	0	0	1	88	10
	Hispanic	30	0	0	0	83	17
Algebra 1, Part 1	Asian	1	**	**	**	**	**
	White	43	0	0	0	98	2
	Black	13	0	0	0	92	8
	Hispanic	2	**	**	**	**	**
General Mathematics	Asian	9	0	0	0	44	56
	White	565	0	1	4	80	15
	Black	193	0	1	1	62	37
	Hispanic	54	0	0	0	69	32

** Number of students in this group is less than 5. Percentage estimates are not printed becaues they are likely to be unstable.

Factor analysis groups items together that are answered the same way, based on some underlying attitudinal or behavioral trait. For example, in the factor analysis, all items related to mathematics anxiety were grouped together. Also, all items related to students' liking of mathematics were grouped together. In all, nine such clusters of items, or factors, were identified by this procedure. The most important of these clusters were the following: liking of mathematics, mathematics anxiety, perception that males do better than females in mathematics, utility of mathematics, peer interest in mathematics, and strategies students used in solving mathematics problems. Nine factor scores were computed for each student in the sample -- one score for each factor or cluster. These scores indicate how much of a particular factor or trait (for example anxiety about mathematics) the student possesses.

Regression analysis was used in the second stage in the analytical process to determine the relationship between the attitudinal factors and performance on the mathematics section of the CAT. Students' scores on the nine different attitude factors, their responses to other survey questions such as the amount of help in mathematics they receive from their parents, and the amount of mathematics they took while in high school were included in the regression analyses of performance on the CAT.

Results of the regression analyses showed that the amount of mathematics taken by students in high school was the most important link to doing well on the CAT. While other variables contributed a small amount to what was known about the variation in CAT scores by gender or students' racial/ethnic group membership, for all groups examined, the higher the level of mathematics courses taken in high school, the better students performed on the CAT.

Regression Findings Overall and by Gender

Table 4.10 presents the results of the regression analyses of CAT performance for all students in the sample and separately by students' gender. For all students in the sample, differences in level of participation in high school mathematics courses explained 75 percent of the variation that was found in their CAT scores. Or, looked at from another perspective, the correlation between performance on the CAT and level of participation in high school mathematics courses was between 0.86 and 0.87 for the twelfth grade student sample.[5] Findings were quite similar for female and male

TABLE 4.10

Amount of Variation in CAT Mathematics Scores Explained Through Regression Analysis on Several Variables: by Gender and Overall

	Percentage of CAT Score Variation Explained		
Related Variable	Overall	Females	Males
Participation in high school mathematics courses	75	72	78
Percentage minority students in the school	3 *	2	4
Mathematics anxiety **	1	1	1
Student discusses mathematics performance with father	--	3	--
Total	79	78	83

* Students in lower minority percentage schools tend to do better on the CAT.

** This item was a factor score obtained in the factor analysis of student attitudes and beliefs.

5. This correlation is very close in value to the correlation between CAT performance and mathematics course participation that was reported earlier for the entire senior class.

students separately. Examination of Table 4.10 indicates that there were three other variables that had some small effect in helping to explain the variation in CAT performance for the student sample, but it is clear that these variables have minor impact compared to the overwhelming effect of course participation.[6]

Regression Findings by Racial/Ethnic Group

Table 4.11 presents the results of the regression analyses for students in each of the four racial/ethnic groups. The results of these analyses indicate that course participation is a major contributing variable in explaining variation in CAT performance among students in each racial/ethnic group. The data also illustrate two variables that have modest importance for Black students: each one explaining five percent of the variation in CAT scores. Specifically, the data indicate that mathematics anxiety is related to Black students' performance on the CAT, with those who are more anxious about mathematics performing less well on the CAT. Mathematics anxiety is also related to CAT performance for Asian and Hispanic students, but to a lesser degree than for Blacks. The influence of the father in Black students' lives also emerges as an important variable. Those students who discussed their performance in mathematics with their fathers performed better on the CAT.[7]

MATHEMATICS ACHIEVEMENT OF HIGH SCHOOL STUDENTS: THE SCHOLASTIC APTITUDE TEST (SAT)

The SAT is probably the single most rigorous standard of performance for Montgomery County students who are college-bound. In Montgomery County about two-thirds of the graduating seniors take the test; the majority take it in their junior year for the first time, and many take it again in their senior year. A small group of students take the test just once, in their senior year. Two scores are obtained from the SAT: a verbal score and a mathematics score. Each score has a possible range of 200 to 800, for a combined SAT total score of 400 to 1600.

It would be expected that performance on the SAT would be related to differences in course participation that are observed by racial/ethnic group and gender. We would expect that the SAT mathematics performance of male and female students would be similar, reflecting their similar course-taking patterns. Large discrepancies in SAT mathematics performance would be expected between Asian and White students on the one hand, and Black and Hispanic students on the other hand, reflecting their different course-taking histories. The following sections show that this hypothesis is upheld for students by racial/ethnic group, but surprisingly large differences in SAT mathematics performance are observed by gender as well.

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6. Only those variables which contributed at least one percent of the variation in CAT mathematics score were considered for discussion.

7. We cannot ignore the fact that many Black students live in single parent homes, and the physical presence of a father in the home of the other Black students may in fact be the critical variable.

TABLE 4.11

Amount of Variation in CAT Mathematics Scores Explained Through Regression Analysis on Several Variables: by Racial/Ethnic Group

Related Variable	Percentage of CAT Score Variation Explained			
	Asians	Whites	Blacks	Hispanics
Participation in high school mathematics courses	77	79	71	76
Mathematics anxiety **	2	--	5	2
Average income of families in the school	--	1	--	3
Student discusses mathematics with father	--	--	5	--
Student discusses mathematics with mother	--	--	--	1
Number of people who help student with mathematics homework and tests	--	--	1 *	--
Percentage minority students in the school	2 *	--	--	--
Liking of mathematics **	1	--	--	--
Total	82	80	82	82

* Students in low minority percentage schools tend to do better on the CAT. Students who need less help with their homework and tests tend to do better on the CAT.

** This item was a factor score obtained in the factor analysis of student attitudes and beliefs.

SAT Results, Overall and By Gender

Table 4.12 presents the overall performance of County students on the two sections of the SAT and compares their performance to the national averages. The data show that Montgomery County students, overall, perform better than high school seniors nationwide on both sections of the SAT.

TABLE 4.12

SAT Score Means by Gender for Students in the Class of 1986
Who Took the SAT in Their Junior and/or Senior Years

Year of Test	All Students	Females	Males	Male/Female Difference
Montgomery County Means				
1985: Scores for Junior Year				
Verbal	477	466	489	23
Mathematics	530	505	561	56
Total Test	1007	971	1050	79
Number of Students	3155 *	1722	1433	
1985 or 1986: Highest Score Obtained in Junior and/or Senior Year				
Verbal	479	472	486	14
Mathematics	530	506	557	51
Total Test	1009	978	1043	65
Number of Students	4185 *	2273	1912	
United States Averages for Seniors **				
1985				
Verbal	431	425	437	12
Mathematics	475	452	499	47
Total Test	906	877	936	59
1986				
Verbal	431	426	437	11
Mathematics	475	451	501	50
Total Test	906	877	938	61

* Numbers and means are slightly different from overall Montgomery County figures since only those students who were enrolled in the County during their sophomore and junior years are included in the analysis.

** Students who take the SAT as seniors tend to average about 30 points lower, overall, than do juniors and seniors combined. This should be considered when making comparisons between seniors nationwide and Montgomery County juniors or juniors and seniors. Data source: Educational Testing Service.

While female students in the County do perform better than the national average on both sections of the test, they score considerably less than County males on the mathematics section, and somewhat less on the verbal section as well. Females who took the SAT in their junior year scored on the average 23 points less than males in the verbal part of the test, and 56 points less on the mathematics section. When the highest scores from junior and/or senior year are used, female vs. male performance parallels quite closely what is observed nationwide: female students scored 14 points less than males in the verbal section of the test, and 51 points less than males in mathematics.

Relationship Between Course-Taking Patterns and SAT Mathematics Scores by Gender

In Table 4.13 SAT mathematics performance of male and female students is presented by the highest level of mathematics courses completed by these students in their junior year. To make this comparison, only SAT results from test administrations in the students' junior year are used. The data presented represent, first, the average SAT mathematics score for all male and female students who completed the various levels of mathematics courses available in the County, and second, the average SAT scores for students who received grades of A or B in these courses.

The data show that there is a definite, positive relationship between course-taking patterns and performance on the SAT. That is, students who completed Calculus by the end of eleventh grade had approximately a 70-80 point advantage over those who had completed Elementary Functions and Analytic Geometry. This latter group had an 80-90 point advantage over those who had just completed Advanced Algebra. This pattern continues as one moves down the table and examines the performance of students who took lesser mts of mathematics while in high school.

It is apparent from Table 4.13, however, that the level of mathematics courses taken by students accounts for only a very small amount of the difference in SAT mathematics performance observed between male and female students. Whereas the difference between male and female score means was 56 points overall, when comparisons are made between genders within the same level of course participation, differences range from a low of 31 points for those who had taken mathematics through Calculus to a high of 50 points for those who had taken mathematics through Geometry.[8] Moreover, comparison of mean SAT scores for students who received A's or B's in these courses shows that the difference in score means by gender typically gets larger for those students who are working at the top of their class. These findings are quite surprising and contradict common belief regarding the strength of association between course-taking patterns and differences in SAT mathematics scores by gender that are observed nationally.

8. These large score differences are still found when participation in both mathematics and science courses is controlled for.

TABLE 4.13

Eleventh Grade SAT Mathematics Score Means by Gender for Students Who Completed Various Mathematics Courses by the End of Their Junior Year

Course *	No. of Stud.	All Students Female	Male	Diff.	Students Who Got A's or B's Female	Male	Difference
Calculus	52	703	734	31	703	741	38
Elem. Funct. & Anal. Geom.	893	625	664	39	634	679	45
Advanced Alg.	386	533	573 **	40	554	599	45
Alg. 2 & Trig. (accelerated)	407	554	597	43	572	603	31
Trigonometry	57	513	549	46	516	566	50
Algebra 2	1130	466	506	40	488	533	45
Geometry	409	392	442	50	456	490	44

* Few students who stopped taking mathematics at the level of Algebra 1 or below took the SAT. Thus, data for these students are not included in this analysis.

Table 4.14 presents the highest SAT mathematics scores obtained by female and male students in their junior and/or senior years in high school. These scores are presented in relation to the highest mathematics course taken by these students in their entire high school careers. The data show a pattern that is very similar to the pattern observed when only eleventh grade SAT scores and mathematics course enrollment are compared.

Consideration of The Relationship of Other Factors to SAT Performance by Gender

The findings presented here, which point to persistent sex differences in SAT scores for male and female students, are in line with national data and with the results obtained by many other investigators (see Chapter 2). We have established, perhaps more thoroughly than others who did not have access to a comprehensive data base containing each student's course-taking history, that these differences persist when the scores of students with comparable mathematics and science educational histories are examined. We have documented the particularly surprising existence of score differences even among the most advanced students, those who had completed Calculus by the end of eleventh grade.

TABLE 4.14

Highest SAT Mathematics Score Obtained in Junior and/or Senior Year by Gender and Highest Mathematics Course Taken in High School

Highest Mathematics Course Taken	No. of Students Fem.	No. of Students Male	Average Score Total County	Average Score Female	Average Score Male	Average Male/Female Difference
Calculus	362	399	678	659	696	37
Pre-calculus	306	284	611	588	635	47
Advanced Alg.	520	396	529	511	552	41
Alg. 2 & Trig. (accelerated)	81	63	598	575	627	52
Trigonometry	96	89	513	494	533	39
Algebra 2	384	256	460	447	480	33
Geometry	224	167	409	391	433	42

* The average score for students completing their high school mathematics with Calculus is somewhat lower than the average for those who completed Calculus by the end of eleventh grade (see Table 4.13). However, those students represented in Table 4.13 are highly accelerated, having finished Calculus by the end of their junior year in high school.

However, unlike earlier investigations, which used Educational Testing Services data to show that, for students in the top 10 percent of their high school class, males outperformed females on the mathematics portion of the SAT by 67 points, our more precise data show that the differences among the Calculus-takers were lower than for students whose mathematics education was less advanced. In general, our data are in line with a more recent ETS study, which examined a number of factors believed to play a part in the persistent male/female differences in SAT mathematics scores and found that females scored 33 points below males after adjustment for course-taking differences.[9]

As was shown in Chapter 2, there is no shortage of theories and speculation as to the reasons for these differences. In recent years, biological/

9. Lee, Valerie M. and Ware, Norma C., When and Why Girls "Leak" Out of High School Mathematics: A Closer Look. Paper presented at the Annual Meeting of the American Educational Research Association, April 1986.

genetic explanations have begun to be favored, with greater male ability in spatial tasks seen as the major explanatory factor. However, most investigators see a number of social and psychological factors, such as differences in career orientation and self-confidence in mathematics ability, as well as the expectations of teachers and parents as playing a major part. The impact of attitudinal or behavioral variables on SAT mathematics performance by gender is addressed below. Data for this discussion were obtained from the responses to surveys of the 331 students in the twelfth grade sample cohort who had taken the SAT in their junior and/or senior years in high school.

Attitudes and behaviors of students: Information provided by our sample of students indicates that their attitudes and behaviors related to mathematics are completely consistent with the theories suggested in the research literature. Female students feel less confident of their abilities in mathematics than do their male peers. Additionally, while female students in large numbers report that mathematics is important for their careers or further education, they are nevertheless confronted by attitudes held by many males in their classes that females are less adequate mathematics performers. Also, female students participated in "female" activities such as sewing, cooking, and shopping significantly more often than males, and males participated in sports, games of strategy and computer activities significantly more often than females.

Influence of significant female role models: Male and female students, alike, have grown up in households in which the female head of household is likely to have expressed to her children her own dislike of and lack of confidence and competence in mathematics. They have also learned their elementary school mathematics from female teachers who were likely not to feel competent in mathematics. These findings suggest that female students are presented with a set of messages that, on the one hand, convey to them the importance of mathematics, but on the other hand, convey a sense that they are not, or need not be as good as males in their classes in mathematics.

Students' educational plans and career aspirations: Students' responses indicate that there is virtually no difference in the amount of college and graduate school education males and females plan to obtain. Taking the SAT in and of itself suggests that this group of 331 students is college-bound. In fact, one-fourth of these students expected to obtain a Ph.D. or other professional degree, and another one-third hoped to obtain a Master's degree. Only 10-12 percent either did not expect to finish college or were not sure of their plans. These figures were remarkably similar for male and female students.

Career aspirations, however, were quite different for these students (see Table 4.15). Males were more likely to aspire to careers in professional occupations utilizing mathematics or the physical sciences, or managerial occupations; females were more likely to want jobs that did not emphasize mathematics, and were less likely to view themselves as future managers. These differences persisted regardless of the level of mathematics taken by the students in high school.

TABLE 4.15

Career Aspirations of Students by Gender and Participation in Mathematics

		Highest Level of Mathematics Taken		
Profession	Gender	Calculus & Pre-calculus	Geometry to Advanced Alg.	Algebra or Less
Mathematics, science, engineering, computers, research, etc.	Female	30	22	6
	Male	42	32	31
	Overall	35	27	17
Other professional career (law, etc.)	Female	62	51	77
	Male	47	30	23
	Overall	55	41	53
Management	Female	9	21	12
	Male	11	32	39
	Overall	10	26	23
Sales, clerical, service, etc.	Female	0	6	6
	Male	0	6	8
	Overall	0	7	6
Number of students	Female	47	82	17
	Male	36	79	13
	Overall	83	161	30

NOTE: Numbers in table are percentages of students choosing each career.

Need for assistance in mathematics homework: The data indicate that there is a consistent gender difference in the need for support in mathematics homework (see Table 4.16). Females participating at all levels in the curriculum, even those participating at the highest levels in mathematics, are more likely than their male counterparts to need help from others when doing homework. While the differences in male and female behavior are not large enough to be statistically significant, the trend in the data is the same across all levels of participation. These data suggest that females may rely on others to too great a degree in solving mathematics problems and thus not develop independent problem-solving skills needed for a testing situation such as the SAT.

Test-related factors: Our final set of hypotheses dealt with the SAT itself. Could the male/female differential in test scores be due to more systematic and thorough test-specific preparation on the part of male students? And, is there something about the nature of the SAT that puts females at a disadvantage in the testing situation?

TABLE 4.16

Gender Differences in Need for Help with Mathematics Homework by Level of Participation in the Curriculum

		Highest Level of Mathematics Taken		
Frequency Student Needs Help With Homework	Gender	Calculus & Pre-calculus	Geometry to Advanced Alg.	Algebra or Less
Very often	Female	17	24	45
	Male	5	17	11
Sometimes	Female	57	49	35
	Male	74	59	72
Hardly ever/never	Female	26	26	10
	Male	19	22	17
No homework	Female	0	1	10
	Male	2	2	0
Number of students	Female	54	89	20
	Male	42	93	18

NOTE: Numbers in table are percentages of students.

With respect to the first question, the data clearly show that there are few gender differences concerning how students prepared for the test. As a matter of fact, the data suggest that females invested more time and effort preparing for the SAT than their male classmates (see Table 4.17). Possibly the amount of time females spent preparing caused them to become disproportionately more anxious than males, resulting in a net loss of efficiency on the test itself. One interesting trend in the data is that, for those who took a special course to prepare for the SAT, twice as many males as females took a course sponsored by a private agency, whereas twice as many females as males took a school system-sponsored course. One might hypothesize that investing in private preparatory courses for males is an indication of parental emphasis on the importance of mathematics for sons, but not for daughters.

The notion that there is some biasing element in the design of the SAT or in the methods used to determine the SAT scores has been raised periodically by critics of the test and rebutted by those responsible for the test design and administration. Much of the criticism is based on claims of "cultural bias" which is believed by many to cause the lower scores for Black and Hispanic students nationwide. The issue of possible sex bias has also been raised by some critics. They draw their ammunition from the fact that males

TABLE 4.17

Gender Differences in Preparation for the SAT

Type and Amount of Preparation	% Females	% Males	% All Students
Type of Preparation			
Special prep course outside the school system	4	9	6
Prep course in a County high school	9	4	7
Instructed by a tutor	1	1	1
Helped by a parent or other relative	0	1	0
Studied on own	68	53	61
None	14	26	19
No answer	4	7	5
Number of students	171	160	331
Amount of Time Spent Preparing			
None	5	8	6
Less than one week	27	28	28
One to two weeks	25	24	25
Three to four weeks	20	24	22
More than four weeks	24	16	20
Number of students	148	121	269

outperform females not only on the mathematics portion of the SAT, but also on the verbal portion, where most educators would have predicted the opposite outcome on the basis of school performance. It is true that gender differences in the SAT verbal scores are much smaller than is the case for the SAT mathematics scores, but their very existence is surprising and suggests the need for more thorough research into test-related factors than has been carried out to date.

A recent study of the SAT verbal scores of students who scored 600 and over on the mathematics portion of the SAT[10] showed that among these high scorers, females had consistently higher verbal scores than males. This pattern was also found among Montgomery County students. Table 4.18 presents the average SAT verbal and mathematics scores of females and males in in the graduating class of 1986 who took the SAT in their junior year. The table presents the average SAT scores within six 100 point score ranges of performance on the SAT mathematics test.

TABLE 4.18

Average Junior Year SAT Performance by Gender: Aggregated Within SAT Mathematics Score Ranges

	Females			Males			Overall		
Mathematics Score	N	Verb	Math	N	Verb	Math	N	Verb	Math
700 or more	74	624	726	180	598	735	254	605	732
600 - 690	326	557	639	415	536	642	741	545	640
500 - 590	514	484	544	421	482	549	935	483	546
400 - 490	497	433	450	283	430	453	780	432	451
300 - 390	248	369	350	117	352	351	365	363	350
200 - 290	63	305	265	17	318	265	80	308	265
Total group	1722	466	505	1433	489	561	3155	477	530

Table 4.18 illustrates that, for students who scored under 600 on the mathematics portion of the SAT, female students performed only slightly better than males on the SAT verbal section. However, for those who scored 600 or more in mathematics, the female/male difference in verbal performance is considerably wider. It is also interesting to note that the male/female gap in mathematics scores is widest in the 700+ range. One wonders if students who score in the top ranges of the verbal or mathematics sections of the SAT are already focused on specific areas of strength or interest, and if this focus in turn, expresses itself in differential scores.

10. Dorans, Neil J. and Livingston, Samuel A., Male-Female Differences in SAT-Verbal Ability Among Students of High SAT-Mathematical Ability. Journal of Educational Measurement, Spring 1987, Vol. 24, No. 1, pp. 65-71.

It must be noted, however, that while there are substantially fewer females than males in the 700+ range in SAT mathematics, those who do score in that range have comparable profiles of verbal and math scores to the males in that score range. That is, both males and females in that category scored substantially better on the mathematics section of the test than they did on the verbal section. This pattern of scores suggests that the high performance of these females in mathematics cannot be explained solely by exceptionally high verbal problem-solving ability as some researchers have suggested.

SAT Performance By Racial/Ethnic Group

Differences in performance on the SAT by racial/ethnic group are more pronounced than differences by gender. Not only are there profound differences in the scores attained by students in the different racial/ethnic groups, there are also large differences in the proportions of students within each group who took the SAT. Table 4.19 illustrates the difference in proportions of students by racial/ethnic group who took the SAT in their junior and/or senior years. The data show that less than half the proportion of Hispanic and Black students, compared to White and Asian students, attempted the SAT in their junior year, and not quite two-thirds the proportion took the SAT in their junior and/or senior years.

TABLE 4.19

Proportion of Students by Racial/Ethnic Group Who Took the SAT in Their Junior and/or Senior Years

Racial/Ethnic Group	Number of Students Enrolled	Students Who Took SAT in Jr. Year		Students Who Took SAT in Jr. &/or Sr. Yrs.	
		Number	Percent	Number	Percent
Asian	499	258 *	52	317	64
White	5313	2658	50	3432	65
Black	857	174	20	332	39
Hispanic	280	60	21	94	34
Total	6969	3155 **	45	4185 **	60

* Numbers are slightly different from overall Montgomery County figures since only those students who were enrolled in the County during their sophomore and junior years are included in the analysis.

** Figures do not add to total since American Indians are not shown.

Differences in SAT mathematics scores for the different racial/ethnic groups parallel to some extent the differences in proportions taking the SAT that are shown in Table 4.19. Mean scores for Black students in Montgomery County are substantially below the means for Asian, Hispanic, and White students in both the verbal and mathematics sections (see Table 4.20). Black students in the County are also the only group to score below high school seniors nationwide on the SAT. County Black students do, however, score about 100 points higher than Black seniors nationwide on the test.

TABLE 4.20

SAT Score Means by Racial/Ethnic Group for Students in the Class of 1986 Who Took the SAT in Their Junior and/or Senior Years

Year of Test	All Students	Asians	Whites	Blacks	Hispanics
Montgomery County Means					
1985: Scores for Junior Year					
Verbal	477	472	480	424	483
Mathematics	530	564	532	445	535
Total Test	1007	1036	1012	869	1018
Number of Students	3155 *	258	2658	174	60
1985 or 1986: Highest Score Obtained in Junior and/or Senior Year					
Verbal	479	482	487	402	452
Mathematics	530	571	537	423	512
Total Test	1009	1053	1024	825	964
Number of Students	4185 *	317	3432	332	94
United States Average for Seniors **					
1985					
Verbal	431	404	449	346	382
Mathematics	475	518	490	376	426
Total Test	906	922	939	722	808

* Numbers and means are slightly different from overall Montgomery County figures since only those students who were enrolled in the County during their sophomore and junior years are included in the analysis.

** Students who take the SAT as seniors tend to average about 30 points lower, overall, than do juniors and seniors combined. This should be considered when making comparisons between seniors nationwide and Montgomery County juniors or juniors and seniors.

Within each racial/ethnic group, female students scored substantially below males on the mathematics portion of the SAT. Using either the SAT scores obtained in students' junior year or their highest scores from their junior and/or senior years, Hispanic males scored over 80 points higher than Hispanic females and White males outscored White females by almost 60 points. The difference between the scores of Asian males and females was about 35 points, and the difference for Black males and females was about 15 points. On the verbal section males generally scored better than females. However, Black females outperformed Black males by approximately 15 points on the SAT verbal section.

Enrollment in higher level mathematics courses is strongly related to the performance of all groups of students on the SAT mathematics section (see Tables 4.21 and 4.22). Students of all racial/ethnic groups who participated in higher levels of mathematics scored better on the SAT than did students in their racial/ethnic group who took less mathematics in high school. Within levels of mathematics course participation, however, scores of Black students were substantially lower than the scores of students in the other three racial/ethnic groups.

TABLE 4.21

Eleventh Grade SAT Mathematics Score by Racial/Ethnic Group for Students Who Completed Various Mathematics Courses by the End of Their Junior Year

Course **	Number of Students	Average for all Students	Avg. for Asians	Avg. for Whites	Avg. for Blacks	Average for Hispanics
Calculus	52	727	719	736	*	--
Elementary Functions & Analytic Geometry	893	645	639	648	599	636
Advanced Algebra	386	552	510	558	502	551
Algebra 2 & Trigonometry (accelerated)	407	575	555	579	505	611
Algebra 2	1130	483	446	489	431	501
Geometry	409	413	422	419	356	390

* Number of students in this group is less than 5. Average grade is not printed due to the instability of this number as an estimate for the population it represents.

** Few students who stopped taking mathematics at the level of Algebra 1 or below took the SAT. Thus, data for these students are not included in this analysis.

What is interesting is that once course-taking patterns are controlled for, Asian students no longer outperform other groups. This may be somewhat misleading, however, since the majority of Asian students participate to the fullest in the mathematics curriculum, whereas students in other groups do not do so in as large proportions.

TABLE 4.22

Highest SAT Mathematics Score Obtained in Junior and/or Senior Year: by Racial/Ethnic Group and Highest Mathematics Course Taken in High School

	All Groups		Asians		Whites		Blacks		Hispanics	
Course	N	Avg. *	N	Avg.	N	Avg.	N	Avg.	N	Avg.
Calculus	761	678	124	667	598	683	22	621	15	668
Elem. Functions & Anal. Geom.	590	611	65	586	480	616	25	566	19	626
Advanced Algebra	916	529	57	501	767	538	74	455	17	512
Alg. 2 & Trig. (accelerated)	144	598	7	583	129	602	*	*	*	*
Trigonometry	185	513	11	453	145	523	21	491	7	457
Algebra 2	640	460	28	418	550	468	50	399	9	441
Geometry	391	409	10	430	313	419	59	358	7	360

* Avg. is average SAT mathematics score for the group.

** Number of students in this group is less than 5. Average grade is not printed due to the instability of this number as an estimate for the population it represents.

Relationship of Attitudes, Beliefs, and Behaviors to SAT Performance

Regression Findings for All Students

When regression analysis was used to relate the effect of students' attitudes to SAT mathematics performance, the results showed that the variation in how students performed in SAT mathematics could be linked to their levels of mathematics anxiety, strategies they used in attacking mathematics problems, how good they felt they were as students in general, and their perceived utility of mathematics. That is, students who were less anxious generally got higher SAT mathematics scores than did students who were more anxious. Students who had several strategies at their disposal tended to get higher SAT scores. Those who reported being good students got higher scores, as did those who felt mathematics was useful for college or later careers. Together, these factors could explain one-third of the variability in SAT mathematics performance among students.

In subsequent analyses, variables that related to students' achievement in areas other than mathematics,[11] participation in mathematics in school, students' educational and career goals, and descriptive variables such as students' gender and racial/ethnic group were added. The results of these analyses showed one variable -- participation in the mathematics curriculum -- related most strongly to students' performance in SAT mathematics. Students who took more advanced mathematics courses while in high school tended to obtain higher SAT mathematics scores than students who stopped taking mathematics courses at lower levels. Participation in the mathematics curriculum in high school accounted for 69 percent of the variation in SAT mathematics scores.

Adding information about how well students performed on the SAT verbal section to what was known about participation in high school mathematics courses improved the prediction equation substantially. Eighty-one percent of the variance in SAT mathematics scores can be explained, or predicted, by knowledge of students' high school mathematics course participation and performance on the SAT verbal section.

By adding information about the student's level of mathematics anxiety the percentage of explained variance raises to 83 percent. And, knowledge of the student's gender adds another one percent.

It may be noted that the attitudes identified above as explaining one-third of the variation in SAT mathematics scores all but disappeared when achievement and course participation variables were introduced. This happened because achievement, participation, and attitudes are apparently so related to each other that it is difficult to isolate their separate effects on student performance. What the statistical model suggests, therefore, is that, while attitudes play a large part in students' potential for performance, how the students achieve in school overall, and the extent to which they participate in the curriculum are of far greater importance.[12] The following diagram illustrates one possible model that could be used to describe this process.

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11. Probably the best predictor of mathematics achievement is prior history of mathematics achievement. Specifically in this case, scores from the eleventh grade administration of the CAT had a correlation of .90 with SAT mathematics scores. However, since we were trying to determine other factors of importance, CAT scores were not included so that other significant variables would have a chance to emerge.

12. Further regression analyses showed that students' attitudes towards mathematics and the type of work they hoped to be doing at age 30 explained over 25 percent of the variation in their participation in the curriculum. Thus, it may be inferred that attitudes play a large part in SAT performance as they influence decisions to persist in the curriculum.

EXHIBIT 4.1

Model Illustrating the Relationship Among Attitudes, Course Participation, and SAT Performance

```
                     ___________________
 ____________       |                   |      ______________
|            |      |      Course       |     |              |
| Attitudes  |--->  |   Participation   |---->|   SAT Math   |
|____________|      |___________________|     |______________|
                     __________________               ^
                    |                  |              |
                    |    SAT Verbal    |------------->
                    |__________________|
```

Regression Findings by Gender

Regression analyses were conducted for male and female students separately. The results (see Table 4.23) show that participation in the high school mathematics curriculum and verbal performance are important in explaining SAT mathematics performance for both male and female students. For females, 84 percent of the variation in SAT mathematics scores may be explained by mathematics course enrollment and SAT verbal performance, and for males, 81 percent is explained. Mathematics anxiety is statistically related to SAT mathematics performance for both males and females, although contributing only a small amount to what is known about the variation in scores. For females, liking of mathematics is also a small, but statistically significantly related variable.

Findings by Racial/Ethnic Group

Separate regression analyses for each racial/ethnic group show the persistent effects of participation in the mathematics curriculum and verbal performance (see Table 4.24). For Asians, Whites, and Hispanics, over three-fourths of the variation in SAT mathematics scores can be explained by mathematics curriculum participation and SAT verbal scores, and for Blacks, over two-thirds of the variation in SAT mathematics scores is explained.

Other variables emerge when regressions are conducted separately for each racial/ethnic group, although each variable contributes in only a small way to what is known about SAT mathematics scores. Some Asian students tend to over-prepare for the SAT, and this preparation appears to be counter-productive. Being a good student and having high educational goals improves Black students' performance on the SAT. For Hispanics, seeing mathematics as a male domain (which differentiates males and females) translates into slightly higher SAT mathematics scores. Small sample sizes precluded analyses by gender within racial/ethnic group.

TABLE 4.23

Amount of Variation in SAT Mathematics Scores Explained Through Regression Analysis on Several Variables: by Gender and Overall

Related Variable	Percentage of SAT Score Variation Explained		
	Overall	Females	Males
Participation in high school mathematics courses	69	71	68
SAT verbal score	12	13	13
Mathematics anxiety *	2	1	1
Student's gender	1	na	na
Liking of mathematics *	--	1	--
Total	84	86	82

* This item was a scale score representing one of the factors obtained in the factor analysis of student attitudes and beliefs.

SUMMARY

The findings presented in this chapter have confirmed many of the widely held beliefs about mathematics course-taking and test achievement differences as they relate to gender and racial/ethnic group membership. With respect to racial/ethnic group, the underrepresentation of Black and Hispanic students in the college preparatory mathematics courses and the low test scores and report card grades of Black students have again been documented. Most troubling is the finding that even at the highest levels of participation, Black students do not perform on standardized tests at the same level as students from the other racial/ethnic groups.

With respect to gender differences, the data suggest only small differences between the sexes with respect to enrollment in advanced courses, grades in mathematics classes, and scores on the CAT, but persistent differences remain in SAT mathematics scores, even among the highest mathematics participators.

Attitudinal differences explain a considerable amount of the differences in the extent to which students participated in the County mathematics curriculum. And, the data clearly show that participation in the curriculum is strongly related to performance on mathematics achievement tests. Thus, one can conclude that school systems can maximize students' ability to perform well on standardized tests by ensuring in all ways possible that students participate to the fullest in the curriculum that is offered. One way of moving in this direction is to ensure that classroom atmospheres are nurturing enough that students maintain positive attitudes towards mathematics and themselves as mathematicians.

TABLE 4.24

Amount of Variation in SAT Mathematics Scores Explained Through Regression Analysis on Several Variables: by Racial/Ethnic Group

	Percentage of SAT Mathematics Scores Explained			
Related Variable	Asians	Whites	Blacks	Hispanics
Participation in high school mathematics courses	73	73	63	59
SAT verbal score	11	10	8	17
Mathematics anxiety *	3	1	--	3
Preparation for the SAT **	2	--	--	--
Educational aspirations	--	--	2	--
Student feels he/she is a good student *	--	--	3	--
Mathematics is a male domain *	--	--	--	3
Total	89	84	76	82

* This item was a scale score representing one of the factors obtained in the factor analysis of student attitudes and beliefs.

** This variable is interesting in that those students who spent the longest time preparing for the SAT tended to score the lowest on the SAT mathematics section.

5

PROGRESS AND PERFORMANCE IN A K-8 MATHEMATICS CURRICULUM: GENDER AND RACIAL/ETHNIC GROUP SIMILARITIES AND DIFFERENCES

BACKGROUND

Chapter 4 illustrated the similarities and differences in mathematics participation and achievement of students by gender and racial/ethnic group membership that were observed at the high school level. The findings indicated that there were negligible differences in the mathematics participation of female and male students, but large differences in the course enrollment and class grades of Asian and White compared to Hispanic and Black students.

Racial/ethnic group differences in participation related directly to performance on standardized achievement tests, although even those Black students who participated in the highest levels of mathematics instruction in high school still did not attain test scores or class grades commensurate with scores and grades attained by their classmates from other racial/ethnic groups.

While minimal differences in participation in courses or performance on the CAT were found by gender, suprisingly large differences in SAT performance were observed. Equally as surprising was the finding that, regardless of level of participation in mathematics and science courses, female students consistently performed worse than their male classmates on the SAT.

Because the subject of mathematics is unique in structure, requiring the learner to proceed in large part in a hierarchical sequence, it can safely be assumed that differences observed at the high school level have their roots in the elementary and/or junior high/middle school experiences of youngsters. Therefore, it is anticipated that the large discrepancies in participation and performance of White and Asian compared to Black and Hispanic students that were found for eleventh graders can be linked to differences in how students progress in the mathematics curriculum in their early school years, and to differences in mathematics achievement that are observed in early grades.

The purpose of this chapter is to present the elementary and junior high/middle school mathematics experiences of male and female, and Asian, White, Black, and Hispanic students. This chapter will show that the racial/ethnic group differences that are observed at the high school level are manifested early in students' school careers. As would be expected, however, only small differences are found in female and male mathematics progress and achievement in the early grades.

The discussion in this chapter also explores the effects of attitudinal variables on mathematics progress and achievement for students from different gender and racial/ethnic groups. Data obtained through the survey and interview processes are examined. The analyses show that there is a relationship between attitudes, student progress in mathematics, and mathematics achievement.

STUDENT PROGRESS IN THE K-8 MATHEMATICS PROGRAM

Student progress in the K-8 mathematics program is assessed using three measures: 1) the number of mathematics objectives and problem solving assessments mastered by students in the ISM curriculum; 2) the number of assessments mastered compared to the level of performance expected of students at each grade; and 3) grades received in mathematics classes.

Number of ISM Objective and Problem-Solving Assessments Mastered

Countywide Progress and Progress by Gender

The average number of ISM objective and problem-solving assessments that were mastered by first through eighth grade students at the end of the 1984-85 school year are presented in Table 5.1. On average, by the end of third grade students had mastered about 74 of the 199 key objective and problem-solving assessments that constitute the ISM program.[1] Over the next two grade levels students mastered another 58 assessments, bringing the average number mastered by the end of fifth grade to 132. Sixth grade students had mastered an average of 153 assessments.[2]

In seventh grade a large number of students leave the ISM curriculum to be placed in the seventh grade mathematics course that prepares students to enter Algebra 1 in eighth grade. These students represent the top students in sixth grade: those students who were working above grade level, and who were deemed to be able to handle the Algebra 1 curriculum in eighth grade. Consequently, primarily students who were working on or below level in sixth grade are still included in the ISM curriculum in seventh and eighth grades. Thus, the average number of assessments that are presented in Table 5.1 as having been mastered by seventh and eighth grade students is lower than would be expected: 159 and 165, respectively.

Minimal differences were observed between male and female students' participation in the ISM curriculum at each grade level.

Progress by Racial/Ethnic Group

For all grades analyzed, students from different racial/ethnic groups progressed through the curriculum at substantially different rates (see Table 5.2). At each grade level, Asian and White students progressed at a higher rate (i.e., had mastered more assessments) than Black and Hispanic students.

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1. End-of-year 1984-85 progress and performance were used so that linkages could be made between these data and responses from students, parents, and teachers who were part of the fourth, sixth, and eighth grade cohorts the following school year.

2. Comparison of these averages to expected levels of performance, which are presented in the next section, indicate that students in the elementary grades progress, on the average, at a rate that is expected of them.

TABLE 5.1

Average Number of ISM Objective and Problem-Solving Assessments Mastered by Grade: Countywide and by Gender

Grade	Countywide		Females		Males	
	N	Avg. No. Obj.	N	Avg. No. Obj.	N	Avg. No. Obj.
1	2452	27	1276	27	1176	27
2	2942	48	1516	48	1426	49
3	2929	74	1509	73	1420	75
4	3116	104	1505	104	1611	105
5	3185	132	1602	132	1583	132
6	3471	153	1712	153	1759	153
7	2228	159	1107	158	1121	160
8	2358	165	1149	166	1209	164

NOTE: Data in this table and Tables 5.2, 5.3, 5.5, and 5.6 were obtained from computer data bases of students enrolled in schools in the County that had computer-assisted assessments. Students included in the analyses were students in grades 3 and 4 who had been in the mathematics curriculum for at least two years, and students in higher grades with at least three years in the curriculum. First and second grade data were obtained from historical records of third grade students.

Table 5.3 presents the progress of Asian, Black, and Hispanic students using the progress of White students as a frame of reference. That is, the numbers in Table 5.3 were obtained by dividing the number of objectives mastered by each minority group in a given grade level by the number mastered by White students, and then multiplying by 100 to obtain a percentage. Thus, for White students, progress in any grade level is 100 percent. Compared to the progress of White students, Asian students progressed at a slightly higher rate: 102 percent of White students' progress. By contrast, Black students progressed at about 89 percent of the rate of White students, and Hispanic students progressed at 91 percent of the rate of Whites. Thus for every year spent in the curriculum, Black and Hispanic students mastered nine-tenths of the material mastered by Asians and Whites.

It is important to note that the percentage of students remaining in the ISM curriculum in grades 7 and 8 increased for Blacks while staying the same for

Hispanics and Whites and decreasing for Asians. Thus, while Black students comprised 12 percent of the students in the ISM curriculum in grades 3 - 6, in seventh grade they were 13 percent of the students, and in eighth grade, 16 percent. Consequently, the proportions of Black students who leave the K-8 curriculum to enter Algebra 1 in the eighth grade is less than their proportion in the student population would suggest.

TABLE 5.2

Average Number of ISM Objective and Problem-Solving Assessments Mastered by Grade and Racial/Ethnic Group

	Asians		Whites		Blacks		Hispanics	
Grade	N	Avg. # Obj.	N	Avg. # Obj.	N	Avg. # Obj.	N	Avg. # Obj.
1	225	28	1839	28	278	25	109	25
2	287	49	2139	49	366	44	149	44
3	286	78	2126	75	363	67	153	68
4	318	109	2265	106	378	93	151	98
5	314	137	2354	134	353	120	161	123
6	326	160	2554	156	432	136	156	144
7	185	163	1643	161	291	146	108	151
8	146	171	1728	169	351	149	128	147

NOTE: Minimal differences in numbers of assessments mastered were observed by gender within racial/ethnic group.

Performance Below, On, or Above Grade Level

With respect to expected performance in specific grade levels, a student's performance is classified as being either below, on, or above the grade level standard (i.e., ISM working level) established by the County. The grade level standard is defined by a range of assessments mastered, and is aimed at having the student ready to succeed in algebra by the end of eighth grade. It is a local standard and should not be confused with national standards such as those of standardized normed tests. Table 5.4 presents the ranges in numbers of objective and problem-solving assessments that students must master in order to be considered working on grade level in the K-8 curriculum. The table presents ranges for each of the nine years of the curriculum, and within each year, presents the ranges for each quarter or

TABLE 5.3

Average Number of ISM Objective and Problem-Solving Assessments Mastered by Grade and Racial/Ethnic Group, Expressed As A Percentage of White Students' Progress

Grade	Asians	Whites	Blacks	Hispanics
1	100	100	89	89
2	100	100	90	90
3	104	100	89	91
4	103	100	88	92
5	102	100	90	92
6	103	100	87	92
7	101	100	91	94
8	101	100	88	87

report card marking period. It may be noted that these ranges have considerable overlap, and a student who has mastered a given number of assessments could be considered working on grade level at several places in the table.

For example, a student who has mastered 50 objectives and problem-solving assessments could be at grade level in the last two quarters of second grade or the first two quarters of third grade. It is only when this performance is compared to the actual grade level the student is in that the below-, on- or above-grade-level classification can be made. If the student in our example is actually in the second half of second grade or the first half of third grade, he/she would be classified as working on grade level. If he/she were a first grader, or in the first half of second grade, he/she would be classified as working above grade level. If, however, the student were in the last half of third grade or in a later grade, he/she would be classified as working below grade level.[3]

3. There is no above-grade-level classification for grade 8 because students are expected to have completed all 199 key objective and problem-solving assessments by the end of the eighth grade.

TABLE 5.4

Ranges of Mastery of Objective and Problem-Solving Assessments That Classify Students as Working On Grade Level

Grade Level	First Marking Period	Second Marking Period	Third Marking Period	Fourth Marking Period
Kdg.	0 - 3	0 - 7	0 - 10	0 - 14
1	4 - 19	8 - 24	11 - 30	15 - 36
2	19 - 42	23 - 48	29 - 53	36 - 59
3	40 - 65	47 - 73	52 - 80	58 - 88
4	64 - 95	72 - 105	78 - 112	85 - 120
5	91 - 125	99 - 131	108 - 137	116 - 142
6	123 - 147	128 - 152	135 - 156	141 - 159
7	147 - 165	150 - 176	156 - 182	158 - 190
8	160 - 192	166 - 198	174 - 199	180 - 199

Performance of Students Countywide and by Gender

Table 5.5 shows the percentages of students in the third through the eighth grades whose performance in the ISM program was below, on, or above the standard established for their grade. As is illustrated vividly by the figures in the table, the percentage of students who were working on grade level decreased with each successive year in school.[4] At the same time, the percentages of students who were working above grade level or below grade level increased as students progressed through the grades.

For example, 76 percent of the third grade students were working on grade level as compared with only 34 percent of the sixth grade students. However, only 9 percent of the students in grade 3 were working below grade level, compared to 26 percent of those in grade 6. About 15 percent of the third grade students were working above grade level, and 40 percent of the sixth grade students were working at this accelerated level.

4. The percentage working above grade level shows a marked increase around fourth grade. This is probably the result of teachers trying to complete the curriculum for some students in preparation for the seventh grade mathematics class leading to Algebra 1 in eighth grade.

There were few differences in the ISM working levels of male and female students. What differences were detected were usually no more than one or two percentage points. Any advantage males had over females, or vice versa, within any ISM working level was not consistent across grades.

TABLE 5.5

Percentage of Students Working Below, On, or Above the Grade Level Standard: Countywide and by Gender

Grade/Status		Countywide N	Countywide %	Females N	Females %	Males N	Males %
1	Below	18	1	10	1	8	1
	On	2164	88	1148	90	1016	86
	Above	270	11	118	9	152	13
2	Below	216	7	118	8	98	7
	On	2410	82	1254	83	1156	81
	Above	316	11	144	10	172	12
3	Below	260	9	153	10	107	8
	On	2229	76	1142	76	1087	76
	Above	450	15	218	14	232	16
4	Below	358	12	178	12	180	11
	On	2171	70	1071	71	1100	68
	Above	587	19	256	17	331	21
5	Below	606	19	308	19	298	19
	On	1579	50	807	50	772	49
	Above	1001	31	487	30	514	32
6	Below	899	26	431	25	468	27
	On	1184	34	593	35	591	34
	Above	1388	40	688	40	700	40
7	Below	995	45	498	45	497	44
	On	1035	47	516	47	519	46
	Above	198	9	93	8	105	9
8	Below	1600	68	767	67	833	69
	On	758	32	382	33	376	31
	Above *	--	--	--	--	--	--

NOTE: Some students were eliminated from this table because of missing data.

* Students working above level in eighth grade were in Algebra classes and are not included in this table or in Tables 5.6, 5.8, and 5.9.

Performance by Racial/Ethnic Group

The data in Table 5.6 show that Asian and White students were more likely than Black and Hispanic students to have been working above level regardless of their grade in school. For example, while 24 percent of the Asian students were working above grade level in third grade and 17 percent of the White students were working at a similar level, the comparable percentages for Black and Hispanic students were 4 and 7, respectively.

TABLE 5.6

Percentage of Students Working Below, On, or Above Grade Level Standard: by Grade and Racial/Ethnic Group

Grade/Status		Asians		Whites		Blacks		Hispanics	
		N	%	N	%	N	%	N	%
1	Below	2	1	7	0 *	6	2	3	3
	On	194	86	1608	87	262	94	99	91
	Above	29	13	224	12	10	4	7	6
2	Below	24	8	111	5	59	16	22	15
	On	220	77	1778	83	288	79	123	83
	Above	43	15	250	12	19	5	4	3
3	Below	17	6	149	7	71	20	23	15
	On	203	70	1626	76	280	77	119	78
	Above	69	24	356	17	14	4	11	7
4	Below	21	7	202	9	102	27	32	21
	On	221	70	1581	70	259	69	107	71
	Above	76	24	482	21	17	5	12	8
5	Below	37	12	380	16	140	40	48	30
	On	145	46	1178	50	164	47	90	56
	Above	132	42	796	34	49	14	24	15
6	Below	51	16	556	22	229	53	62	40
	On	102	31	875	34	153	35	53	34
	Above	173	53	1123	44	50	12	41	26
7	Below	73	40	669	41	189	65	64	59
	On	85	46	813	50	98	34	39	36
	Above	27	15	161	10	4	1	5	5
8	Below	79	54	1102	64	309	88	105	82
	On	67	46	626	36	42	12	23	18
	Above	--	--	--	--	--	--	--	--

* Percentage is less than half of one percent.

Although the percentage of students working above grade level for each of the four racial/ethnic groups had at least doubled between third and sixth grades, large discrepancies among the four groups still existed. Black and Hispanic students were far less likely than Asian and White students to have been working above grade level. Additionally, Black and Hispanic students were much more likely to have been working below grade level in any of the grades in the K-8 curriculum.

Longitudinal Trends in Performance in the K-8 Curriculum

The previous section displayed the performance of students in the ISM curriculum for eight different groups of students: those in grades 1 through 8 during 1984-85. While these data indicated that differences in performance existed among racial/ethnic groups in each grade level, no linkages were possible across grades, i.e., it was not possible to predict the performance of a group of students in third grade, given their performance in second grade.

This section investigates the longitudinal trends in mathematics performance for students who were served by the program for several years. For this analysis, three different cohorts of students were used: students who were in the third grade in 1984-85, those in the fifth grade in 1984-85, and those in the seventh grade. For each cohort, it was possible to examine performance in the curriculum for a three year period, the year they just completed in 1984-85, plus the prior two years. Thus, for the third grade cohort, we have a history of their mathematics performance as of the end of their third, second, and first grades in school. For the fifth grade cohort, we have end of fifth, fourth, and third grade mathematics performance. And, for the seventh grade cohort, we have end of seventh, sixth, and fifth grade performance.

The mathematics performance history of the three cohort groups provides two points of overlapping data. For fifth grade, we have the most recent performance of the fifth grade cohort, as well as the least recent performance of the seventh grade cohort. Similarly, for third grade, we have the most recent performance of the third grade cohort, and the least recent performance of the fifth grade cohort.

Comparison of the third grade performance of students who were included in the third and fifth grade cohorts enables us to compare the three year performance history from first to third grade with the three year history from third to fifth grade. Similarly, the three year history from third to fifth grade can be compared to the three year history from fifth to seventh grade. By linking each three year history it is possible to project what the likely pattern of performance would be through all grade levels for students who start in the curriculum by the beginning of first grade.

<u>Systemwide Performance</u>

Exhibit 5.1 illustrates the three year performance history for the three cohorts of students. The exhibit contains three sections: the first section shows the performance of the third grade cohort as they were at the end of third grade and as they were as first graders; the second section shows the

performance of the fifth grade cohort, both in fifth and third grades, and so on.

EXHIBIT 5.1

Longitudinal History of Performance in the K-8 Curriculum for Three Samples of Students

Third Grade Cohort, n=2369

Performance as First Graders		Performance as Third Graders: Below	On	Above	
	Below	0.3 %	0.4 %	0 %	1 %
	On	7	70	11	88
	Above	0	6	5	11
		7	76	16	

Fifth Grade Cohort, n=2680

Performance as Third Graders		Performance as Fifth Graders: Below	On	Above	
	Below	7 %	4 %	1 %	12 %
	On	10	43	20	73
	Above	0	3	13	16
		17	50	34	

Seventh Grade Cohort, n=1797

Performance as Fifth Graders		Performance as Seventh Graders: Below	On	Above	
	Below	27 %	8 %	0.1 %	35 %
	On	15	31	5	51
	Above	0.2	10	5	15
		42	49	10	

Looking at the third grade cohort as an example, several pieces of information can be obtained. In the first grade, only 1 percent of the students were below grade level, 88 percent were on grade level, and 11 percent were above level. By third grade, 7 percent were below level, 76 percent were on level, and 16 percent were above level. Thus, the beginnings of the pattern of movement of students out of the on-grade-level category into both the below and above categories is demonstrated early.

The exhibit also illustrates that very few students moved from performance below grade level in the curriculum to performance above grade level two years later. Additionally, a comparatively small number moved from below level to on level performance in the two year period. However, in the seventh grade cohort over one-fourth of the students performed below level in both sixth and eighth grades. Thus, there is some evidence to suggest that once a student falls below grade level, he or she is likely to continue to perform in mathematics at a reduced level.

Minimal differences in performance were found for students by gender, but major differences were found by racial/ethnic group composition. The next section presents the longitudinal trends in performance in the curriculum by racial/ethnic group.

Longitudinal Trends in Performance by Racial/Ethnic Group

Table 5.7 presents the estimated probabilities of students performing below, on, or above grade level in the K-8 curriculum. The column in the table representing first grade is labelled "actual." This label indicates that the probabilities in this column are actually what are observed for first grade students in the County. The rest of the columns are all labelled "predicted." Probabilities for grades 2 through 6[6] are predicted by using the actual figures for first grade, and the probabilities that can be derived from the longitudinal performance of the third, fifth, and seventh grade cohorts that were discussed in the above section. Due to idiosyncracies that may exist in a particular cohort's set of data, these probabilities may differ somewhat from what occurs in real life. However, since the computational method is identical for students in all racial/ethnic groups within a cohort, the patterns that emerge for the four groups can be interpreted with full confidence, and the small differences that may exist between predicted probabilities and "true" probabilities can be ignored.

The data in Table 5.7 show that the pattern of moving through the K-8 curriculum is quite different for the four racial/ethnic groups. While all groups of students start out roughly the same in first grade, by the end of sixth grade, Asian students have a fifty-fifty chance of being above level, White students have a 40 percent chance of being above level, Hispanic students have a 30 percent chance, and Black students have a 19 percent chance.

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6. Probabilities for seventh and eighth grade are not predicted since the situation is somewhat confused by those accelerated students who leave the curriculum at the end of sixth grade.

TABLE 5.7

Predicted Status of Students by Racial/Ethnic Group Based on First Grade Performance in the K-8 Curriculum

Group	Status	1 Actual	2 Predicted	3 Pred.	4 Pred.	5 Pred.	6 Pred.
All Students	Below	.01	.06	.08	.09	.15	.23
	On	.88	.83	.77	.71	.51	.38
	Above	.11	.12	.16	.19	.34	.39
Asians	Below	.01	.05	.03	.03	.06	.12
	On	.86	.78	.73	.67	.49	.36
	Above	.13	.17	.24	.29	.44	.50
Whites	Below	.01	.04	.06	.08	.14	.21
	On	.87	.82	.75	.72	.51	.38
	Above	.12	.13	.18	.21	.35	.40
Blacks	Below	.02	.12	.17	.24	.34	.42
	On	.94	.82	.78	.70	.48	.39
	Above	.04	.06	.05	.08	.19	.19
Hispanics	Below	.02	.09	.12	.14	.20	.37
	On	.92	.90	.81	.80	.61	.35
	Above	.07	.03	.09	.08	.21	.30

At the other end of the spectrum, 12 percent of the Asian students are likely to be below grade level by the end of the sixth grade, compared to 21 percent of the Whites, 37 percent of the Hispanics, and 42 percent of the Blacks. What is most disturbing about this pattern is its early onset: by the end of second grade, large differences in predicted performance by racial/ethnic group are evident.

Problem-Solving Assessments

Research in mathematics instruction suggests that certain students may face additional hurdles in solving word problems that they do not face in performing simple computations. This is particularly true if the students have difficulty in reading. The ISM assessment system periodically examines students' ability to solve mathematical word problems. Starting at the second grade working level in ISM, students are expected to master problem-solving assessments which are geared to each grade level. In each grade level from 2 to 8 there is one problem-solving assessment per semester or two assessments per year. Each assessment carries with it two points, which are added to the number of objective assessments that have been mastered, to determine the student's below-, on-, or above-grade-level status. Thus, the number of problem solving "points" can be examined as another standard of the level of student performance in the curriculum.

Problem-Solving Assessments Countywide and by Gender

Table 5.8 presents the average number of problem-solving points attained by students in grades 1-8 as of the end of the 1984-85 school year. The table presents the problem-solving data for County students, overall, and by gender. Small differences in average number of problem-solving assessments are observed for female and male students. These differences generally favor the males.

Examination of Table 5.8 shows that, by the end of third grade, students had mastered, on the average, approximately three problem-solving assessments for which they received almost six points. Compared to the standard of four assessments or eight points, students finishing the third grade were approximately one assessment or one semester behind in problem-solving. By

TABLE 5.8

Average Number of Problem-Solving Points Attained by Students in the K-8 Curriculum: Overall, and by Gender

Grade	Overall		Females		Males		Standard
	N	Avg.	N	Avg.	N	Avg.	
1	2456	0.3	1277	0.3	1179	0.4	0 *
2	2953	2.7	1522	2.6	1431	2.8	4
3	2953	5.9	1522	5.8	1431	6.0	8
4	3151	9.5	1522	9.3	1629	9.6	12
5	3211	13.0	1614	13.0	1597	13.1	16
6	3505	16.2	1731	16.1	1774	16.3	20
7 **	2232	17.5	1111	17.4	1121	17.6	24
8 **	2361	18.4	1150	18.5	1211	18.2	28

* The number of points used to compute the standard equals 2 times the number of problem solving-assessments students on or above grade level should have mastered by the end of the school year.

** Performance of seventh and eighth grade students reflects the departure of the best students from ISM.

the end of fifth grade, students were an average of 1.5 assessments or semesters behind in problem-solving (the equivalent of three points), and by the end of sixth grade they were almost two semesters or assessments behind (almost four points).

Problem-Solving Assessments by Racial/Ethnic Group

Table 5.9 presents the problem-solving assessment data by racial/ethnic group. Much larger differences were found among the racial/ethnic groups than were found by gender. Examination of the data for third graders shows that White and Asian students were about two points below the standard of eight points for the end of third grade, or within one semester of being on grade level in problem-solving. For Black and Hispanic students the difference was over three points between their average problem-solving level and the standard, or over one semester difference. By the end of fifth grade the difference was more dramatic. White and Asian students ended fifth grade somewhat more than one semester behind their grade level in problem-solving. Black and Hispanic students, however, were 2 1/2 semesters behind grade level in problem-solving.

TABLE 5.9

Average Number of Problem-Solving Points Attained by Students in the K-8 Curriculum by Racial/Ethnic Group

	Asians		Whites		Blacks		Hispanics		
Grade	N	Avg.	N	Avg.	N	Avg.	N	Avg.	Standard
1	226	0.4	1841	0.4	278	0.1	110	0.2	0 *
2	290	2.8	2141	2.9	367	1.8	154	2.3	4
3	290	6.4	2141	6.2	367	4.4	154	4.7	8
4	320	10.2	2291	9.8	384	7.2	152	8.0	12
5	314	13.9	2377	13.4	355	10.6	162	11.3	16
6	327	17.8	2580	16.9	439	12.1	156	14.2	20
7	185	18.6	1646	18.1	291	14.3	109	15.4	24
8	146	20.0	1729	19.3	353	14.5	128	15.3	28

* The number of points used to compute the standard equals 2 times the number of problem solving-assessments students on or above grade level should have mastered by the end of the y ar.

It appears, then, that the problem-solving data further support the findings observed above among the racial/ethnic groups regarding the number of objectives mastered, overall, and performance in the curriculum at the below-, on-, or above-grade-level categories.

Grades Received in Mathematics Classes

The final indicator of student performance in the K-8 mathematics curriculum is the grade received in mathematics class. While grades assigned by teachers might be somewhat subjective, they are considered to be a reflection of how good or poor the teacher feels the student's performance has been during the school year. Whereas ISM performance data were available for all students who were enrolled in the computer-assisted assessment schools, mathematics grades were available only for those students in the fourth, sixth, and eighth grade sample groups who participated in the student survey process. This is a much smaller number of students; approximately 300 in each sample group.

Grades Countywide and by Gender

Table 5.10 contains the average grades in mathematics received by the sample students, overall, and by gender. The data show two interesting trends: as students progress through school, the grades they receive in mathematics get somewhat lower; and after first grade, females tend to get slightly higher mathematics grades than males. This latter finding is consistent with the pattern observed in the high school analysis of grades in Chapter 4.

Grades by Racial/Ethnic Group

While the pattern of grades in mathematics is fairly similar for male and female students, statistically significant differences are observed by racial/ethnic group at early grades (see Table 5.11). Later chapters of this report will attempt to address the causes of these differences, which appear as early as first grade. Suffice it to say, nonetheless, that the early history of Black and Hispanic students falling below grade level in mathematics performance, coupled with these students' lower report card grades in mathematics, may be the beginning of the cycle that produces the vast differences between Asians and Whites on the one hand, and Blacks and Hispanics on the other hand, that are observed at the high school level.

PERFORMANCE AND ACHIEVEMENT IN MATHEMATICS

Students' achievement in mathematics is analyzed both in terms of the MCPS K-8 mathematics curriculum and nationwide levels of performance. Achievement in the MCPS curriculum is assessed by students' performance on criterion-referenced tests (CRT's) in mathematics which were developed and administered by the County. Achievement in mathematics relative to national norms of performance is assessed by students' total mathematics scores on the California Achievement Tests (CAT). This section of the report presents the performance data for all students who were in the third, fifth, and seventh grades in 1984-85.

TABLE 5.10

Mathematics Grades Received by Students in Their Prior Three Years of School: by Grade Level and Gender

Sample/Grade Level	Countywide N	Countywide Avg. Grd.	Females N	Females Avg. Grd.	Males N	Males Avg. Grd.
Fourth Grade Sample						
First grade	229	3.3	113	3.3	116	3.3
Second grade	266	3.3	129	3.3	137	3.2
Third grade	259	3.1	128	3.2	131	3.0
Average of all three grades	219	3.2	106	3.3	113	3.2
Sixth Grade Sample						
Third grade	271	2.9	132	2.9	139	2.9
Fourth grade	318	2.9	164	3.0	154	2.8
Fifth grade	321	2.9	166	3.0	155	2.8
Average of all three grades	266	2.9	129	3.0	137	2.9
Eighth Grade Sample						
Fifth grade	259	2.9	133	2.9	126	2.9
Sixth grade	293	2.9	149	3.0	144	2.8
Seventh grade	298	2.8	152	2.9	146	2.7
Average of all three grades	253	2.9	130	2.9	123	2.8

NOTE: Grades for the upper elementary and junior high levels are A, B, C, D, and E (failing). In the lower grades, students receive O (outstanding), S (satisfactory), and N (needs improvement). For analysis purposes, O was equated to A, S was equated to B, and N was equated to D. Average grades are computed using A=4, B=3, C=2, etc.

TABLE 5.11

Mathematics Grades Received by Students in Their Prior Three Years of School: by Grade Level and Racial/Ethnic Group

	Asians		Whites		Blacks		Hispanics	
Sample/Grade Level	N	Av. Grd.	N	Av. Grd.	N	Av. Grd.	N	Av. Grd.
Fourth Grade Sample								
First grade	54	3.5	77	3.4	55	3.2	43	3.1
Second grade	64	3.6	84	3.3	65	3.1	53	3.2
Third grade	65	3.4	84	3.1	59	2.8	51	2.9
Average of all three grades	54	3.5	76	3.3	50	3.0	39	3.0
Sixth Grade Sample								
Third grade	62	3.3	78	2.8	71	2.9	60	2.7
Fourth grade	81	3.2	86	2.8	82	2.8	69	2.8
Fifth grade	84	3.3	84	2.9	81	2.7	72	2.8
Average of all three grades	61	3.3	76	2.9	70	2.8	59	2.8
Eighth Grade Sample								
Fifth grade	63	3.1	75	3.1	67	2.7	54	2.7
Sixth grade	73	3.2	82	2.9	75	2.7	63	2.8
Seventh grade	79	3.2	79	2.8	77	2.5	63	2.6
Average of all three grades	62	3.1	73	3.0	64	2.6	54	2.7

NOTE: Grades for the upper elementary and junior high levels are A, B, C, D, and E (failing). In the lower grades, students receive O (outstanding), S (satisfactory), and N (needs improvement). For analysis purposes, O was equated to A, S was equated to B, and N was equated to D. Average grades are computed using A=4, B=3, C=2, etc.

Performance on the CRT's

Performance Countywide and by Gender

Performance on the CRT's is assessed in terms of the estimated proportion of the curriculum in grades 3 - 8 students have attained. For students who took the CRT's in 1984-85, third graders had mastered 32 percent of the 3-8 curriculum, fifth graders had mastered 57 percent, and seventh graders mastered 70 percent (see Table 5.12).[7] There was a slight difference in the percentage of the 3-8 curriculum mastered by females and males, with male students in the third and fifth grades mastering one to two percent more of the curriculum than their female peers.

TABLE 5.12

CRT Mathematics Performance of Third, Fifth, and Seventh Grade Students: Countywide and by Gender

Grade Tested	Countywide		Females		Males	
	N	Avg. Score	N	Avg. Score	N	Avg. Score
3	2860	32	1478	32	1382	33
5	3185	57	1605	56	1580	58
7	2461	70	1234	70	1227	70

NOTE: Scores are average total curriculum domain scores and represent the estimated percent correct for the total curriculum bank in grades 3-8.

Performance by Racial/Ethnic Group

While small differences in performance were observed by gender, racial/ethnic group differences are much larger (see Table 5.13). In all three grades tested, Black students' performance indicates that they had mastered at least 10 percent less of the curriculum than their Asian and White peers. Hispanic students also had mastered less of the curriculum than Asians and Whites, but they demonstrated somewhat greater knowledge of the curriculum than Black students.

Relationship of Performance in the Curriculum and CRT Performance

In all three grades examined, students of each racial/ethnic group who performed above grade level in the curriculum performed substantially better on the CRT's than students from the same racial/ethnic group who performed on grade level in the curriculum (see Table 5.14). Additionally, those who performed on grade level in the curriculum performed substantially better on

7. CRT items are located in the 3-8 mathematics curriculum by determining their difficulty using the Raasch model of latent trait theory. Since the CRT's were administered only in grades 3 - 8 in 1984-85, scores bear relationship to the 3-8, rather than the entire K-8 curriculum.

TABLE 5.13

CRT Mathematics Performance of Third, Fifth, and Seventh Grade Students by Racial/Ethnic Group

	Asians		Whites		Blacks		Hispanics	
Grade Tested	N	Avg. Scr.	N	Avg. Scr.	N	Avg. Scr.	N	Avg. Scr.
3	281	36	2079	34	348	23	152	25
5	327	63	2344	58	354	40	157	50
7	215	75	1809	72	325	60	109	66

NOTE: Scores are average total curriculum domain scores and represent the estimated percent correct for the total curriculum bank in grades 3-8.

TABLE 5.14

CRT Mathematics Performance of Students by Grade Level, Racial/Ethnic Group, and Level of Performance in the Curriculum

	Asians		Whites		Blacks		Hispanics	
Grade/Level of Performance	N	Avg. Scr.	N	Avg. Scr.	N	Avg. Scr.	N	Avg. Scr.
Third Grade								
Below	15	17	136	16	67	14	19	14
On	201	34	1593	33	267	24	121	25
Above	64	44	340	48	12	41	11	43
Fifth Grade								
Below	[illegible]	36	374	39	139	33	45	37
On	155	58	1158	55	165	51	89	51
Above	137	76	788	72	49	69	23	73
Seventh Grade								
Below	72	64	664	60	185	54	57	58
On	87	80	802	76	99	70	35	74
Above	28	88	153	87	4	*	5	89

* Average score is not presented since the number of students is less than five and the score estimate is likely to be unstable.

NOTE: Numbers in this table differ somewhat from those in Table 5.13 due to some missing data.

the CRT's than students who performed below grade level in the curriculum.[8]

For students in the third grade, those who were working above level demonstrated mastery of 2 - 3 times as much of the curriculum as students who were working below level. Students working above level in fifth grade showed mastery of twice as much of the curriculum as their peers who were working below level. Similarly, students in the third grade who were working on grade level mastered twice as much of the curriculum as students working below grade level, and for the fifth grade, students working on grade level mastered 1 1/2 times as much of the curriculum as those working below grade level.

The data also indicate that students of all racial/ethnic groups performed more similarly when they were first grouped by their level of performance in the curriculum. That is, students in the four racial/ethnic groups who were working on grade level in the fifth grade performed more similarly than did students in the four racial/ethnic groups when all levels of performance were considered together. Thus, performance in the curriculum is clearly linked to later performance on criterion-referenced tests. Of critical importance, then, is how to ensure that all students have the opportunity to participate to the fullest extent possible in the K-8 curriculum. This issue will be explored again in later sections of this report.

Performance on the California Achievement Tests (CAT)

Overall County Performance on the CAT

Overall, County students perform quite well on the California Achievement Tests (CAT). They performed better on the CAT than over two-thirds of the students, nationally, who took the test. Countywide, students in the third grade performed slightly better on computation skills than they did on mathematical concepts (72 vs. 68 NCE), but students in the fifth and seventh grades fared better on concepts (see Table 5.15).

When performance on the CAT is compared to performance in the mathematics curriculum. a strong relationship is found (see Table 5.16). Students who were working above level in the curriculum obtained CAT scores primarily in the top two stanines on the CAT (stanines 8 and 9). Over half the students who were working on level in the curriculum scored in the top three stanines of the CAT, and over one-third scored in stanines 4 through 6. For those who were working below level in the curriculum, three-fourths scored in stanines 4 through 6.

CAT Performance by Gender

Slight differences in NCE scores were observed between female and male

8. Findings are similar for male and female students as well. Since male and female students performed similarly, overall, no separate discussion of their CRT performance by working level in the curriculum will be presented here.

TABLE 5.15

CAT Mathematics Performance of Students by Grade Level: Countywide and by Gender

Grade Level/ Subtest	Grade Tested	Countywide N	Countywide Avg. Score	Females N	Females Avg. Score	Males N	Males Avg. Score
Third Grade	3	2815		1448		1367	
Computations			72		71		73
Concepts			68		67		69
Total Mathematics			72		70		73
Fifth Grade	5	2980		1513		1467	
Computations			71		72		67
Concepts			72		71		73
Total Mathematics			73		73		73
Seventh Grade	5	1808		916		892	
Computations			62		63		61
Concepts			64		62		65
Total Mathematics			64		63		64

NOTE: Scores are average Normal Curve Equivalent (NCE) scores.

students. In the third grade males outperformed females slightly on both sections of the mathematics test (2 NCE points difference). In the fifth and seventh grades, however, a pattern similar to that observed among high school students was observed: females performed better than males in computations, and males performed better than females in concepts (see Table 5.15).

Table 5.17 presents the stanine score performance of students by gender on the total mathematics section of the CAT. Other than in the third grade cohort, where significantly more males than females attained a score in the ninth stanine, performance of females and males was quite similar. The relationship between CAT stanines and performance in the mathematics curriculum was similar for males and females and is not presented separately here.

CAT Performance by Racial/Ethnic Group

Table 5.18 presents the NCE score performance of students from the four racial/ethnic groups. Clear differences are found for the four groups; Black and Hispanic students perform less well than White and Asian students.

TABLE 5.16

Performance on the CAT Controlling for Performance in the K-8 Curriculum: Third, Fifth, and Seventh Grade Students

Grade	Working Level in Curriculum	% in Stanines 9	8	7	% in Stanines 4 thru 6	% in Stanines 1 thru 3
Third n=2801	All students	27	15	19	36	3
	Above level	73	14	10	2	0
	On level	20	16	23	39	2
	Below level	0	1	4	72	23
Fifth n=2956	All students	30	16	19	33	2
	Above level	64	21	10	5	0
	On level	17	18	28	37	1
	Below level	3	2	8	75	12
Seventh n=1807	All students	10	14	22	50	4
	Above level	41	28	27	5	0
	On level	12	21	29	37	1
	Below level	1	2	13	75	9

TABLE 5.17

Stanine Distribution by Gender on the CAT Total Mathematics Subtest

Grade	Grade Tested	Gender	9	8	7	6	5	4	3	2	1
Third	3	Females	24	16	20	18	12	7	3	1	0 *
		Males	30	14	19	16	11	7	2	1	0 *
Fifth	5	Females	29	16	20	17	12	5	1	0 *	0 *
		Males	30	16	18	17	11	6	2	1	1 *
Seventh	5	Females	10	13	23	23	19	8	3	2	1
		Males	11	14	22	23	17	9	2	1	0 *

* Percentage is less than half of one percent.

NOTE: Numbers are percentages of students in each group.

TABLE 5.18

CAT Mathematics Performance of Students by Grade Level and Racial/Ethnic Group

Grade/ Subtest	Grade Tested	Asians N	Asians Avg. Scr.	Whites N	Whites Avg. Scr.	Blacks N	Blacks Avg. Scr.	Hispanics N	Hispanics Avg. Scr.
Third Grade	3	261		2077		340		136	
Computations			81		73		59		64
Concepts			71		70		55		58
Total Mathematics			78		74		58		62
Fifth Grade	5	274		2257		319		128	
Computations			81		71		60		64
Concepts			78		74		57		63
Total Mathematics			82		75		59		64
Seventh Grade	5	130		1367		234		75	
Computations			70		63		54		57
Concepts			67		66		51		55
Total Mathematics			70		65		52		56

NOTE: Scores are average Normal Curve Equivalent (NCE) scores.

It may be noted, however, that all four racial/ethnic groups in the County perform better than at least half to 60 percent of the nation's students.

Table 5.19 presents the CAT data by stanine grouping for the four racial/ethnic groups. These data further substantiate the differences by racial/ethnic group that were found when the NCE scores were examined, and support the research indicating that differences between the racial/ethnic groups are found quite early in the students' school careers. When the CAT stanine performance in mathematics for each racial/ethnic group is examined in light of students' performance in the curriculum, it is once again clear that students who performed at a higher level in the curriculum also performed at higher levels on the CAT (see Tables 5.20 and 5.21).

These tables illustrate a disturbing finding for Black and Hispanic students, however. Results from the third grade Countywide testing show that students from all four racial/ethnic groups who were working above level in the curriculum did quite well on the CAT. The overwhelming majority scored in stanines 8 and 9, and comparatively few students scored in stanines 4 through 7. However, for the fifth and seventh grade students this pattern is not upheld in the data. Black and Hispanic students in the fifth grade who performed at the highest levels in the curriculum did not attain the same level on the CAT as their Asian and White classmates. Moreover, for students who were working either on level or below level in the third, fifth, and seventh grades, Black and Hispanic CAT performance did not measure up to the performance of Whites and Asians.

That this discrepancy between performance in the curriculum and performance on the CAT is observed for Black and Hispanic students is not a new finding. Nonetheless, observing the phenomenon in these data among students working at advanced levels in the curriculum as well as among those working at lesser levels only serves to illustrate the pitfalls that could be encountered if educational decisions were to be made solely on the basis of test scores.

TABLE 5.19

Stanine Distribution by Racial/Ethnic Group: CAT Total Mathematics Score

Grade	Grade Tested	Racial/Ethnic Group	Stanine 9	8	7	6	5	4	3	2	1
Third	3	Asians	42	15	16	13	8	4	2	0	0
		Whites	29	17	21	17	10	6	2	0 *	0 *
		Blacks	11	6	13	19	24	16	7	2	2
		Hispanics	10	12	17	25	18	13	3	2	1
Fifth	5	Asians	47	15	19	12	4	2	0 *	0	0
		Whites	31	17	19	16	10	5	1	0 *	0 *
		Blacks	9	10	15	19	24	15	6	2	1
		Hispanics	13	13	20	27	17	5	3	1	2
Seventh	5	Asians	17	24	17	24	12	5	2	0	0
		Whites	11	15	24	24	17	7	2	1	0 *
		Blacks	3	6	15	18	27	19	6	4	3
		Hispanics	7	4	15	25	24	16	7	[illegible]	0

* Percentage is less than half of one percent.

NOTE: Numbers are percentages of students in each group.

TABLE 5.20

Performance on the CAT Controlling for Performance in the K-8 Curriculum: Third and Fifth Grade Students by Racial/Ethnic Group

Grade & Racial/ Ethnic Gp.	Working Level	% in Stanines 9	8	7	% in Stanines 4 thru 6	% in Stanines 1 thru 3
Third Grade						
Asians n=260	Above level	75	17	8	0	0
	On level	32	14	22	32	1
	Below level	0	13	0	50	38
Whites n=2067	Above level	73	14	11	3	0
	On level	22	19	24	35	1
	Below level	0	2	6	74	19
Blacks n=339	Above level	77	15	0	8	0
	On level	10	7	16	60	6
	Below level	0	0	0	69	31
Hispanics n=135	Above level	64	18	18	0	0
	On level	7	13	19	58	3
	Below level	0	0	0	75	25
Fifth Grade						
Asians n=273	Above level	78	13	7	2	0
	On level	26	19	28	27	0
	Below level	0	5	29	62	5
Whites n=2236	Above level	64	21	10	5	0
	On level	18	19	28	36	0 *
	Below level	4	3	9	75	9
Blacks n=317	Above level	36	32	17	15	0
	On level	8	10	25	56	2
	Below level	0	1	4	76	20
Hispanics n=121	Above level	45	35	10	10	0
	On level	7	12	28	49	3
	Below level	4	0	0	73	23

* Percentage is less than half of one percent.

TABLE 5.21

Performance on the CAT Controlling for Performance in the K-8 Curriculum: Seventh Grade Students by Racial/Ethnic Group

Racial/ Ethnic Gp.	Working Level	% in Stanines 9	8	7	% in Stanines 4 thru 6	% in Stanines 1 thru 3
Asians n=130	Above level	57	29	10	5	0
	On level	12	37	19	30	2
	Below level	5	0	17	76	2
Whites n=1367	Above level	39	29	28	4	0
	On level	12	21	31	36	0 *
	Below level	1	3	14	76	7
Blacks n=234	Above level	**	**	**	**	**
	On level	7	10	28	51	4
	Below level	0	3	9	71	17
Hispanics n=75	Above level	**	**	**	**	**
	On level	14	11	21	54	0
	Below level	2	0	5	77	16

* Percentage is less than half of one percent.

** Percentages are not presented here since the number of students in this group is less than five and the percentage estimates are likely to be unstable. It must be remembered that students working above level in grade 8 are likely to be participating in Algebra 1 and would not be included in the analysis of the K-8 curriculum data.

RELATIONSHIP BETWEEN ACHIEVEMENT AND OTHER VARIABLES

Relationship Between Achievement and Performance in the K-8 Curriculum

As would be expected given the measures of performance that were examined in this chapter, strong relationships are observed between students' performance in the K-8 mathematics program and mathematics achievement. For students in all three grades examined, the relationship between the CRT's, the criterion-referenced measures of achievement in the K-8 curriculum, and the CAT, the norm-referenced achievement measure, hovers around a correlation of 0./ (see Table 5.22). Thus, half the variance found in the CRT scores and half the variance found in the CAT is common variance, i.e., differences in students' scores on the CAT explain half the difference in their scores on the CRT's, and vice versa. The strength of this correlation means that students who do well on the CRT will probably do well on the CAT, and students who do well on the CAT will probably do well on the CRT.[9]

TABLE 5.22

Correlations Between Participation and Performance Variables

Third Grade n=2836	CRT	CAT	ISM Working Level	ISM Problem-Solving
CRT	1.00			
CAT	.71	1.00		
ISM Working Level	.46	.54	1.00	
ISM Problem-Solving	.60	.63	.65	1.00

Fifth Grade n=2937	CRT	CAT	ISM Working Level	ISM Problem-Solving
CRT	1.00			
CAT	.74	1.00		
ISM Working Level	.72	.74	1.00	
ISM Problem-Solving	.68	.69	.86	1.00

Seventh Grade n=1783	CRT	CAT	ISM Working Level	ISM Problem-Solving
CRT	1.00			
CAT	.68	1.00		
ISM Working Level	.76	.69	1.00	
ISM Problem-Solving	.70	.65	.87	1.00

9. "Half" the variance is obtained by squaring the correlation coefficient. (.7) (.7) = .49.

The relationship between measures of day-to-day performance in the curriculum and the achievement measures is moderate in the early grades, but grows stronger over time. At the third grade level the correlation between students' working level in the curriculum and the achievement measures is 0.46 between working level and CRT scores, and 0.54 between working level and CAT scores. Slightly higher correlations are found between students' mastery of the problem-solving assessments and the achievement measures (0.60 and 0.63). However, for students in the fifth and seventh grades, the relationship between the achievement measures, ISM working level, and level of problem-solving assessments mastered was as strong, if not stronger than the relationship between just the measures of achievement. Thus, it appears that performance in the curriculum becomes increasingly important as students move through the grades. This finding suggests that an early emphasis on all aspects of the curriculum, particularly for minority students, might have a payoff in later achievement.

Relationship Between Achievement, Performance in the Curriculum and Other Variables

Chapter 4 presented a discussion of the findings concerning the relationship of mathematics achievement on the CAT and SAT to participation in mathematics courses and other attitudinal and behavioral variables. This section contains the findings of similar factor analyses and regression analyses that were used to investigate the relationship of class performance, attitudes, and behaviors to third and fifth grade CAT performance. Data for these analyses came from data files of CAT performance and survey responses of students in the fourth and sixth grade sample cohorts. There were 277 students in the fourth grade cohort, and 326 students in the sixth grade. Since students in the eighth grade cohort had not taken the CAT since fifth grade, no analyses of CAT scores were performed for this cohort.

Regression Findings for All Students

In both the fourth and sixth grade cohorts, three variables emerged as the most important in relation to CAT mathematics performance. Collectively they explained three-fourths of the variation in students' CAT scores. First, accounting for approximately two-thirds of the variation in CAT scores was students' performance in the K-8 mathematics curriculum. The greater the number of objectives in the curriculum students had mastered, the higher their CAT scores were likely to be. Second, how well students do in their mathematics class is important. The average report card grades in mathematics for the most recent three school years added important information about how students were likely to do on the CAT, and brought the amount of explained variation in CAT scores up to approximately 75 percent. Finally, students in schools that had high CAT scores, overall, tended to do better in CAT mathematics. However, this last variable only contributed a small amount towards what was known about CAT mathematics performance.

Regression Findings by Gender

Separate regression analyses for females and males show that participation in the K-8 curriculum and doing well in mathematics class are important variables in the CAT performance of both gender groups (see Table 5.23). In addition to these variables, several other variables were found to contribute small, but statistically significant information to what is known about CAT performance. These variables, which relate to the socio-economic status of students at the school level, include: average performance of students within the school on the overall CAT battery, average income level of students' families at the school level, and average number of years experience of teachers in the school.

Regression Findings by Racial/Ethnic Group

Analyses of CAT performance by racial/ethnic group membership yield similar results to those found by gender (see Table 5.24). Participation in the K-8 curriculum, doing well in mathematics classes, and a few school-related variables account for the majority of the variation in CAT performance among students. It is interesting that Black students who attend high-achieving elementary schools appear to benefit considerably from attending these schools in the early elementary grades. Over ten percent of the variation in the third grade CAT scores of Black students can be attributed to differences in overall achievement at the school level. However, this advantage seems to disappear by the time the CAT is administered in fifth grade.

SUMMARY

In Chapter 4 large differences were reported in the high school course-taking patterns of Asian, White, Black, and Hispanic students, and relatively small differences were found for male and female students. Based on these findings, large racial/ethnic group differences were expected in the mathematics experiences of elementary and junior high/middle school students, and few differences were expected by gender.

For the most part, the findings presented in this chapter confirmed these expectations. Asian and White students performed at a higher level in the K-8 curriculum than did Black and Hispanic students. Moreover, this pattern started very early in elementary school, and was observed in all grade levels as students progressed through the elementary and junior high/middle school grades. The evidence suggests that once a student falls below the standard level of performance for his/her grade level, he/she is likely to never catch up to the grade level standard in the curriculum again. This pattern is especially true for Black and Hispanic students. Male and female students, on the other hand, performed at about equal levels in the County's K-8 curriculum.

Mathematics achievement, as measured by students' scores on the CRT's and CAT, varied by racial/ethnic group, with Asian and White students outperforming Black and Hispanic students. This pattern was found as early as the third grade, the first time students are tested on the CAT, and continued through grade 7. When level of performance in the K-8 curriculum is taken into account, differences in CAT performance by racial/ethnic group diminish. However, Black students typically performed below students in the other three racial/ethnic groups on the CAT, even when students were stratified by working level in the curriculum. What few gender differences were detected were minor relative to the magnitude of the racial/ethnic group differences.

TABLE 5.23

Amount of Variation in CAT Mathematics Scores Explained Through Regression Analysis on Several Variables: by Gender and Overall, Grades 4 and 6

	Percentage of CAT Score Variation Explained		
Related Variable	Overall	Females	Males
Fourth Grade			
Number of objectives mastered in the K-8 curriculum	67	72	64
Average mathematics grade for the past three years	6	6	5
Average CAT total battery score in the school	3	--	4
Average income level of families in the school	--	2	--
Mathematics problem-solving strategies *	1	1	--
Teacher experience	--	--	3
Total	77	81	76
Sixth Grade			
Number of objectives mastered in the K-8 curriculum	63	57	68
Average mathematics grade for the past three years	9	11	7
Average CAT total battery score in the school	1	--	2
Utility of mathematics *	--	2	--
Total	73	70	77

* This item was a scale score representing one of the factors obtained in the factor analysis of student attitudes and beliefs.

TABLE 5.24

Amount of Variation in CAT Mathematics Scores Explained Through Regression Analysis on Several Variables: by Racial/Ethnic Group, Grades 4 and 6

Related Variable	Percentage of CAT Score Variation Expl[illegible]ned			
	Asians	Whites	Blacks	Hispanics
Fourth Grade				
Number of objectives mastered in the K-8 curriculum	68	69	61	62
Average mathematics grade for the past three years	--	4	5	19
Average CAT total battery score in the school	--	--	11	--
Average education of teachers in the school	5	--	--	--
Teacher experience	3	--	--	--
Mathematics problem-solving strategies *	--	3	3	--
Mathematics anxiety *	--	2	--	--
Total	76	78	80	81
Sixth Grade				
Number of objectives mastered in the K-8 curriculum	6 **	72	6[illegible]	68
Average mathematics grade for the past three years	61 **	3	3	10
Average CAT total battery score in the school	4	--	--	--
Teacher experience	--	5 ***	--	--
Total	71	80	65	78

* This item was a scale score representing one of the factors obtained in the factor analysis of student attitudes and beliefs.

** Note these variables were reversed in order of importance for Asian students.

*** Students in schools with less teacher experience did better on the CAT.

A disturbing pattern was observed regarding students' report card grades in mathematics class. While students in the four racial/ethnic groups had fairly similar mathematics grades in early elementary school, differences emerged and grew wider as students progressed through school, with Black students consistently having the worst grades. By gender, female students had slightly higher grades than males.

The elementary and junior high/middle school data suggest a troublesome pattern of progress, performance, and rewards for performance of Black and Hispanic students compared to Asian and White students. Given the hierarchical nature of mathematics instruction, with such large differences emerging as early in students' educational careers as the data indicate, one could predict the large differences in participation and performance that are found at the high school level.

Moreover, the data clearly show that participation in the mathematics curriculum is strongly related to performance on achievement tests. Additionally, doing well (getting good grades) in the curriculum enhances this relationship. Thus, students who do not progress at a steady rate or whose progress is less than satisfactory are likely to achieve less well on measures of mathematics achievement than their peers.

We suggest once again, then, that school systems can maximize students' ability to perform well on standardized tests by ensuring in all ways possible that students participate to the fullest in the curriculum that is offered. We must ensure that classroom atmospheres are nurturing enough that students maintain positive attitudes towards mathematics and themselves as competent mathematicians. But, most importantly, extreme and heroic efforts must be taken in the early elementary grades to ensure that students do not fall below grade level in mathematics. Those who begin to slip must be given every opportunity to be brought back up to grade level standard as quickly as possible.

The data strongly suggest that, for all students to have equal opportunities to pursue mathematics in high school and beyond, these actions must take place as early as grades 1 and 2 in school. To wait until third or fourth grade to begin remediation activities may be too late.

SECTION III:

FINDINGS RELATED TO ATTITUDES AND BELIEFS ABOUT MATHEMATICS
BY GENDER AND RACIAL/ETHNIC GROUP

STUDENTS' ATTITUDES AND BELIEFS ABOUT MATHEMATICS: THE RELATIONSHIP TO PARTICIPATION AND PERFORMANCE BY GENDER AND RACIAL/ETHNIC GROUP

BACKGROUND

The previous two chapters presented the mathematics participation and performance history of County students. Attitudinal and behavioral characterists of the students were also explored, to investigate their relationship to participation and performance in mathematics. The results of statistical analyses showed that participation in the mathematics curriculum was the variable that was most closely related to performance of students on standardized and criterion-referenced achievement tests. However, the analyses also demonstrated that there was a significant relationship between students' attitudes about mathematics and how likely they were to persist in the mathematics curriculum. Thus, for students included in this study, there appears to be a strong link between attitudes, participation in the curriculum, and ultimate performance on achievement measures. Chapter 2 presented findings from the most recent research efforts which also suggested strong links between participation and performance on the one hand, and how students feel about themselves and mathematics on the other hand.

This chapter presents the students' attitudinal and behavioral data as they relate to mathematics participation and performance by gender or racial/ethnic group. These data were gathered through surveys of students in the four sample cohorts: students in fourth, sixth, eighth, and twelfth grades. There were approximately 300 students in the fourth, sixth, and eighth grade cohorts, and almost 600 in the twelfth grade cohort.

The discussion in this chapter explores students' reported feelings about mathematics from several different perspectives: liking of mathematics; competence in mathematics; mathematics anxiety; utility of mathematics for a career or in life in general; and the suitability of mathematics for both females and males. The discussion also presents students' perceptions of the supports they receive from the home and school in learning mathematics. Also included are actual quotes obtained from students in the surveys and from focus groups that were conducted with eighth, eleventh, and twelfth grade students.[1] These comments are added where relevant in elaboration of the statistical data and to show the depth of feeling expressed by the students.

Voluminous data were gathered from the students to support this chapter. The discussion that follows presents these data in summary form, highlighting the statistically significant differences, where they were observed, across the four cohorts by gender or racial/ethnic group membership. If no discussion is presented illustrating such differences, the reader may assume that no significant differences were found, or that at most, only isolated,

1. Focus groups (structured group discussions with up to 10 students at a time) were used to stimulate group sharing of common beliefs and concerns. Each focus group was made up of students of the same gender, racial/ethnic group, and level of achievement in mathematics.

unrelated differences were observed. Detailed responses to all survey questions are contained in the appendix to Chapter 6.

It may be recalled that students were selected for the four cohort groups in a stratified random selection process, so that each gender and racial/ethnic group would have students of similar achievement histories. This selection process resulted in each gender and racial/ethnic group having approximately the same distribution of mathematics achievement among its students.

The purpose of this stratified selection process was to separate the potential relationship of achievement and experiences in mathematics from the effects of other variables which might contribute positively or negatively to the mathematics experiences of different gender or racial/ethnic group students. By so doing, we may assume that attitudinal or behavioral differences that are observed between gender or among racial/ethnic groups are unrelated to achievement differences among the students. In fact, the null hypothesis would suggest that, if the educational process operates in the same way for students of different gender and racial/ethnic groups, there should be no differences among the gender and racial/ethnic groups in attitudes or behaviors concerning mathematics once achievement differences are controlled for. Accepting this null hypothesis, we may assume that any differences that do emerge in attitudes or behaviors among these groups are indeed indicative of different experiences and/or beliefs.

The findings from analyses of the survey responses suggest that females and Blacks have had experiences related to mathematics that are different from those of the other gender or racial/ethnic groups, and they hold different beliefs. These differences occur regardless of the achievement level of the students.

FINDINGS BY GENDER

Differences were found by gender in students' feelings of competence in mathematics, amount of help needed in mathematics, perceptions of the utility of mathematics, and whether or not they they participated in activities which might foster mathematical or problem-solving skills. Finally, students of both genders reported turning to their fathers more often for help with mathematics problems, and typically reported that their mothers were not good in mathematics.

Competence in Mathematics

In general, females and males expressed equal confidence in their performance on mathematics tests and homework, however, females perceived that they needed assistance with mathematics homework or tests more often than males. Females and males felt equally willing to ask questions in mathematics class. After fourth grade, however, there were statistically significant differences in females' and males' perceptions concerning whether or not they had a good mind for mathematics (see Table 6.1). These differences exist despite the evidence that females do as well as males on the standardized mathematics tests given throughout their school years (with the exception of the SAT), get better grades in mathematics classes than males, and participate in the same levels of mathematics courses as males through most of high school.

TABLE 6.1

Students' Feelings Concerning Whether or Not They Had a Good Mind for Mathematics by Gender: Students in Grades 4, 6, 8, and 12

Gender	4th Graders Saying "Yes" %	N	6th Graders Saying "Yes" %	N	8th Graders Who SA or A %	N	12th Graders Who SA or A %	N
Females	59	(80)*	40	(65)	67	(109)	51	(145)
Males	69	(97)*	62	(97)	75	(114)	62	(183)

* The difference in male and female perceptions in fourth grade is not statistically significant.

NOTE: In fourth and sixth grades the statement was worded "I am smart in math."

Comments of male and female students are quite revealing. Theresa, an eleventh grader in Pre-calculus, stated, "Compared to other students in my class, I don't think I do as well." Although Theresa is participating in mathematics at an accelerated level, she does not feel competent in mathematics. Some of Theresa's male classmates suggested that female students place too much emphasis on the grades they receive. Marc, a Calculus student, reported, "In Calculus, there were some females in class, and we did about the same - C work. So I guess they felt, 'I'm not going to make it,' and dropped out." However, Jonathan, an eighth grader, asserted simply, "Boys are more interested in math and perform better."

Lorraine, another twelfth grader in advanced level mathematics, approached females' perceptions of their abilities in mathematics from another angle. "There's an attitude that girls can't do math," she said. "After a while you start to believe it. I don't really think this is true, but subconsciously you might believe it. It's the stereotype."

Other females in Lorraine's class felt that males were not innately more adept than females but received more encouragement to perform well. "They're pushed more, and teachers pay more attention to them. There's more pressure on White males to perform in math than there is on us," reported Susan. According to Herb, however, "In this area boys and girls have an equal chance. I lived in the middle of nowhere for a couple of years, and there girls aren't supposed to learn anything. They're not encouraged in school at all. Boys aren't encouraged that much either, but girls definitely are not encouraged. It's different here."

Utility of Mathematics

Comments from females and males indicate that females tend to see higher level mathematics courses as a means to an end, whereas males see these courses as closely related to their career goals. According to Mary, who plans on taking four years of mathematics in high school, "Some colleges will look at your transcript and say, 'She has a lot of advanced math.' I'm not going into math, but I know they (the colleges) want to see it." Her classmate Erica agrees, "I'm not into math and analytical things. I do math because I have to do it. It's something you need to know." Peter expresses the feeling of many males who see science and technology as good places to find jobs when they finish their schooling. "I plan to major in engineering," he said. "That's where jobs are opening up." It may be recalled that the discussion in Chapter 4 illustrated large differences in the career aspirations of female and male students. Males indicated preferences for careers in science, technology, mathematics, and management more often than females, whereas females preferred careers in other professional areas such as law and other social science domains.

Mathematics as a Male Domain

Students' responses to survey questions that address mathematics as a male domain and the importance of careers for men and women illustrate that males and females have different views of mathematics. In the early grade levels, and continuing through secondary school, a higher percentage of students felt men needed to know a lot of mathematics, compared to the percentage who felt women needed to know a lot of mathematics. For the fourth, sixth, and eighth grade cohorts, about twenty percent more students felt men needed to know mathematics, compared to the percentage feeling this way about women. It is only in the twelfth grade cohort that the percentages feeling that men and women needed mathematics were similar. Additionally, larger percentages of students in the fourth and sixth grade cohorts, compared to those in the eighth and twelfth grades, felt that men made better scientists and engineers than women.

The data suggest that these views of mathematics are learned at an early age. However, as they grow older students' perceptions change somewhat. Perhaps it is through the educational process that students begin to see the utility of mathematics for both males and females and recognize that people of both sexes can perform well in mathematics.

Table 6.2 contains the gender differences in responses to mathematics as a male domain questions. Across all four cohorts, statistically significant gender differences were observed concerning whether males were better than females in mathematics, men made better scientists and engineers than women, and women needed to know a lot of mathematics. The data show a disturbing proportion of male students who feel that boys are better in mathematics than girls and that men make better scientists and engineers than women.

Participation in "Male" or "Female" Activities

The data concerning the types of activities students engage in after school are not surprising, but are nonetheless disturbing in their evidence con-

TABLE 6.2

Gender Differences in Perceptions of Mathematics as a Male Domain: Students in Grades 4, 6, 8, and 12

	4th Graders Saying "Yes"		6th Graders Saying "Yes"		8th Graders Who SA or A		12th Graders Who SA or A	
Gender	%	N	%	N	%	N	%	N
Boys are better at math than girls								
Females	0	(0)	2	(3)	4	(6)	8	(24)
Males	28	(40)	26	(41)	11	(17)	14	(40)
Men make better scientists and engineers than women								
Females	21	(28)	13	(22)	6	(10)	9	(25)
Males	45	(64)	33	(52)	17	(26)	21	(61)
Women need to know a lot of math								
Females	28	(48)*	39	(64)*	46	(75)	53	(150)
Males	32	(45)*	31	(49)*	33	(51)	39	(116)

* The difference in male/female perceptions in fourth and sixth grade is not statistically significant regarding the need for women to know a lot of math.

cerning the types of activities students pursue. Female students reported significantly more often that they used recipes in cooking and baking; sewed, knitted or did other needlework; did crossword puzzles; and did jigsaw puzzles. Male students, on the other hand, significantly more often used a home computer; used home chemistry sets; made model cars, trains, planes, etc.; played games of strategy such as chess, checkers, and Dungeons and Dragons; and played team sports such as soccer, football, and baseball.

Moreover, whereas males were likely to be interested in participating in sports teams in school or joining computer clubs and the like, females were much more likely to want to leave school when the bell rang and go home, get together with their friends, or shop. While these activities may or may not be directly related to proficiency in mathematics, some research findings suggest that being involved in activities that involve problem-solving or planning strategies may have some spin-off in the ability to tackle mathematical problems.

What the data show, in any case, is that females tend to do "female things" and males tend to do "male things." To the extent that mathematics is presented to females as a male domain, this mind set of females doing "female things" is bound to interfere with female students' acceptance of the utility of mathematics in their lives. This feeling is graphically stated by Jane, an eighth grader who complained about her Algebra 1 class, "I can't relate to motion problems because they have nothing to do with anything I'm interested in."

Supports for Mathematics in School

Students perceive their teachers as most important in their lives in school. While over half the students in eighth and twelfth grade felt they had had good mathematics teachers, several of the female students blamed previous teachers for their lack of success in mathematics. According to Mary, "In elementary school I never had to do anything and I passed. Then in high school I didn't know what I was doing, so I flunked it." "My Algebra 1 teacher never did anything, so I didn't learn what I was supposed to," added Jane.

Students in all four cohorts were asked to provide information about teachers' support of female students in mathematics, in particular, instances in which teachers might have provided the impression to students that female students were not as good as males in mathematics. The students reported that about 10-15 percent of their teachers had commented that girls were not good at mathematics and/or boys were better at mathematics than girls. However, about 15-25 percent of the students indicated that they had heard their teachers make positive comments about girls as mathematics learners.

Few students saw their school counselors or principals as influencing males and females differently in mathematics participation.

Supports for Mathematics in the Home

Eighth and twelfth grade students were asked to report the kinds of help they received in mathematics at home, and who, in their families, were good in mathematics. Half the eighth graders and 40 percent of the twelfth graders indicated that their fathers were good in mathematics. Less than one-third of the eighth graders and only 15 percent of the twelfth graders felt their mothers were good in mathematics, however.

Comments from students support these percentages. "If I have a problem I go to my dad," stated Mary. "My mom is a nurse. She didn't go far in math." Her friend, Angela agreed, "My mom always helped me when I was in elementary school. She still helps my brothers and sisters. As we get older and take higher math (junior high and high school mathematics), my dad helps us." Amy summed up the conflict between her parents regarding mathematics. She said, "My mother says I can stop taking math. My father says I should take more, I might learn to like math. My mother hated math. I hate it too." Mary, Angela, and Amy were all working below level in mathematics.

Perceptions of their mothers' capabilities in mathematics may well influence students' feelings regarding the utility of mathematics for females. Whether or not overt statements are made in the home concerning the ability of females to perform well in mathematics, the students have observed their mothers, the primary female role models in their lives, living useful lives without mathematics. One can infer without too much imagination that in homes where mothers express the feeling that they are not good in mathematics, female students would also tend to feel this way about their own abilities in mathematics.

FINDINGS BY RACIAL/ETHNIC GROUP

Racial/ethnic group differences were found in students' liking of and perceived utility of mathematics. In light of performance and participation differences illustrated in Chapters 4 and 5, Black students expressed a surprisingly strong liking of and perceived utility of mathematics.

Liking of Mathematics

Overall, the majority of students in the County expressed a liking for doing mathematics problems. More than half of the students in each of the four cohort groups thought mathematics was fun. However, students' liking of mathematics <u>classes</u> diminishes as they progress through school. The wish to pursue mathematics in the future also changed as students moved through their school careers. Racial/ethnic group differences were observed in students' liking of mathematics.

Three items expressing students' liking for mathematics emerged with consistently significant racial/ethnic group differences in responses: the best part of my day is math, I would like to have a job using math, and math is fun (see Table 6.3). Examination of the data indicates a fairly consistent pattern of agreement with the statements across the four cohorts, with Asian students agreeing most frequently, White students agreeing least frequently, and Black and Hispanic students in the middle.

The fact that Asian students were uniformly more positive than any other group is not that surprising, given their history of proficiency in mathematics. What is somewhat surprising is the level of commitment to mathematics shown by Black students, especially in light of their underenrollment in higher level mathematics classes in the County and the disparity in grades they received from teachers, both of which were discussed in the previous two chapters.

Comments from Black students, especially from those in the advanced level mathematics classes, help explain their feelings of the importance of education and the need for advanced mathematics. These students intend to become professionals, and financial prosperity is a strong motivator for their career choices and commitment to school. They see mathematics as one of the subjects needed to pursue this path.

Will, a Black twelfth grader taking Calculus, stated, "No one is going to accept a standard of living lower than what they've been brought up in. My parents went through years of school to get to where they are. I know I'm going to have to go through years of school too." His classmate Dionne added, "My parents said, 'Look, you're a Black female, you're going to have to push more to get what you want in life and there are going to be a lot of people pushing you down.'" Neither Will nor Dionne plans on a mathematical or scientific career, but they have both taken four years of mathematics in high school.

TABLE 6.3

Racial/Ethnic Group Differences in the Liking of Mathematics: Students in Grades 4, 6, 8, and 12

Racial/Ethnic Group	4th Graders Saying "Yes"		6th Graders Saying "Yes"		8th Graders Who SA or A *		12th Graders Who SA or A *	
	%	N	%	N	%	N	%	N
The best part of my day is math								
Asians	57	(37)	47	(39)	36	(30)	29	(31)
Whites	44	(38)	22	(19)	15	(12)	8	(17)
Blacks	52	(35)	31	(26)	28	(25)	18	(24)
Hispanics	47	(26)	27	(19)	26	(17)	17	(22)
I would like to have a job using math								
Asians	53	(34)	51	(42)	35	(29)	36	(39)
Whites	35	(30)	24	(20)	23	(19)	22	(46)
Blacks	45	(30)	30	(25)	30	(27)	20	(26)
Hispanics	47	(27)	31	(22)	22	(14)	18	(24)
Math is fun								
Asians	77	(49)	71	(59)	68	(56)	58	(63)
Whites	65	(56)	48	(41)	40	(32)	43	(89)
Blacks	69	(46)	58	(48)	61	(55)	50	(67)
Hispanics	71	(41)	49	(35)	48	(30)	48	(63)

* SA = strongly agree, A = agree.

Supports (or Lack Thereof) for Mathematics in the School

Black students who were working at accelerated levels in mathematics felt they were not viewed by their teachers as being as capable as their Asian and White peers. "It seems like whatever you do, every year when you come into a school or into a different class, the first thing you have to do is prove to the teacher that you belong in there and that they don't have to talk down to you," stated Clarence, a Calculus student. Robert, also a Calculus student added, "I got mad when the teacher acted surprised that James (his friend) got a 750 on the SAT. He made it sound like, 'How can this Black boy get a high score like that?' From then on he would try to pick on James. 'Why don't you do this one, you got a 750 on math?'"

Other Black students felt they had to perform better than their White classmates to be recognized in mathematics. George, an eleventh grader, stated, "I was told in ninth grade by my math teacher that I shouldn't try to take Algebra 2 with Trigonometry (the accelerated course) in tenth grade. But I was still getting A's in Geometry. With my teachers, I have to do 100 percent, compared to a White boy's 95 percent. I don't think it's fair, but I don't think it's going to change."

When asked who had offered support or encouragement to them to participate in mathematics courses or pursue careers in mathematics, few students in the eighth and twelfth grade cohorts reported they had received support or encouragement from their teachers. However, a large proportion of the students indicated that they discussed various aspects of their schooling, such as grades, test scores, and classes with their guidance counselors. Only four percent of the eighth graders and six percent of the twelfth graders reported, nonetheless, that a counselor had been instrumental in influencing them towards a career in mathematics or science. What is interesting is that the majority of the students who commented on the counselor's influence were non-White.

Support (or Lack Thereof) for Mathematics from Peers

Many students reported receiving comments from their friends indicating that it is not "cool" to participate in higher level mathematics classes. Black students reported feeling this pressure, and also expressed their sense of isolation and concern about being the only Black or one of a handful of Black students in an honors-level class.

Paul, an eleventh grader in Pre-calculus commented, "It's getting better now that more Blacks are coming into the higher academic classes. When we were sophomores they were far and few between. I'm glad to see more Blacks taking the classes and working together. In the past there were just two of us and we had to stick together." Martin, a twelfth grader, agreed, "In Pre-calculus, I was the only Black in the class. I would not go to a White person and tell them I didn't understand." Finally, according to Walter, "You really don't want to think about the color thing, but you're Black, and it is rare in this school to be in an honors class (if you are Black). And you just want to prove, 'I have intelligence and we're not all dumb.' I can do it just like the White people."

SUMMARY

In this chapter we have looked at the attitudes and beliefs of students towards mathematics. Clear differences were observed in how the students feel about mathematics and themselves as mathematics performers.

Female students seem to be less confident in their abilities in mathematics than their male counterparts. They also turn to others more frequently for help than do males. A surprisingly large group of males reported that they were better in mathematics than females. Additionally, male and female students alike reported that their mothers were not as good in mathematics as their fathers were. Finally, female students view the utility of mathematics differently than males do. Whereas males view mathematics as important for their career goals, females tend to view mathematics as just one of the academic subjects needed for entry into a good college or university.

These differences in the attitudes and beliefs of males and females may help to explain some of the differences in their SAT performance in mathematics.

Few racial/ethnic group differences in students' attitudes towards mathematics were observed. What was observed, however, was a deep commitment on the part of high achieving Black students to do well in mathematics so they could move on to good colleges and professional careers. Additionally, Black students reported feeling of frustrated regarding incidents they felt were caused by racism or lower expectations on the part of teachers. These findings indicate that there are concerns that must be addressed regarding Black students' perceptions of their treatment in the school setting.

THE HOME ENVIRONMENT - PARENTAL ATTITUDES, BELIEFS, EXPECTATIONS, AND SUPPORT: ITS EFFECT ON STUDENTS' MATHEMATICS PARTICIPATION AND PERFORMANCE BY GENDER AND RACIAL/ETHNIC GROUP

BACKGROUND

The previous chapter examined students' gender and racial/ethnic group differences in attitudes and beliefs regarding mathematics and themselves as mathematics performers. The data illustrated a few important differences among students in their attitudes and beliefs. By gender, interest in and liking of mathematics in the early grades was similar for males and females. However, female students reported feeling less confident about their abilities in mathematics than males, and males felt they were better in mathematics than females. Both groups perceived their fathers to be better in mathematics than their mothers.

By racial/ethnic group, Asian students were the most positive about mathematics. However, the data illustrated a commitment to and interest in higher level mathematics among Black students that was not anticipated, given the underrepresentation in high level courses and relatively poor mathematics grades of Black students in general.

Research repeatedly has illustrated that attitudes and beliefs of students are very much influenced by those around them -- their peers, their teachers, and particularly their parents. As will be documented in the chapter in Volume II that addresses student responses, the students singled out support and encouragement from their parents as the most important influencing factor in their desire to do well in school and persist in higher level mathematics.

This chapter examines the attitudes and beliefs of parents regarding mathematics and mathematics education, as they relate to differences observed by gender or racial/ethnic group membership. As was the case in Chapter 6, only statistically significant findings are presented in the text of this chapter. Detailed responses to the parent surveys are contained in the appendix to Chapter 7.

FINDINGS RELATED TO GENDER DIFFERENCES

Responses from parents indicate that there is some similarity in the way students and parents feel about mathematics for females. Somewhat more male parents than female parents feel that males are better in mathematics than females, and parents are more inclined to notice an early interest in mathematics on the part of their sons than their daughters. Several female parents readily admitted being inadequate mathematics performers, which is consistent with students' assessments of their parents' abilities. Additionally, more fathers than mothers help their children with mathematics homework in advanced level classes. Finally, parents are less likely to want their daughters to pursue education or careers in mathematics, science, or technology than they are to want their sons to pursue education and careers in these areas.

Mathematics As A Male Domain

Most of the parents reported that they felt that mathematics was important for both male and female students. They also recognized the fact that most people needed careers today. Two-thirds to three-fourths of the parents did not agree with the statements "boys are better at math than girls," "men make better scientists and engineers than women," and "men make better math teachers than women." Additionally, almost all parents agreed that women needed careers as much as men did. However, there remains a group of about one-fourth to one-third of the parents who indicated that males were better in mathematics and made better scientists and engineers than females. As was the case for the students themselves, male parents were more likely to attribute better mathematics skills to males than were female parents.[1] Moreover, parents, overall, were more likely than students to see mathematics as a male domain.

Parents' Perceptions of Their Children's Early Interest in Mathematics

With the exception of parents of twelfth graders, the parents of male students were significantly more likely to report that their children had an early interest in mathematics or computers than parents of females (see Table 7.1). Whereas three-fourths of the parents of males in grades four, six, and eight recognized an early interest in mathematics on the part of their children, slightly more than half of the parents of females observed this early interest.

TABLE 7.1

Parents' Perceptions of Students' Early Interest in Mathematics, Computers, and Mechanics: by Grade Level and Gender

Gender	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Female	61	56	48	38 *
Male	76	82	71	48 *
Number of Parents	135	126	128	232

NOTE: Numbers in table are percentages of parents who responded "yes."

* This difference is not statistically significant.

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1. Although it was possible to analyze parents' responses to these items by students' gender, this was not done. Since parents of males in this study might have female children as well, and vice versa, we could not be sure that the answers obtained referred solely to the specific child in our study cohort.

Parents' Perceptions of Their Own Competence in Mathematics

Differences in parents' perceptions of their own competence in mathematics were observed when parents' gender was considered. For each grade level cohort, 10-20 percent more fathers than mothers agreed that they had a good mind for mathematics. Approximately 70 percent of the mothers felt they had a good mind for mathematics, compared to about 90 percent of the fathers. Differences in the percentages were statistically significant for grades four and eight, and were almost significant for grades six and twelve. These differences help support the feelings expressed by the students that their mothers were not as good in mathematics as were their fathers.

Parents' Reports of Who Helps Students With Homework

The extent to which parents are involved in their children's homework can be instrumental in conveying to the students the importance of mathematics in their lives. The majority of the parents reported that someone in the household regularly helped the students with homework or studying for tests. In the early grades this person was more likely to be the mother than the father, but as students got into the higher grades, the father was the more likely helper. Parents reported that this was because the father was the person in the household who was best in mathematics (see Table 7.2).

Specifically, parents of fourth graders reported that 54 percent of the mothers helped with mathematics homework, compared to 40 percent of the fathers. By eighth grade, 27 percent of the mothers helped, compared to 38 percent of the fathers. And, in twelfth grade, only 19 percent of the mothers helped, compared to 33 percent of the fathers.

TABLE 7.2

Parents' Reports of Who Helps Student With Homework and Why: Grades 4, 6, 8, and 12

Parent who Helps/ Reason Parent Helps	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Mother Helps	54	37	27	19
Mother Better at Math	12	20	39	44
Mother Better with Student	8	11	8	6
Mother Only One Available	65	61	56	29
Father Helps	40	41	38	33
Father Better at Math	30	45	70	70
Father Better with Student	11	10	4	6
Father Only One Available	11	35	24	14

NOTE: Percentages for reasons parent helped do not add to 100 because there were other miscellaneous reasons given for helping.

Parents' Educational Goals for Their Children

The research literature suggests that there is a relationship between parents' educational expectations for their children and what the children actually accomplish. The students who participated in this study's cohort samples reported that their parents played an important role in shaping their educational and career goals.

Over 90 percent of the parents would like their children to obtain a minimum of a bachelor's degree in college. Forty percent would like their children to earn a master's degree or doctorate as well. With the exception of parents of fourth grade students, there were no statistically significant differences in parents' educational goals for their children based on the students' gender. In fourth grade, however, parents of males had significantly higher educational goals for their children than did parents of females (see Table 7.3).

TABLE 7.3

Fourth Grade Parents' Educational Goals for Their Children by Gender

Students' Gender	Doctorate	Master's Degree	Bachelor's Degree	Some College
Females	31	8	52	9
Males	35	23	42	0

NOTE: Numbers in table are percentages of parents who picked each choice.

Employment Goals

The data show that parents of female students have different career goals for their children than do parents of male students (see Table 7.4). Whereas almost twice as many parents of males would like to see their children pursue mathematical or scientific careers than would parents of females, more parents of females than parents of males would like their children to enter other professions not requiring mathematics or science.

With the exception of students who took Calculus or Pre-calculus, parents of females participating at all levels in the curriculum indicated that they preferred non-technical careers for their children more often than did parents of males. Thus, for all levels of participation in the curriculum except for the most advanced, male students appear to be receiving more encouragement from their parents to consider mathematical or scientific careers than female students.

TABLE 7.4

Parents' Employment Goals for Their Children by Gender:
Grades 4, 6, 8, and 12

Employment Goal	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Mathematics, Science, Engineering Professions				
Females	18	12	23 *	16 *
Males	34	30	36 *	29 *
Other Professions				
Females	33	54	47 *	34 *
Males	34	22	29 *	27 *
Management or Administration				
Females	8	2	3 *	15 *
Males	11	2	3 *	11 *
Clerical, Sales, Services, etc.				
Females	41	32	28 *	35 *
Males	20	46	32 *	33 *

* Differences in the employment goals of eighth and twelfth grade parents are not statistically significant when analyzed by students' gender.

FINDINGS BY RACIAL/ETHNIC GROUP

Parents' responses by racial/ethnic group indicate that mathematics is considered important by all groups of parents. Parents in all racial/ethnic groups have high educational and career goals for their children. What is surprising is the depth of commitment towards mathematics expressed by Black parents; a commitment that is not generally reported in the research literature. This section presents differences in responses of parents by racial/ethnic group.

Students' Need to Persist in High Level Mathematics

Statistically significant racial/ethnic group differences were found in parents' perceptions regarding who should persist in high level mathematics. Black and Hispanic parents were significantly more likely than Asian and White parents to agree that all students needed to take as much mathematics as possible (see Table 7.5). Black parents were least likely to agree that students should take high level mathematics courses only if they could get an A or B in the course. These feelings on the part of Black parents are consistent with the commitment towards mathematics that was observed among Black students in the previous chapter.

TABLE 7.5

Parents' Perceptions of Students' Need to Persist in Mathematics: by Students' Grade Level and Racial/Ethnic Group

Grade Level	% Asian Parents	% White Parents	% Black Parents	% Hispanic Parents
Students should take as much math as possible regardless of their career goals				
Fourth Grade	74 *	69 *	90 *	87 *
Sixth Grade	65	71	80	86
Eighth Grade	78	67	94	88
Twelfth Grade	78	60	80	82
Students should take honors or advanced math classes only if they think they can get an A or B				
Fourth Grade	35	24	7	42
Sixth Grade	36	24	21	36
Eighth Grade	41	29	3	40
Twelfth Grade	50	13	20	37

NOTE: Numbers in table are percentages of parents who strongly agreed or agreed with the statement. These percentages are based on cell n's of 30-40 for the fourth, sixth, and eight grade cohorts, and 45 or more for twelfth grade.

* The difference among fourth grade parents on this item is not statistically significant by racial/ethnic group.

Mathematics As A Male Domain

Statistically significant differences were observed among parents from the various racial/ethnic groups regarding how they viewed males and females in mathematics. While the findings are not altogether consistent across the four grade level cohorts, in general, Asian and Hispanic parents seem to be more likely to view mathematics as more of a male-oriented domain than do White and Black parents (see Table 7.6).

TABLE 7.6

Parents' Perceptions of Mathematics As A Male Domain:
by Students' Grade Level and Racial/Ethnic Group

Grade Level	% Asian Parents	% White Parents	% Black Parents	% Hispanic Parents
Boys are better at math than girls				
Fourth Grade	35	17	17	42
Sixth Grade	48	34	17	18
Eighth Grade	47 *	32 *	27 *	20 *
Twelfth Grade	28 *	19 *	16 *	27 *
Men make better scientists and engineers than women				
Fourth Grade	41 *	14 *	24 *	26 *
Sixth Grade	50 *	29 *	24 *	36 *
Eighth Grade	41	15	18	36
Twelfth Grade	46	17	18	36
A woman needs a career as much as a man does				
Fourth Grade	91	98	100	97
Sixth Grade	94 *	90 *	97 *	97 *
Eighth Grade	81	92	97	100
Twelfth Grade	85	92	100	94
Men make better math teachers than women do				
Fourth Grade	15	19	3	26
Sixth Grade	10 *	8 *	14 *	18 *
Eighth Grade	28	5	15	12
Twelfth Grade	22 *	8 *	6 *	11 *

NOTE: Numbers in table are percentages of parents who strongly agreed or agreed with the statement. These percentages are based on cell n's of 30-40 for the fourth, sixth, and eight grade cohorts, and 45 or more for twelfth grade.

* Differences among racial/ethnic groups within a grade level where asterisks are present are not statistically significant.

Perceptions of Mathematics Teachers

Parents were asked to provide their perceptions of the mathematics teachers who had taught their children. Their responses indicated that some parents were very pleased with the mathematics teachers their children had had, while others were not so pleased. Parents from the four racial/ethnic groups differed significantly in their perceptions of the mathematics teachers who had taught their children (see Table 7.7). In general, Black and White parents were most likely to report that their children had been taught by outstanding teachers, and they were also most likely to report that their children had been taught by ineffective teachers. In Asian and Hispanic cultures the teacher is considered a person of great authority and usually is not questioned. It is possible that the differences observed among parents in this study reflect these cultural differences rather than any differential treatment provided to their children by the teachers or the school system.

TABLE 7.7

Parents' Perceptions of Mathematics Teachers Their Children Had: by Students' Grade Level and Racial/Ethnic Group

Grade Level	% Asian Parents	% White Parents	% Black Parents	% Hispanic Parents
Student Had Outstanding Mathematics Teacher(s)				
Fourth Grade	41 *	33 *	48 *	29 *
Sixth Grade	33	42	62	64
Eighth Grade	28	41	44	28
Twelfth Grade	17	35	38	40
Student Had Bad Mathematics Teacher(s)				
Fourth Grade	6	26	28	10
Sixth Grade	13	32	28	11
Eighth Grade	13	31	23	12
Twelfth Grade	20	33	42	31

NOTE: Numbers in table are percentages of parents who strongly agreed or agreed with the statement. These percentages are based on cell n's of 30-40 for the fourth, sixth, and eight grade cohorts, and 45 or more for twelfth grade.

* This difference among racial/ethnic groups is not statistically significant.

Parents' responses concerning their interactions with teachers varied as well. While almost half of all parent respondents believed that teachers were always right in evaluating their children's mathematics ability, approximately 90 percent of the parents indicated that they would question a teacher if they disagreed with the teacher's evaluation of their child.

Statistically significant differences were found by parents' racial/ethnic group concerning how willing they would be to question their child's mathematics teacher if they disagreed with the teacher's assessment of their child. Black and White parents were more likely to question the teacher than were Hispanic or Asian parents (see Table 7.8). This finding is in keeping with the assumption of cultural differences suggested above.

TABLE 7.8

Parents' Inclinations Towards Questioning Their Children's Mathematics Teachers If They Disagreed with the Teacher's Assessment of the Student: by Students' Grade Level and Racial/Ethnic Group

Grade Level	% Asian Parents	% White Parents	% Black Parents	% Hispanic Parents
Fourth Grade	82 *	85 *	100 *	81 *
Sixth Grade	65	95	100	79
Eighth Grade	63	97	94	68
Twelfth Grade	78	91	98	86

NOTE: Numbers in table are percentages of parents who strongly agreed or agreed with the statement. These percentages are based on cell n's of 30-40 for the fourth, sixth, and eight grade cohorts, and 45 or more for twelfth grade.

* This difference among racial/ethnic groups is not statistically significant.

Parents' Perceptions of Children's Early Interest in Mathematics

Differences in parents' perceptions of their children's early interest in mathematics or computers varied by racial/ethnic group. Parents of White students were significantly least likely to recognize an early interest in mathematics or computers in their children (see Table 9). And, White parents were significantly least likely to recognize an early interest in mathematics or computers in their children, regardless of the child's gender (see Table 7.10). Parents of White females were least likely of any group to recognize this early interest in their children.

TABLE 7.9

Parents' Perceptions of Students' Early Interest in Mathematics, Computers, and Mechanics: by Grade Level and Racial/Ethnic Group

Racial/Ethnic Group	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Asians	71	74 *	67	54
Whites	51	61 *	40	32
Blacks	79	72 *	81	47
Hispanics	77	75 *	58	51
Number of Parents	135	126	124	232

NOTE: Numbers in table are percentages of parents who responded "yes."

* This difference among racial/ethnic groups is not statistically significant.

TABLE 7.10

Parents' Perceptions of Students' Early Interest in Mathematics, Computers, and Mechanics: by Grade Level, Gender and Racial/Ethnic Group

Gender and Racial/Ethnic Group	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Females				
Asians	71	50 *	62	46 *
Whites	41	46 *	33	26 *
Blacks	77	64 *	79	45 *
Hispanics	50	69 *	39	53 *
Males				
Asians	69	86 *	71	62 *
Whites	58	81 *	50	39 *
Blacks	81	80 *	83	50 *
Hispanics	100	80 *	82	50 *
Number of Parents	135	126	124	232

NOTE: Numbers in table are percentages of parents who responded "yes."

* Differences among racial/ethnic groups within grade levels and genders with asterisks are not statistically significant.

SUMMARY

The findings presented in this chapter demonstrate that parents feel mathematics is an important area of study for their children. The majority of the parents want their children to take as much mathematics as possible, and recognize the utility of mathematics for future careers. There is a feeling among many parents, however, that not all students are capable of handling high level mathematical concepts, and female students in particular do not receive the level of encouragement and support from their parents to persist in mathematics that male students receive.

Parents' responses to survey questions indicate that, despite the movement of women into the work force in greater numbers, mothers do not view themselves as competent in mathematics, and they communicate this message to their children. Fathers are more likely to help older children with their mathematics homework, whereas mothers are more likely to help children who are in the elementary grades and still dealing with elementary mathematical concepts. Moreover, while parents of today's students seem to be encouraging their daughters somewhat more than parents of the past did to take as much mathematics as possible, their goals for their children's future employment indicate that they still view mathematics and science careers as being primarily for men.

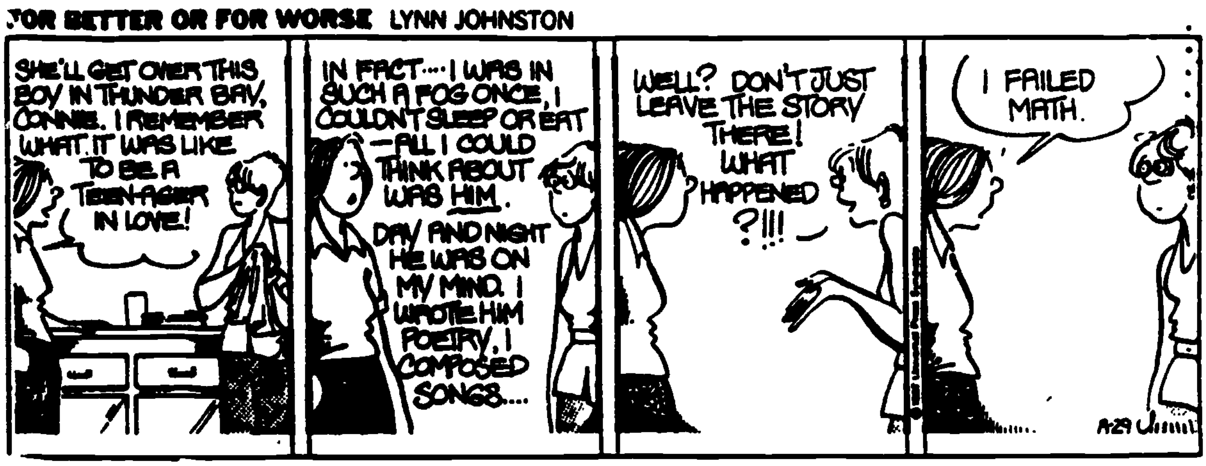
It appears that parents are communicating different messages to their daughters than they are to their sons regarding the importance of mathematics in their lives. Daughters are presented with information suggesting that women still do not need mathematics in the same way that men do: their mothers do not use much mathematics and admit to being poor in mathematics; and in general, parents of both sexes encourage sons more than they do daughters to pursue mathematical or science careers. These findings suggest that subtle or not-so-subtle messages are received by females indicating that they should not expect to be as good in mathematics as males are. The media reinforce this message in not-so-subtle ways (see Exhibit 7.1).

If male and female students view the need for mathematics preparation differently -- males seeing mathematics as essential for careers, and females viewing mathematics as important for a good education but not for career purposes -- one could conjecture that the amount of effort they would spend trying to achieve maximum understanding of the more complex mathematical concepts might be quite different. This difference in understanding of complex ideas could well translate into differential performance on the SAT, even among students who have covered the identical mathematics curriculum in high school.

The responses of parents by racial/ethnic group are consistent with and support the responses provided by their children. The majority of parents want their children to take as much mathematics as possible, and recognize the utility of mathematics for future careers. Moreover, these findings show Black parents to be the most supportive of students' persistence in higher level mathematics courses. In fact, Black parents felt that their children should participate in these classes regardless of the report card grades they were likely to receive. This finding contradicts common stereotypes that suggest that Black students do not receive the support for education from the home that students from other racial/ethnic groups receive.

EXHIBIT 7.1

Media Representation of Women and Mathematics



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THE SCHOOL ENVIRONMENT: TEACHERS', COUNSELORS', AND PRINCIPALS' ATTITUDES AND EXPECTATIONS CONCERNING MATHEMATICS FOR STUDENTS BY GENDER AND RACIAL/ETHNIC GROUP

BACKGROUND

Past research has shown that teachers are very influential in shaping students' attitudes and beliefs about mathematics and mathematics education, their decisions to pursue advanced mathematics, and their career choices. Research has also recognized the key role that counselors play in this regard, through their advising of students in course selection and career options.

The recent research on school effectiveness has demonstrated that student achievement is often related to the expectations the principal and school staff have communicated to the students concerning their performance. Students who have attended schools where expectations are high tend to perform better than students in schools with lower expectations of their students. Many studies have suggested that there are gender and racial/ethnic group differences in what is expected of students in mathematics: males, Whites, and Asians receive more encouragement and more is expected of them than is true for females, Blacks, and Hispanics.

This chapter describes the setting in which mathematics instruction takes place. It examines the attitudes, beliefs, and opinions about mathematics and mathematics instruction reported by a sample of elementary and secondary school mathematics teachers, and by a sample of guidance counselors at the junior high/middle and senior high school levels.

This chapter also examines teachers', counselors', and principals' perceptions of the underlying causes for gender and racial/ethnic group discrepancies in mathematics participation and achievement, as well as their perceptions of the steps that must be taken to eliminate these discrepancies. The chapter also presents teachers' evaluations of and expectations for students related to the students' actual performance.

As in Chapters 6 and 7, this chapter presents only those findings which were statistically significant. Detailed responses of teachers and guidance counselors are contained in the appendix to Chapter 8.

The findings presented in this chapter indicate that teachers, counselors, and principals have different perceptions regarding the interest in and ability to succeed in mathematics for students from different gender and racial/ethnic groups.

ATTITUDES AND BELIEFS ABOUT MATHEMATICS FOR STUDENTS BY GENDER

The responses to questions dealing with gender differences in mathematics suggest that school personnel feel participation and performance in mathematics for female and male students is much more similar today than was true in the past. They point to changing career goals on the part of females, and greater sensitivity on the part of school staff to the needs of females in mathematics and science as reasons for the gender gap having narrowed. However, the majority of counselors and principals feel that some gender differences still exist, and that females learn in subtle ways that mathematics is still thought of as a male domain. The majority of the school staff feel this message is communicated to females at home.

A small but non-trivial percentage of counselors and principals feel that school staff help support these gender differences. Most feel that they, themselves, do not foster these differences, but staff at "other schools" do. Suggestions for improving the situation for females are focused primarily on the elementary school mathematics program. Counselors and principals feel that elementary mathematics teachers need better training in mathematics, and that the curriculum needs to include career education and indoctrination in the utility of mathematics for both males and females. Specific responses from teachers, counselors, and principals follow.

Teachers' Attitudes

Teachers' self reports indicate that they do not feel there are major differences in the performance of female and male students in mathematics, or in female and male students' need for mathematics. Over 90 percent of the teachers felt males and females had equal abilities in mathematics.

Counselors' Attitudes and Beliefs

Responses to Likert scale agree/disagree statements in the counselor surveys such as "Boys are better at math than girls" suggest that most of the counselors do not consider mathematics as a male domain. However, while approximately 10-15 percent felt that females were better students than males, the same proportion felt females did not take mathematics and science courses as seriously as males. Additionally, about 15 percent of the junior high/middle school counselors felt that male students were more career oriented than were female students. And, when asked if men made better scientists and engineers than women or women made better mathematics teachers than men, one-fourth to one-third of the high school counselors were not sure.

Moreover, when asked to suggest reasons for differences among male and female students in terms of performance on the SAT, half the counselors reported that they felt females saw mathematics as a male-oriented subject. Other reasons suggested by at least 10 percent of the counselors included: more family support for males to pursue mathematics, differential treatment of males and females by mathematics teachers, and male students' greater interest in mathematics and science careers. Overall, 60 percent of the counselors provided an excuse for the differences in SAT performance that suggested mathematics was a male domain.

"I feel both male and female students could perform equally well on the SAT," stated one high school guidance counselor. "Our culture expects females to be more emotional and less logical than males. Society expects boys to be better at math than girls, and since kids aim to please us, that 's what happens." Many counselors agreed with this point of view. "Women still like the arts and humanities," stated a counselor from another high school. "Some still like to teach, some still want to be a mother, wife, etc. All of this is OK. If a female is headed for a mathematics or science field, we must push her as hard as we can, but we shouldn't push women into something they don't want to do just to make Montgomery County look good."

Principals' Attitudes

The majority of the principals did not feel there were gender differences in mathematics in their schools. Those who did observe differences tended to blame society for instilling different values and interests in mathematics in males and females. Nonetheless, when asked to explain the differences in SAT mathematics scores between males and females, 54 percent of the principals provided a sex role reason for this difference. Stated one principal, "Math is not their thing. Girls don't think of themselves as future mathematicians." Another principal added, "The analytical component of mathematics is more interesting to boys." Another added, "Girls think they can't be smart and attract boys." "Boys like intriguing games, problem-solving tricks and riddles," asserted yet another principal. "Girls like to read. They're more chatty, social."

Several principals felt differences had their root in elementary school mathematics. "In elementary schools most mathematics teachers are women," stated one principal. "They bring with them the stereotypes they were raised on." Others felt females were intimidated by mathematics. According to one principal, "Girls wait for boys to answer the mathematics questions."

ATTITUDES AND BELIEFS REGARDING RACIAL/ETHNIC GROUP DIFFERENCES IN MATHEMATICS

Comments from counselors and principals suggest that the majority of school staff blame societal factors for the differences in performance and achievement that are found between Asian or White and Black or Hispanic students. These staff pointed to the parental encouragement and pressure to achieve that Asian and White students receive on the one hand, and the lack of parental support and economic disadvantage of Black and Hispanic students on the other hand. This perception does not agree with our study findings which show a deep commitment to education on the part of the parents of Black students of both genders, and parents of Hispanic males.

Solutions counselors and principals would suggest focused primarily on providing support, encouragement, and role modeling for Black and Hispanic students. Many suggested parent outreach programs to teach parents how to work with their children in mathematics, and to instill in the parents a sense of the importance of mathematics in their children's education. Several would make modifications to the elementary school mathematics program and retrain elementary teachers responsible for teaching mathematics. A few counselors and principals felt there was nothing the school system could do to change things. Perceptions obtained specifically from counselors and principals are presented below.

Counselors' Perceptions

Seventy-nine percent of the counselors felt performance and achievement differences emanated from the home. Half the junior high/middle school counselors and over 40 percent of the high school counselors isolated differences in parental influence of minority students as contributing to performance and achievement differences. One-third to one-fourth of the counselors felt performance and achievement differences were related to differences in the socio-economic status of the students. Half the junior high/middle school counselors and one-third of the high school counselors felt teachers had different expectations for Black and Hispanic students.

According to one counselor, "The White and Asian students we have are brighter and have generally better academic backgrounds, more accommodating home environments, have parents with higher expectations and better education, and are directed toward goals to a greater degree than our Black and Hispanic students." Another counselor added, "In the case of Blacks there is a lack of parental help, support, and encouragement all along the line. Hispanics are adversely affected by the language component and often have interrupted education."

Several counselors reported that Black and Hispanic students were not motivated to take higher level mathematics courses. "They would rather take easy math," stated one counselor. "They only want to take what is required for graduation." Another counselor who agreed with this statement added, "These students see mathematics courses as requiring a lot of work. This interferes with their social time at school." Some counselors suggested that this pattern of opting for the easy courses was encouraged by school staff and parents. "Principals, teachers, and parents do not like to see kids not succeed, so they are placed in courses that usually guarantee success," asserted one counselor. "This does not necessarily result in an attainment of higher level mathematics functions," the counselor added.

When asked how they would try to eliminate these differences, the majority of the counselors who responded suggested more support for students at the local school level, including more encouragement from teachers, counselors and principals. They also suggested that teachers have the same expectations of all students, and that students' elementary mathematics preparation be strengthened. Many suggested training programs for parents in which they could learn how to help their children with their homework. Some counselors felt that society's problems were so large that the schools could not do anything that would make a difference.

Principals' Perceptions

Principals' perceptions also reflect a tendency toward generalizing the reasons for racial/ethnic group differences. Two-thirds of the principals blamed societal and family problems as the causal factors in the differences in performance and achievement that are observed between the racial/ethnic groups. "It is difficult to change 400 years of cultural history," stated one principal. "Asian parents place a high premium on education," added another principal. "Asian parents are hard-working individuals. Their children are artistic and good in mathematics. Most Asian families are intact with both parents home. Hispanic children are loosely supervised, without a father or mother." "White students are wealthier," reported another principal. "They have better opportunity, greater emphasis on education. Hispanics are disadvantaged and have a language problem. They drop out of school more frequently."

Many principals felt the school system needed to play an active role in helping the family to help the student at home. Others felt more could be done within school to provide encouragement, motivation, and remedial instruction to Black and Hispanic students. Several principals felt that the ISM program (the K-8 curriculum) fragmented mathematics instruction too much and interfered with the learning of major concepts. They also indicated that having so many objectives-based assessments needlessly intimidated weaker students and caused them to become anxious about mathematics. But some expressed feelings that were similar to the following: "Differences will never be eliminated unless socio-economic levels are equal and students have the same academic orientation and values."

TEACHERS' RATINGS OF STUDENTS' PERFORMANCE IN MATHEMATICS BY GENDER AND RACIAL/ETHNIC GROUP

The most recent mathematics teachers of students in the four cohort samples were contacted and asked to rate the students on several aspects of classroom behavior.[1] This section presents these ratings. Generally, while teachers reported that the majority of students were capable of handling typical mathematics instruction in their classes, they also reported that many students do not come to their classes prepared to work or in the proper frame of mind to fully attend to instruction.

Teachers' ratings are related to students' level of participation in the curriculum, with students who participated at accelerated levels in the curriculum receiving significantly higher ratings from teachers in almost all categories investigated, and those participating at lower levels receiving lower ratings. Nonetheless, results of analysis of covariance[2] computations show that there is a tendency on the part of teachers to view female and Asian students more positively than they do other students,

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1. About half the students were rated by their most recent teacher, and the other half were rated by their two most recent teachers. Since the ratings were quite similar across teachers, multiple teacher ratings per student were averaged. Thus, the unit of analysis for teacher ratings is the student rather than the teacher.

2. Analysis of covariance combines analysis of variance and regression analysis methodologies. It is especially useful in the type of analysis presented here, where one variable (participation in the curriculum) is assumed to be related to both the outcome variables (teacher ratings of student behaviors and traits) and independent variables such as gender and racial/ethnic group. Analysis of covariance enables the researcher to investigate the relationship of participation in the curriculum to teacher ratings separately from students' gender and racial/ethnic group, and then to determine whether gender and racial/ethnic group have a relationship to teacher ratings over and above what is produced by the student's level of participation in the curriculum.

regardless of their level of participation in the curriculum. The appendix to this chapter presents the results of the Analyses of Covariance.

Differences in Teacher Ratings by Students' Gender

There were only a few isolated differences between teachers' ratings of male and female students' classroom behavior that were statistically significant. Where they occurred, teachers perceived female students as better prepared for class, more careful, and more studious than males. However, after removing the relationship between students' participation in the curriculum and teachers' ratings of their behavior through use of analysis of co-variance, a significant relationship between gender and teachers' ratings of behavior was found. Teachers' ratings of female students' behavior were significantly more positive than their ratings of male students' behavior regardless of students' level of participation in the curriculum. Female students were also viewed by their teachers as being significantly more anxious about mathematics than males, however.

Differences in Teacher Ratings by Students' Racial/Ethnic Group

Asian students in the elementary school grades were judged by their teachers to be significantly more careful than other students (see Table 8.1). Asian students in grades 4, 6, and 8 were deemed more studious than other students (see Table 8.2). Black students were judged least studious by their teachers, and Blacks and Whites were reported to be least careful in class. These differences remained even after the relationship between level of participation in the curriculum and teacher ratings of behaviors was accounted for through analysis of covariance. Moreover, after controlling for level of participation in the curriculum, Asian and Hispanic students in the elementary grades were rated significantly better prepared for class than White and Black students. In the secondary grades, Asian and White students were rated significantly better prepared than Hispanic and Black students.

TABLE 8.1

Percentage of Students by Racial/Ethnic Group Reported to be Careful in Mathematics Class by Their Teachers: Grades 4 and 6

Racial/Ethnic Group	% Students Grade 4	% Students Grad 6
Asians	58	63
Whites	16	42
Blacks	31	38
Hispanics	38	59

NOTE: There were between 30 and 40 students in each racial/ethnic group in the fourth and sixth grade cohorts who were rated by their teachers.

TABLE 8.2

Percentage of Students by Racial/Ethnic Group Reported to be Studious in Mathematics Class by Their Teachers: Grades 4, 6, 8, and 12

Racial/Ethnic Group	% Students Grade 4	% Students Grade 6	% Students Grade 8	% Students Grade 12
Asians	58	70	72	54 *
Whites	42	44	67	39 *
Blacks	33	33	49	37 *
Hispanics	36	62	50	35 *

* This difference is not statistically significant.

NOTE: There were between 30 and 40 students in each racial/ethnic group in the fourth, sixth, and grade cohorts who were rated by their teachers. In the twelfth grade cohort there were between 50 and 60 Asians, Hispanics, and Blacks, and over 80 Whites.

Forty to sixty percent of the students in each grade level cohort were rated outstanding or above average in overall ability by their teachers. Another one-fourth to one-third were rated average. Despite the fact that students in the sample cohorts were chosen so there would be approximately equal achievement across the racial/ethnic groups, teachers rated students in the four racial/ethnic groups differently.

With the exception of the eighth grade cohort, teachers rated Asian and White students significantly higher in overall ability than they did Black and Hispanic students (see Table 8.3). Asian and White students were more likely to receive a rating of outstanding or somewhat above average from their teachers than were Hispanic and Black students, and Hispanic and Black students were more likely to be rated somewhat or significantly below average than were Asians and Whites. When the relationship between level of participation in the curriculum and overall ability was controlled via analysis of covariance, Asian students still received differentially higher ratings of overall ability from their teachers than did students from the other racial/ethnic groups. These differences in ratings were not quite statistically significant, however.

SUMMARY

The findings from surveys of teachers, counselors, and principals indicate that students receive different messages from school staff regarding their need for and ability in mathematics, depending on their gender and racial/ethnic group membership. Females receive messages that suggest they do not need to be as serious about mathematics as their male peers, they do not need mathematics for their future careers, and they are not as competent in mathematics as are males. Many school staff reported that they supported both males and females in their interests in mathematics, but felt that society reinforced stereotypes concerning females' inadequacies in mathematics.

TABLE 8.3

Teachers' Ratings of Students' Overall Ability by Racial/Ethnic Group: Grades 4, 6, 8, and 12

Rating and Racial/Ethnic Group	% Students Grade 4	% Students Grade 6	% Students Grade 8	% Students Grade 12
Asians				
Outstanding	28	31	14 *	12
Somewhat above average	36	33	56	40
Average	25	23	26	27
Somewhat below average	8	13	5	17
Significantly below avg.	3	0	0	4
Whites				
Outstanding	7	20	20 *	14
Somewhat above average	33	34	46	40
Average	42	27	29	28
Somewhat below average	16	10	0	12
Significantly below avg.	3	10	6	6
Blacks				
Outstanding	14	8	8 *	7
Somewhat above average	20	30	43	17
Average	40	35	27	44
Somewhat below average	26	22	14	19
Significantly below avg.	0	5	8	13
Hispanics				
Outstanding	7	9	20 *	5
Somewhat above average	21	41	30	24
Average	33	32	37	43
Somewhat below average	29	3	10	26
Significantly below avg.	10	15	3	2

* This difference is not statistically significant.

NOTE: There were between 30 and 40 students in each racial/ethnic group in the fourth, sixth, and grade cohorts who were rated by their teachers. In the twelfth grade cohort there were between 50 and 60 Asians, Hispanics, and Blacks, and over 80 Whites.

School staffers felt that the differences in participation and performance in mathematics that are observed among different racial/ethnic groups stem from home variables. They view Asian and White students as coming from homes in which education is supported and participation in mathematics is encouraged. They blame economic factors and fragmentation of families for the lack of motivation and interest in mathematics they feel is dominant among Hispanic and Black students. While many school staffers feel that school systems need to work hard to overcome these obstacles, some feel there is nothing that the schools can do.

The data suggest that school staff tend to view female, Black, and Hispanic students differently than they view male, White, and Asian students. Less is expected of females, Blacks, and Hispanics in mathematics, which may lead to lower performance on their part. Also, many school staff attribute negative educational values to the families of certain groups of students, e.g., Black families, whereas the parental survey data indicate that these families want to be involved in their children's education. In fact, the data presented in Chapter 7 showed Black parents to be most vocal of all parent groups in expressing support for their children's participation in mathematics.

These findings suggest that school systems and parents could work more closely to foster a greater understanding of each other's views and expectations. In particular, school staff need to communicate to parents the importance of mathematics in their children's futures, and illustrate ways in which parents can work with the school to encourage their children to persist in mathematics.

SUMMARY AND RECOMMENDATIONS

SUMMARY AND RECOMMENDATIONS

OVERVIEW

Background

For more than a decade, Montgomery County Public Schools (MCPS) has had priority goals for the education of female, Black, and Hispanic students in key academic areas such as mathematics. The school system has devoted a great deal of time, attention, and resources to the development of innovative curricula, staff awareness and sensitivity to cultural differences and sex role stereotypes, and staff training in promising practices and strategies such as differentiated instruction. The following are some of the major steps that have been taken:

- MCPS led the nation in establishing a Board of Education policy in 1972 that mandated specific actions on the part of staff to address the problem of underachievement and underrepresentation of Black students in academic and extracurricular areas.

- In the mid 1970's, MCPS conducted an institutional study required by Title IX, and designated a Title IX Coordinator in the Department of Human Relations. Annual conferences have been conducted by the Department of Human Relations and the Office of Instruction and Program Development, to provide staff with ways of fostering interest of female, Black, and Hispanic students in technical courses and careers.

- The school system was the first in the greater Washington D.C. area to publish standardized test score results in 1978, showing differential performance by gender and racial/ethnic group.

- Commitment to increasing Black and Hispanic students' achievement and participation was reiterated in 1983 when the Board of Education set the priority to:[1] "implement a special emphasis program that will result in substantial gains in a) the performance of minority students in the classroom and on standardized and criterion-referenced tests; b) the participation of minority students in programs for the gifted and talented, higher level academic courses, and extracurricular activities."

- In 1985 MCPS adopted a policy on Women's Equity which stipulated actions that school and central office personnel must take to ensure equal opportunity and elimination of sex role stereotypes concerning student participation in courses, athletics, and other extracurricular activities, as well as staff employment opportunities.

- In 1985 the MCPS Board of Education adopted the Initiatives for Sex Equity, which had several long-range goals: improvement of SAT scores for females, increased enrollment of females in computer science

1. PRIORITIES: Montgomery County Board of Education, Montgomery County Public Schools, September 1983.

courses and advanced courses in mathematics and science, and increased participation of women in nontraditional careers.

Such self-examination and leadership is essential to a vital school system.

In the last 10-12 years, substantial progress has been made toward these goals. For example, today, the performance of female, Black, and Hispanic students in the County far exceeds national levels of achievement for these groups. Within the state of Maryland as well, females, Blacks, and Hispanics outperform their peers in the other local school systems. This contrasts sharply with conditions in 1978 when Black students at all grade levels and Hispanic students in grades 7, 9, and 11 scored below national norms in mathematics achievement.

Despite these gains, the performance of female, Black, and Hispanic students continues to be a major concern. MCPS's proposal to the National Science Foundation (NSF) for funds to conduct a study of the participation and performance of female and minority students in mathematics is just one indicator of the continued interest in these areas. The unprecedented award by NSF to a school system rather than to an institution of higher education reflects NSF's judgment that MCPS is on the cutting edge of research, curriculum development, and student data management in these areas.

Study Focus and Objectives

This study of female, Black, and Hispanic students' mathematics participation and performance explored those factors which were believed to contribute to differential course-taking histories within the context of the elementary, junior high/middle, and high school environments. It was assumed that many of the decisions students make concerning high school mathematics participation have their roots in the elementary years.

Thus, while a major focus of this study was the junior/high middle school and high school mathematics participation and performance of female, Black, and Hispanic students, the study also examined the mathematics participation and performance of elementary school children. Particular attention was devoted to those factors that might help explain the differential participation and performance of female compared to male and Black and Hispanic male and female students compared to Asian and White males and females.

The overall goals of the study were threefold:

- to identify at what points, if any, in the educational process differences appear in the mathematics participation and performance of females compared to males, and Blacks and Hispanics compared to Whites and Asians, and to describe these differences

- to identify the factors in the school, home, and society that contribute to the differential mathematics participation of female, Black, and Hispanic students at the elementary, junior high/middle and senior high school levels

- to provide, where possible, the policy implications of the research and suggest alternatives or solutions which schools might wish to explore in increasing the enrollment and achievement of females, Blacks, and Hispanics in mathematics.

This chapter contains a summary of the major findings of the NSF-funded study, and provides recommendations that result from these findings. The data show that, in many areas, MCPS has made great strides toward meeting the needs of its students in mathematics instruction. However, while the mathematics performance and participation of MCPS's female, Black, and Hispanic students has shown substantial improvement over the last decade, differences are still observed for students in different gender and racial/ethnic groups. This study represents one more step in MCPS's initiative in meeting the complex needs of all students in mathematics. Based on the findings in Montgomery County, we can only speculate that gender and racial/ethnic group performance and participation differences must be far greater in school systems that have not devoted similar time, attention, and resources to these issues.

FINDINGS: AT WHAT POINT DO DIFFERENCES APPEAR?

Findings by Gender

Participation and Performance

The data show that participation and performance in the mathematics curriculum is fairly equal for male and female students from kindergarten through the first years of high school. It is only when the mathematics requirements for graduation and college admission are satisfied that gender differences emerge, with female students leaving high school with slightly less mathematics than males.

Achievement in mathematics was measured in the elementary and junior high/middle school grades by scores on the mathematics sections of the California Achievement Tests (CAT) and performance on locally-developed and calibrated criterion-referenced mathematics tests (CRT's). At the high school level, achievement was measured by the results of administration of the CAT in eleventh grade, and the Scholastic Aptitude Test (SAT) in eleventh and twelfth grades.

Both male and female students in Montgomery County performed better on the CAT and SAT than did comparable students nationwide (see Table 9.1). Male and female students in the County performed equally as well on the CAT and the CRT's. However, surprisingly large differences emerged in SAT mathematics performance, with male students significantly outperforming females. This difference in SAT mathematics performance was observed regardless of the amount and complexity of mathematics and science courses taken by the students, and despite the fact that female students received higher grades than male students in all mathematics classes (see Table 9.2).

Attitudes and Beliefs About Mathematics

The results of surveys of samples of students in the fourth, sixth, eighth, and twelfth grades indicate that clear differences exist among groups of students in their levels of anxiety, confidence in, liking of, and perceived

TABLE 9.1

SAT Score Means by Gender for Students in the Class of 1986 Who Took the SAT in Their Junior and/or Senior Years

Year of Test	All Students	Females	Males	Male/Female Difference
Montgomery County Means				
1985: Scores for Junior Year				
Verbal	477	46[illegible]	489	23
Mathematics	530	505	561	56
Total Test	1007	971	1050	79
Number of Students	3155 *	1722	1433	
1985 or 1986: Highest Score Obtained in Junior and/or Senior Year				
Verbal	479	472	486	14
Mathematics	530	506	557	51
Total Test	1009	978	1043	65
Number of Students	4185 *	2273	1912	
United States Averages for Seniors **				
1985				
Verbal	431	425	437	12
Mathematics	475	452	499	47
Total Test	906	877	936	59
1986				
Verbal	431	426	437	11
Mathematics	475	451	501	50
Total Test	906	877	938	61

* Numbers and means are slightly different from overall Montgomery County figures since only those students who were enrolled in the County during their sophomore and junior years are included in the analysis.

** Students who take the SAT as seniors tend to average about 30 points lower, overall, than do juniors and seniors combined. This should be considered when making comparisons between seniors nationwide and Montgomery County juniors or juniors and seniors. Data source: Educational Testing Service.

TABLE 9-2

Highest SAT Mathematics Score Obtained in Junior and/or Senior Year by Gender and Highest Mathematics Course Taken in High School

Highest Mathematics Course Taken	No. of Students Fem.	No. of Students Male	Average Score Total County	Average Score Female	Average Score Male	Average Male/Female Difference
Calculus	362	399	678	659	696	37
Pre-calculus	306	284	611	588	635	47
Advanced Alg.	520	396	529	511	552	41
Alg. 2 & Trig. (accelerated)	81	63	598	575	627	52
Trigonometry	96	89	513	494	533	39
Algebra 2	384	256	460	447	480	33
Geometry	224	167	409	391	433	42

NOTE: Separate analyses were conducted controlling both mathematics and science course enrollment, and very small, random changes in average male/female differences in SAT performance were observed. Thus, for simplicity of presentation, only differences in performance within level of mathematics course enrollment are presented in this report.

utility of mathematics. Female students seemed to be somewhat less confident in their abilities in mathematics than their male counterparts. They also turned to others for help more frequently than did males. A large group of males reported that males were better in mathematics than females. Additionally, male and female students alike reported that their mothers were not as good in mathematics as their fathers were.

Students' responses by gender indicate that there was little difference between males and females in the types of colleges they hoped to go to, and the number of years of college and graduate school that they planned on completing. Career aspirations, however, were quite different for these students. Males were more likely to aspire to careers in professional occupations utilizing mathematics or the physical sciences, or managerial occupations; females were more likely to want jobs that did not emphasize mathematics, and were less likely to view themselves as future managers. This difference in career objectives may have an influence on how much effort students are willing to take to understand the higher level mathematical concepts, and this, in turn, has an effect on SAT performance.

Supports for Mathematics in the Home and School

The data show that students' feelings about the utility of mathematics and the importance of doing well in school result in large part from parental expectations and pressures, and to a slightly lesser extent from the school environment. With the exceptions of only the very top female mathematics performers (those who finish high school mathematics with Calculus), female students receive less encouragement from the school, home, and society to pursue mathematics than male students receive.

Parents' responses to survey questions indicate that the students' mothers do not view themselves as competent in mathematics, and they communicate this message to their children. Fathers are more likely to help older children with their mathematics homework, whereas mothers are more likely to help children who are in the elementary grades and still dealing with elementary mathematical concepts. Moreover, while parents of today's students seem to be encouraging their daughters somewhat more than parents of the past did to take as much mathematics as possible, their goals for their children's future employment indicate that they still view mathematics and science careers as being primarily for men.

Principals' and counselors' responses suggest that many of them adhere to these views regarding gender and mathematics. More than 50 percent of the principals and about 60 percent of the counselors indicated that differences in the mathematics performance of males and females could be attributable to the following factors: females are not interested in mathematics, they feel they do not need mathematics for their careers, or they are not as competent in mathematics as are males. These views also appear to be reinforced by what students see in the classroom in terms of teacher competencies. In elementary school, where 90 percent of the classroom teachers are women, many teachers admit they are not comfortable teaching mathematics. At the secondary level, where preparation in mathematics content is necessary for certification to teach mathematics, just over half the teachers are women. This situation, coupled with the general preponderance of male teachers in the mathematics and science areas in secondary schools, provides further evidence to female students that many women are not traditionally expected to be proficient in technical areas.

Findings by Racial/Ethnic Group

Participation and Performance

Racial/ethnic group differences in mathematics participation and performance were observed early in the students' educational history.[2] Asian and White

2. It is impossible to determine without further study whether students in all racial/ethnic groups actually start elementary school with similar mathematical skills, or whether many Asian and White students come to school already advanced, with skills that their peers do not have, and which are not assessed by the tests given in the early grades. This question cannot be resolved without extensive examination of children in the preschool years, an area which was outside the scope of the current research effort. It is an area, however, in which further study would provide useful data to school systems nationwide.

students made more progress in the K-8 mathematics curriculum than did Hispanic and Black students, and the pattern was observed early in the elementary school years. While it is assumed that all students start out equally in the mathematics curriculum in kindergarten and first grade, by the end of second grade, Black and Hispanic students tend to fall below grade level in their mastery of curriculum objectives in greater numbers than do Asian and White students, and Asian and White students begin to move ahead or accelerate in the curriculum in greater numbers than do Hispanic and Black students.

The evidence suggests that once a student falls below the standard level of performance in the curriculum for his/her grade level, he/she is not likely to ever again catch up to that grade level standard of performance. And, with each year in school, additional students either fall behind or move ahead, producing a difference in the progress of Black and Hispanic compared to Asian and White students that gets wider each successive year. Exhibits 9.1, 9.2, and 9.3 illustrate the cumulative effect of differences in progress for each racial/ethnic group throughout the elementary school years.

The result of the cumulative differences between the groups is that, by the end of the elementary school years, as critical decisions are being made concerning class placement for seventh grade mathematics, as many as one-third to one-half of the Hispanic and Black students have fallen so far behind in the mathematics curriculum that there is little or no possibility of their being placed in a level of seventh grade mathematics that would allow them to be ready to take Algebra 1 in eighth or ninth grade.[3] It is no great surprise, then, to find that at the high school level, the most advanced mathematics courses (Pre-calculus and Calculus) are dominated by Asian and White students.

The pattern of performance on mathematics achievement measures by racial/ethnic group is comparable to the pattern observed for student progress and participation in the curriculum. Although students in each racial/ethnic group in Montgomery County performed better, on the average, than did comparable students nationwide on the standardized achievement measures, Asian and White students in the County outperformed Black and Hispanic students (see Table 9.3). This pattern, which is comparable to what is observed nationally for the four racial/ethnic groups, was found as early as the third grade, the first time students are tested on the CAT, and continued through eleventh grade. Performance differences on the SAT were also large. Not only did Asian and White students outperform Hispanic and Black students on the test, but the proportions of each group who opted to take the test differed markedly as well: Asian and White students took the SAT in the largest numbers.

3. Students who progress normally through the mathematics curriculum would be expected to take Algebra 1 in the ninth grade, and be able to complete mathematics courses at least through Algebra 2 or Advanced Algebra in high school. Accelerated students take Algebra 1 in the eighth grade, and can take Calculus if they remain in the accelerated mathematics courses throughout high school. Sixty percent of the Black students and 52 percent of the Hispanic students in this study left high school with Geometry, Algebra 1, or lower mathematics courses as the last mathematics course they completed. Comparable figures for White and Asian students were 32 and 13 percent, respectively.

EXHIBIT 9.1

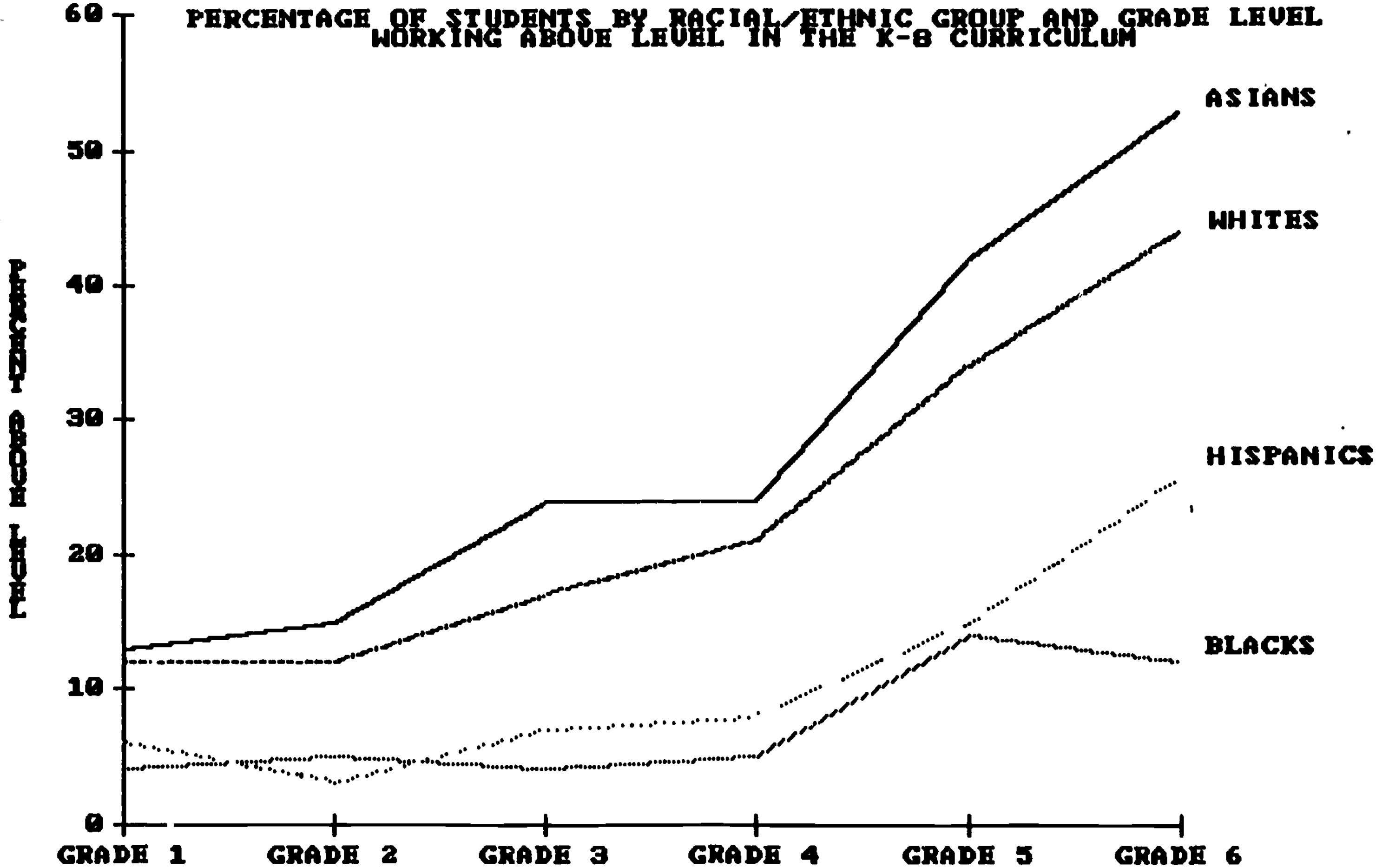
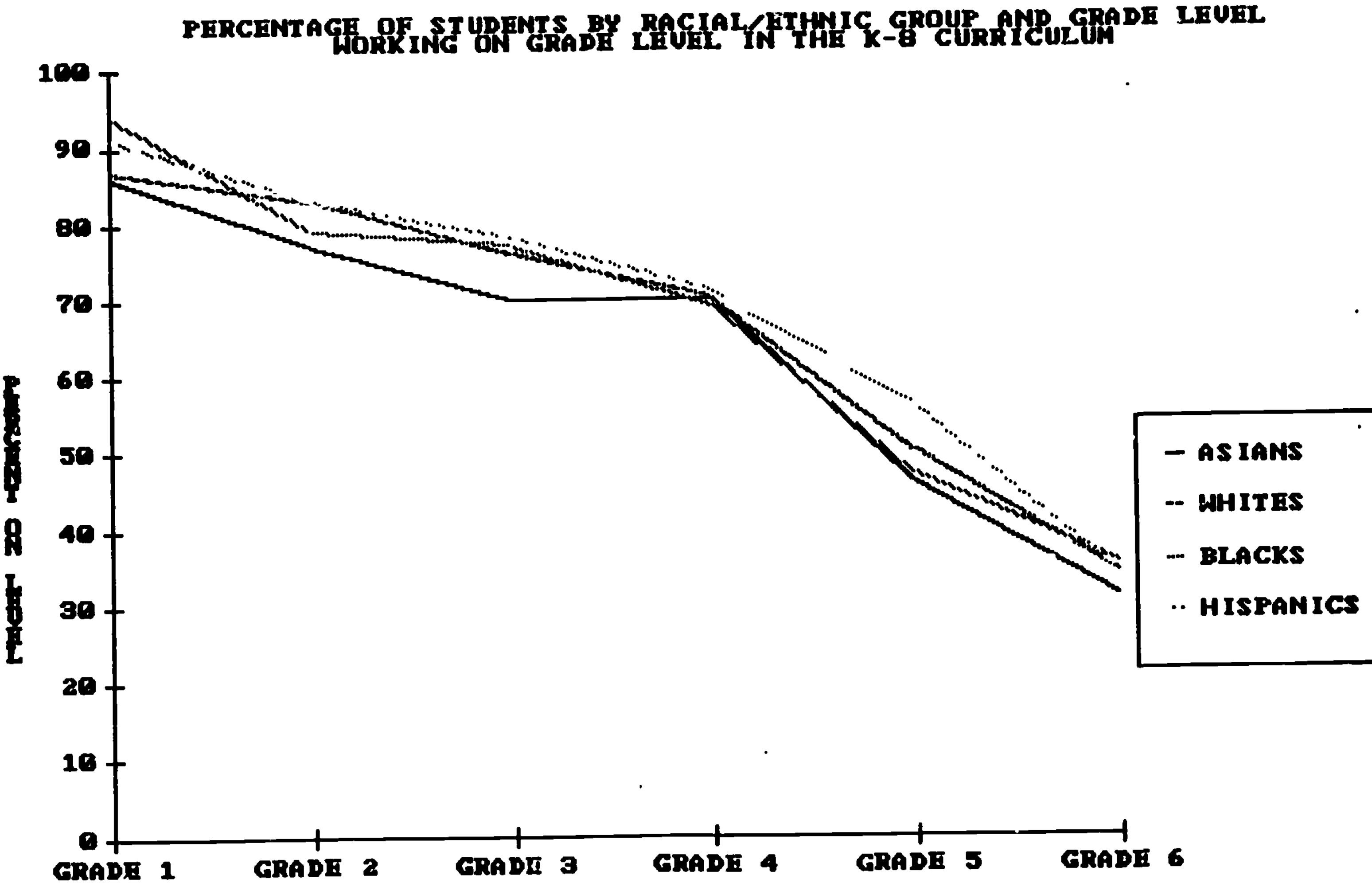

PERCENTAGE OF STUDENTS BY RACIAL/ETHNIC GROUP AND GRADE LEVEL
WORKING ABOVE LEVEL IN THE K-8 CURRICULUM
PERCENT ABOVE LEVEL
60
50
40
30
20
10
0
ASIANS
WHITES
HISPANICS
BLACKS
GRADE 1
GRADE 2
GRADE 3
GRADE 4
GRADE 5
GRADE 6

EXHIBIT 9.2



PERCENTAGE OF STUDENTS BY RACIAL/ETHNIC GROUP AND GRADE LEVEL
WORKING ON GRADE LEVEL IN THE K-8 CURRICULUM
PERCENT ON LEVEL
100
90
80
70
60
50
40
30
20
10
0
GRADE 1
GRADE 2
GRADE 3
GRADE 4
GRADE 5
GRADE 6
ASIANS
WHITES
BLACKS
HISPANICS

EXHIBIT 9.3

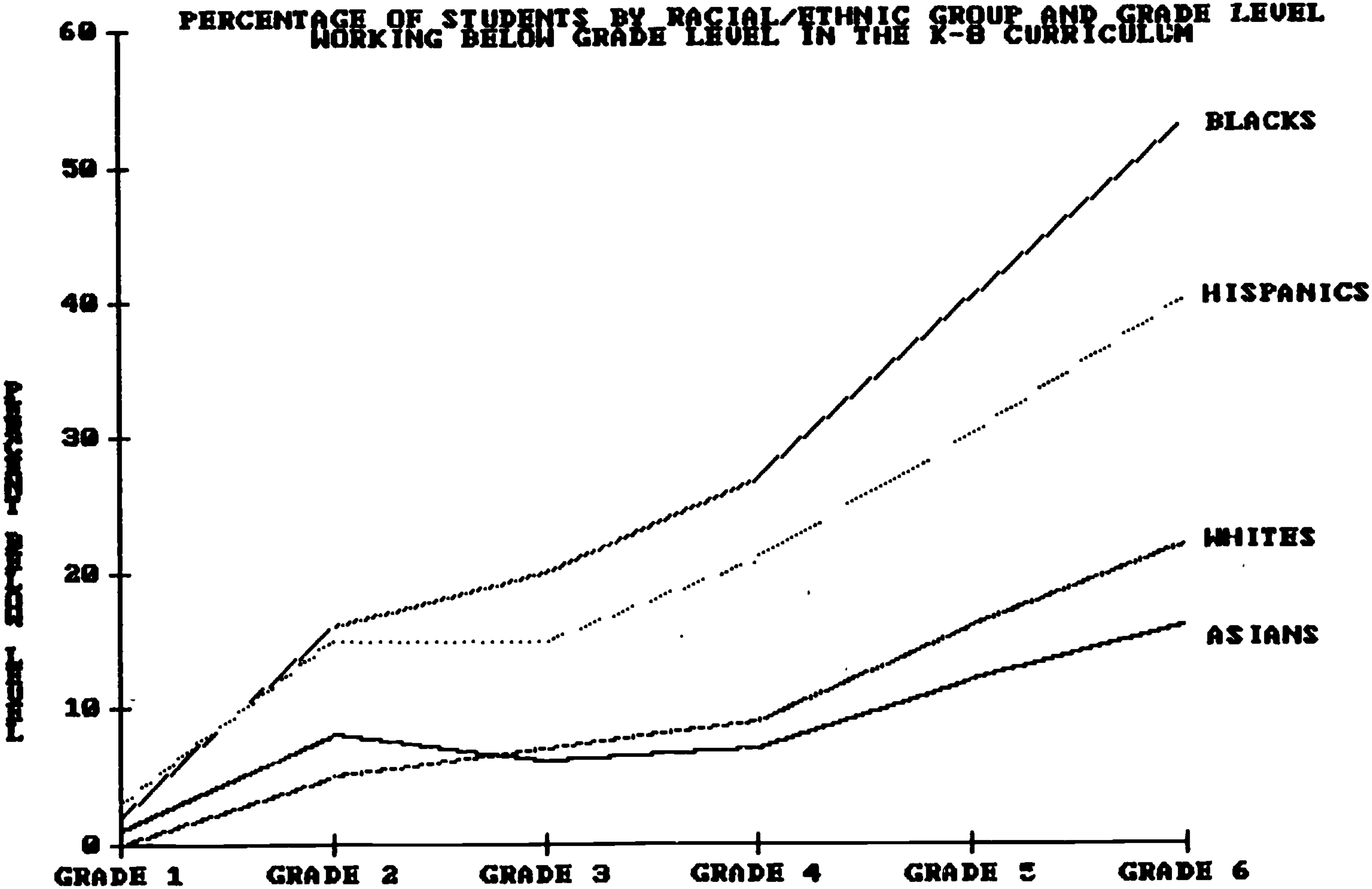

PERCENTAGE OF STUDENTS BY RACIAL/ETHNIC GROUP AND GRADE LEVEL
WORKING BELOW GRADE LEVEL IN THE K-8 CURRICULUM
60
50
40
30
20
10
0
BLACKS
HISPANICS
WHITES
ASIANS
GRADE 1
GRADE 2
GRADE 3
GRADE 4
GRADE 5
GRADE 6

TABLE 9.3

Stanine Scores of Students in the Class of 1986 on the Eleventh Grade CAT Mathematics Section by Racial/Ethnic Group

Stanine	% of Students Nationally in Each Stanine	% of All Asians in MCPS	% of All Whites in MCPS	% of All Blacks in MCPS	% of All Hispanics in MCPS
9 (highest)	4	37	20	4	11
8	7	12	12	3	6
7	12	15	19	11	10
6	17	16	24	21	19
5	20	11	15	23	25
4	17	7	8	25	17
3	12	2	2	11	8
2	7	0 *	0 *	1	2
1	4	0 *	0 *	1	1
Number of Students		499	5,313	857	280

* Percentage is less than half of one percent.

Further, while performance on standardized achievement tests of students in all gender and racial/ethnic groups appears to be related to level of participation in the mathematics curriculum, Black students, regardless of level of participation in the curriculum, consistently scored lower on the standardized tests than did their classmates who were in the other racial/ethnic groups. Even at the highest levels of participation (students enrolled in Algebra 2 Trigonometry, Advanced Algebra, Pre-calculus, or Calculus at the high school level), Black students did not perform on standardized tests at the same level as students from the other racial/ethnic groups (see Table 9.4).

Attitudes and Beliefs About Mathematics

Few racial/ethnic group differences in attitudes toward mathematics were observed; the majority of the students and parents felt mathematics was necessary, and generally, students liked mathematics. High achieving Black students expressed a greater commitment to mathematics compared to what

TABLE 9.4

Eleventh Grade CAT Performance of Students in the Class of 1986: by Highest Mathematics Course Taken in High School and Racial/Ethnic Group

Highest Mathematics Course Taken and Racial/Ethnic Group		N	High *			Middle	Low
			Sta. 9	8	7	Stanine 4-6	Stanine 1-3
Calculus	Asian	155	79 %	14 %	7 %	1 %	0 %
	White	670	78	17	5	0 **	0
	Black	24	67	17	17	0	0
	Hispanic	16	75	19	6	0	0
Pre-calculus	Asian	93	41	18	33	8	0
	White	568	46	27	22	6	0
	Black	36	22	33	28	17	0
	Hispanic	23	52	30	13	4	0
Advanced Algebra	Asian	76	12	18	22	47	0
	White	923	12	19	41	28	0
	Black	99	4	3	41	52	0
	Hispanic	31	16	7	32	45	0
Algebra 2 with Trig.	Asian	16	31	19	13	38	0
	White	155	43	27	25	6	0
	Black	6	17	0	67	17	0
	Hispanic	7	29	14	43	14	0
Trigonometry	Asian	25	8	12	8	72	0
	White	189	13	21	32	34	0
	Black	26	8	0	35	58	0
	Hispanic	8	0	13	38	50	0
Algebra 2	Asian	48	6	4	17	71	2
	White	760	4	8	29	59	0 **
	Black	103	1	2	15	81	2
	Hispanic	29	0	7	17	76	0
Geometry	Asian	28	0	4	7	89	0
	White	564	1	4	13	82	0 **
	Black	121	0	2	4	93	2
	Hispanic	34	0	0	6	94	0
Algebra 1	Asian	22	0	0	0	82	18
	White	381	1	1	5	91	4
	Black	108	0	0	1	88	10
	Hispanic	30	0	0	0	83	17

* Stanines 9, 8, and 7 are shown separately to illustrate the differences among the racial/ethnic groups.

** Percentage is less than half of one percent.

students in other racial/ethnic groups showed. They expressed a desire to do well in mathematics so they could move on to good colleges and professional careers. This commitment was reinforced by their parents' feelings about the importance of mathematics.

Supports for Mathematics in the Home and School

Parents in general felt that mathematics was important in their children's futures. Parents of Black students were the most vocal in expressing this belief. They were significantly more likely to feel that all students needed as much mathematics as possible, and that their children should continue in mathematics even if their chances of receiving a grade of A or B were unlikely. Parents of Black students were also most vocal in expressing their willingness to interact with their children's teachers or other school staff if they felt their children were having problems in school.

Responses from students also indicate that Black students perceive differences in how they and other students are treated in class. High achieving Black students reported that they had to prove themselves to the teacher each time they entered a new mathematics class. They felt that teachers who had Black students in their honors or accelerated classes saw them as tokens, or as inferior to White students in the class. Black students felt a sense of isolation in these classes, especially in schools in which there might be only one or two Black students in each honors class.

These feelings articulated by high performing Black students were substantiated by teachers' assessments of students' performance in class. While students in the four racial/ethnic groups had fairly similar mathematics grades in early elementary school, in the later elementary and secondary years Black students consistently had the worst grades, even if they were working at accelerated levels in the curriculum. Hispanic students' grades were just slightly higher than those of Blacks. Whites and Asians had the best grades.

Survey responses indicate that many counselors and principals feel educational problems begin in the home. Sixty-seven percent of the elementary and junior high/middle school principals surveyed and 79 percent of the junior high/middle and high school counselors surveyed felt that the differences in achievement and performance in mathematics that are observed among different racial/ethnic groups stemmed from home variables. They viewed Asian and White students as coming from homes in which education is supported and participation in mathematics is encouraged. They cited economic factors and fragmentation of families as reasons for the lack of motivation and interest in mathematics they felt was dominant among Hispanic and Black students. While many school staffers felt that school systems needed to work hard to overcome these obstacles, some felt that these problems emanated from society and there was nothing that the schools could do until society changed.

Lastly, the data concerning personal characteristics of teachers indicate that there are few potential mentors or role models among the teaching staff for the three minority groups: Asians, Hispanics, and Blacks. Among counselors, there is also underrepresentation of Asians and Hispanics. Montgomery County is well aware of this problem, however, and is expending considerable effort and resources to recruit minority staff.

Several interpretations are possible for the discrepancy between the attitudes and beliefs of Black students and their parents toward education in general and mathematics in particular, and the degree of reinforcement these students receive through their test scores, class grades, and beliefs expressed by school staff. A cursory look at the data might suggest that there is a bias toward Black students that is expressed through these factors. However, another hypothesis is that the school system, in an effort to make advanced level classes more available to minority students, has placed some Black youngsters in classes above the level that their "paper credentials" would indicate to be appropriate. We cannot determine the real reason without more intensive data collection efforts than were possible in this study. However, if the latter interpretation were to be borne out, the fact that Black students can successfully complete these advanced level classes despite their lower test scores and report card grades would support the continuation of the practice of encouraging them to participate in higher level classes.

Overall, our findings suggest a different pattern of participation, performance, and rewards for performance of Black and Hispanic students compared to Asian and White students, and they corroborate the results of other research efforts. Further, the views of many school staff and Black parents appear to differ regarding perceived parental support of their children's persistence in accelerated mathematics classes. Greater efforts to promote understanding between the school and the home would help in overcoming these differences.

FINDINGS: WHAT FACTORS CONTRIBUTE TO DIFFERENTIAL PERFORMANCE AND PARTICIPATION?

The findings presented above indicate that the pattern of participation and performance in mathematics differs markedly for females compared to Black and Hispanic students. While males and females participate and perform in mathematics at almost equal levels until the middle of their high school years, differences in the participation and performance of Black and Hispanic students compared to White and Asian students occur quite early in elementary school.

Results of statistical analyses of the available data suggest that attitudes and beliefs about mathematics, classroom participation, and test performance are highly related to each other. Generally, students who performed at higher levels in the curriculum felt less anxious, liked mathematics better, and saw a greater use for mathematics than did students who performed at lower levels. They also had a greater variety of strategies they could use to attack mathematics problems. Regardless of gender or racial/ethnic group membership, the more favorably students view the subject of mathematics, and themselves as competent mathematics performers, the more likely they are to persist in higher levels of the mathematics curriculum. Thus, attitudes about mathematics play an important part in shaping students' participation and performance in the mathematics curriculum.

Results of regression analyses show that participation and performance in the mathematics curriculum is strongly related to students' performance on achievement measures such as the CAT and SAT. Between two-thirds and three-fourths of the variation in how students perform on the achievement measures can be directly related to how well they have performed or to what extent they have participated in the mathematics curriculum. Moreover, doing well (getting good grades) in the curriculum enhances this relationship.

Those students who performed at accelerated levels in the curriculum produced the highest average scores on the standardized tests. Those students who performed at average levels in the curriculum performed better on the standardized tests than students who performed at lower levels in the curriculum. While it is conceivable that the relationship between performance in the curriculum and test performance is circular, with those who do well in class doing well on tests and thus being spurred on to continue to do well in class, etc., it seems likely that increasing students' opportunities to attain more curriculum objectives might have substantial payoffs in test performance down the road.

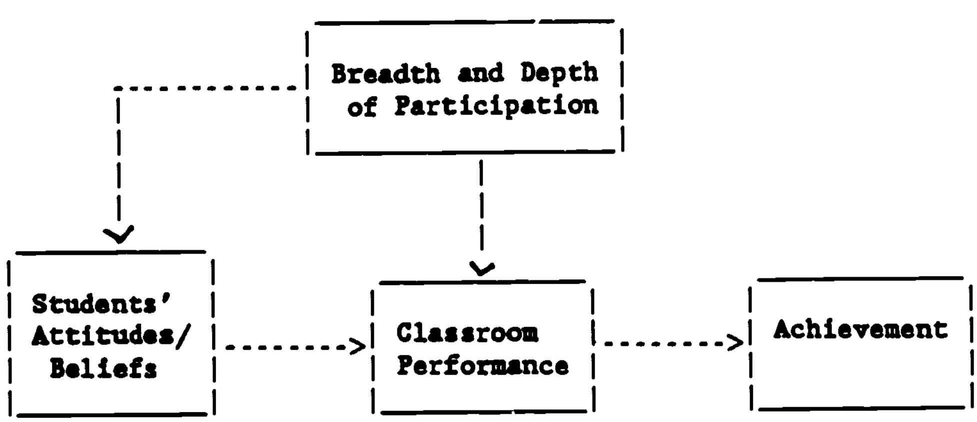
The fact that differences in the participation and performance of many Black and Hispanic students compared to Asians and Whites occur very early in the school years suggests that Black and Hispanic students do not cover the same breadth and depth in the curriculum as do Asian and White students. Thus, whereas for students, overall, a model linking attitudes and performance in the curriculum, and achievement might be formulated as follows:

> attitudes influence students' ability or willingness to perform or participate in the curriculum, and performance and participation in the curriculum ultimately influence students' mathematics achievement,

the impact of the breadth and depth of participation in the curriculum must be considered when examining the ultimate performance and achievement of Black and Hispanic students. Thus, the model shown in Exhibit 9.4 is suggested.

EXHIBIT 9.4

Proposed Model of Factors Related to Mathematics Achievement



POLICY IMPLICATIONS AND RECOMMENDATIONS

The findings from this study indicate that students in Montgomery County participate and achieve in mathematics at levels that are better than national averages. However, the study identified several areas in which MCPS students of different genders and/or racial/ethnic groups participated or achieved differently from each other.

Since students in Montgomery County receive educational services that are equal to or better than those provided elsewhere in the nation, we feel that these findings are especially significant. The fact that we have extensive data bases of student information, as well as procedures for monitoring the progress of students in the K-8 mathematics curriculum, places us ahead of most school districts in the country in terms of what we can provide to our students. Given these supports, the finding that differences exist here suggests that the problems with which we are dealing are deep-seated and difficult to address. Further, given the benefits of the Montgomery County education, we feel it likely that the status of female, Black, and Hispanic students in mathematics in school districts across the country might well be far worse than what we have observed here. Indeed, research studies conducted elsewhere suggest that these problems are widespread.

Based on our study findings a number of viable strategies emerge as ways of coping with these problem areas. The following sections contain recommendations that school systems can use to improve mathematics instruction and students' experiences in mathematics.

Participation and Performance by Gender

Attitudes and Beliefs

While differences in participation and performance in mathematics by gender do not emerge until the last year or two in high school, the findings from this study indicate that differences in attitudes and beliefs about mathematics start much earlier. The study has demonstrated the relationship between attitudes and beliefs and participation and performance in mathematics. Thus, these suggestions are intended to address the differences in attitudes and beliefs that are observed.

- School systems should look for ways to communicate more strongly to female students and their parents the importance of mathematics for all students, and the viability of technical careers for females as well as males. And, since students' early attitudes and beliefs are largely developed at home, parent education should be a major focus of this effort.

- School systems need to launch public relations campaigns to change the image of mathematics. Mathematics should be thought of as exciting, challenging, and desirable as opposed to necessary or a means to an end. Particularly at the junior/high middle school level, where students seem to be influenced most heavily by peer pressures, an effort should be made to try to staff mathematics classrooms with exciting, dynamic, and charismatic teachers, and to present material in a way that broadens students' understanding of the importance and relevance that mathematics has to a multitude of disciplines and careers.

- If school systems truly want as many students as possible to enroll in more advanced mathematics courses, the notion that honors classes should be taken only if the student can be well assured of a grade of A or B should be reconsidered. It is likely that many students, particularly females, are reluctant to enroll in classes in which the prospect of a low grade carries such a stigma. Also, for some students, mathematics knowledge appears to be acquired in fits and spurts, with the student appearing to be stuck in a rut for a time, and then, almost overnight, having everything fall into place. Maintaining narrow performance standards could result in these students being unnecessarily eliminated from higher level mathematics classes. If anything, students who demonstrate that they are willing to aspire to higher standards by enrolling in these advanced level classes should be awarded some tangible or psychological reward for risking their good grade-point-averages in this way. Thus, the data suggest that the practice of weighted grades for honors or advanced level classes makes a lot of sense, and we suggest that school systems consider adopting this practice if they do not already do so. Additionally, school systems that compute weighted grades for honors level classes in which the students receive grades of A or B should consider expanding this policy to grades of A, B, or C.

Performance on the SAT

The solutions to the differential SAT mathematics performance by gender are not as readily apparent as are some of the other solutions suggested by this study. While we have moved somewhat closer than other research efforts have in examining this issue, large differences in performance still exist for which there are no definitive explanations. Further research is needed regarding the differential performance of females and males on the SAT. The following activities are recommended as starting points for this research:

- Intensive case studies of statistical outliers, e.g., those females who perform exceptionally well on the SAT mathematics section, should be conducted. Use of case studies rather than survey techniques would allow for greater in-depth examination of the attitudes, beliefs, and home and school factors that have surfaced in the current study as being important variables to consider.

- It would be useful and interesting to compare the performance of male and female students within the same school system on each item of the SAT mathematics section. Those items (if any) that appear to discriminate between females and males could be examined in relationship to course enrollments of the students and SAT verbal performance. Whereas ETS has conducted analyses of SAT performance and course enrollment data across various school systems where courses of the same name could differ substantially in content, Montgomery County has the benefit of its extensive historical computer data files for large groups of students who have taken the same course of study. Comparison of SAT performance for these students might yield some new information that was hidden in the analyses that were conducted by ETS across many school districts. Inclusion of SAT verbal performance in these analyses would enable us to examine whether differences that emerge are test-specific or mathematics-specific.

Progress and Performance of Black and Hispanic Students in the K-8 Mathematics Curriculum

The data from this study indicate that differences in student progress through the elementary school mathematics curriculum emerge as early as the first and second grade. Black and Hispanic students tend to fall behind in greater numbers than White and Asian students, and they do not accelerate above level in as great numbers either.

Suggestions for Remediation and Enrichment Programs

School systems must take extraordinary steps to ensure that students who fall below grade level in their progress through the mathematics curriculum in the early grades have every opportunity to be brought back up to grade level as soon as possible. The following steps could be taken to address this need:

- Summer school programs could be designed and put into place for students in kindergarten, first, and second grades who are in danger of or who have already fallen below grade level in mathematics, or who did not come to school with the appropriate mathematics readiness skills. Parents must be made aware of why participation in these programs is essential for their children.

- After school programs in mathematics could be established for students in grades 3-6 who need to be brought up to grade level in mathematics or who are in immediate danger of falling below level. Students in these grades could participate in both after school and summer school programs if needed. In school systems in which large numbers of students are bussed to school, transportation should be provided for the after school programs so that those students most in need of the services will be able to participate.

- School systems should consider establishing mathematics resource teacher or mathematics specialist positions in elementary schools with large numbers of students in the early grades who need remediation in mathematics. These teachers could work with small groups of students, and also serve as resource people to the classroom teachers who are in need of assistance in teaching mathematics.

- School systems should consider establishing after-school and/or summer school enrichment programs in mathematics especially geared for elementary school students who have the potential to be moved from on-level to above-level performance with a little assistance. Parents of Black and Hispanic students should be contacted directly by school staff and strongly encouraged to enroll their children in these programs. Transportation should be provided as part of this program.

Parental Support

We feel that school systems, parents, and other community members could work more closely together to meet the needs of the students. We suggest the following:

- School systems should develop or adopt programs which foster support of the educational goals at home. These programs could include workshops for parents that give them the skills necessary to help their children with homework assignments. The workshops could be conducted either in group settings, or recorded on video tape so the parents could use them at home. MCPS currently uses parent awareness workshops for this purpose. The County has also endeavored to adopt and evaluate the success of programs developed outside the school system that foster parent involvement. The Family Math program, developed at the University of California, Berkeley is an after school program designed to provide parents with hands-on experience working with their children in mathematics at home. It is currently being tried in several schools in Montgomery County. PIBS (Parent Involvement in Basic Skills) is another program supported by the school system to involve parents in their children's work. Additionally, MCPS conducts a homework hotline on local Cable TV. Responses to this program indicate that it may be an effective means of reaching students and parents in the home.

- A lending library of video tapes could be developed to be used by students and parents to learn essential mathematical concepts. These tapes could be made available in school and public libraries as well as in housing and recreation centers and day care centers.

- School systems could explore ways of obtaining cooperation from recreation centers and day care centers to provide tutoring services to students. The tutoring sessions could take place in the recreation centers and day care centers, and could be conducted by trained high school students or adult volunteers. MCPS recruits adult tutors through its connections with businesses and industry.

Teacher Training

The data indicate that elementary school teachers may not have the requisite training to be as comfortable teaching mathematics as they are teaching other subjects. Thus, students may not be receiving as complete instruction in mathematics as they do in reading, for example, in the early years. Or, teachers may not be as aware of the variety of ways mathematical concepts can be introduced to students who have different learning modalities. The following suggestions address these needs:

- School systems need to explore ways of retraining their pool of elementary school teachers. Montgomery County's Department of Quality Integrated Education, in cooperation with American University, sponsors a program in several County elementary schools which retrains classroom teachers in effective strategies for teaching science and mathematics. Montgomery County staff who have been involved in this program feel it has substantial benefits. The success of this program could be evaluated for potential dissemination to other school systems. Similar positive results have been obtained in elementary teacher training programs developed and conducted by MCPS, which were supported by Title II EESA funds.

- o School systems or the NSF could consider developing a set of video tapes that could be used to train teachers in the most critical mathematical concepts or strategies that are deemed to be lacking. Teachers could borrow these tapes for self-instruction as needed.

- o Montgomery County has retrained elementary school teachers who were interested in teaching junior high/middle school mathematics. Those who were involved in this effort felt it was an effective way to acquire staff in areas of great need. School systems could consider retraining some junior high/middle school mathematics teachers who would be interested in teaching mathematics in the elementary school.

- o School systems should consider in-service training for junior and senior high school teachers in career awareness activities, and ways they can be more nurturing in the classroom and more sensitive to racial and sex role stereotypes.

Participation and Performance of Black and Hispanic Students in the Secondary School Curriculum

Large differences in participation and performance in the secondary school curriculum were observed by racial/ethnic group. A good part of the differences in participation that are observed at the secondary level are most likely a result of options being closed due to student differences in progress through the K-8 curriculum. Nevertheless, the study data suggest that many students leave the mathematics curriculum early or do not participate in the most advanced levels in the curriculum for other reasons. The following suggestions are aimed at keeping these students, for whom options have not been closed as a result of their progress in the K-8 curriculum, involved in the secondary school mathematics curriculum at the highest levels possible:

- o School systems need to communicate more fully to students and their parents the importance of taking as much mathematics as possible in high school. Many parents are unaware of the importance to their children of staying in the mathematics curriculum after high school graduation requirements have been met. Responses from Black and Hispanic parents on the study surveys indicate that they would undoubtedly support the school system in its efforts to increase student enrollment in accelerated mathematics classes if they were made aware of the importance of these classes to their children's futures. School systems could use the resources of prominent community members from the same racial/ethnic group to assist in this communication process.

- o Black and Hispanic parents need to be made more aware of the importance of SAT performance in their children's college plans. Parents should be instructed in the options available to students in preparing for the test, and the potential benefit to students of taking the test early in their high school years for practice purposes.

APPENDICES

APPENDIX TO CHAPTER 2:

REFERENCES

REFERENCES

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APPENDIX TO CHAPTER 3:

ISM OBJECTIVES AND DATA COLLECTION INSTRUMENTS

ISM OBJECTIVES

School | Teacher | Student

MATHEMATICS

✓I for Introduced
✓M for Mastered

Student Record for Level C and D Objectives - Grade 1

Numeration

I	M	Code		Objective
		14-C	K	Orders sets
		15-C		Orders numerals (1-9)
		16-C	K	Uses zero to name a set with no members
		17-C	K	Writes numerals 0-9
		18-C	K	Demonstrates what is needed to make two unequal sets of objects equal in number (1-9)
		19-D	K	Reads and writes 2-place numerals
		20-D	K	Names missing numbers 0-100, before, after or between given numbers (counting by ones)
		21-D		Names missing numbers 0-100, before, after or between given numbers (counting by tens)

Place Value

I	M	Code		Objective
		01-C		Groups objects into sets of ten
		02-C		Demonstrates a teen number as a set of ten and 1-9 ones
		03-C		Names sets of tens to 90
		04-D	K	Demonstrates with objects and names the number of tens and ones in numerals through 2 places

Addition

I	M	Code		Objective
		01-C		Puts two sets of objects together and names the number of the new set
		02-C	K	Reads and demonstrates with objects addition sentences (sums to 10)

Subtraction

I	M	Code		Objective
		01-C		Takes elements from a set of objects and names the number of the set removed and of the remaining set
		02-C	K	Reads and demonstrates with objects subtraction sentences (sums to 10)

Money

I	M	Code		Objective
		01-D		Identifies and states value of a penny, nickel and dime
		02-D	K*	Uses symbol for cent (¢)

Time and Temperature

I	M	Code		Objective
		02-D	K	Identifies time on a clock (hours)
		03-D	K*	Identifies day, week and month on a calendar

Length

I	M	Code		Objective
		03-C	K	Measures length using non-standard units

I	M	Code		Objective
		Capacity		
		02-D		Measures the capacity of a container with objects by counting
		Weight and Mass		
		01-C		Compares weights on a primary balance
		Geometric Figures		
		05-C		Identifies and names cube, sphere, cone
		06-C		Chooses a 3-D object that has a face of a given shape (□ ○ △)
		07-D		Classifies paths (straight or not straight, closed or not closed)
		08-D	K	Continues a repeating geometric pattern
		Statistical Graphs and Tables		
		03-D		Constructs a bar graph with a group
		04-D		Interprets a bar graph constructed by the group
		Common Fractions		
		02-D	K	Distinguishes among one-half, one-third and one-fourth of a region or object
		Number Sentences		
		01-C		Demonstrates the meaning of the symbols =, > and < by comparing sets of concrete objects (numbers 0-9)
		02-D		Reads orally number sentences using the symbols =, > and < (sums to 10)

School | Teacher | Student

MATHEMATICS

✓I for Introduced
✓M for Mastered

Student Record for Level E and F Objectives - Grade 2

I	M	Numeration		
		22-E	K	Reads and writes 3-place numerals
		23-E		Names objects with ordinal number names and identifies objects given ordinal names to tenth
		24-E	K	Names missing numbers in a sequence (before, after or between given numbers - up to 1000 - counting by ones)
		25-E	K	Names missing numbers in a sequence (before, after or between given numbers - up to 1000 - counting by tens)
		26-E		Names missing numbers in a sequence (before, after or between given numbers - up to 1000 - counting by fives)
		27-E		Names missing numbers in a sequence (before, after or between given numbers - up to 1000 - counting by twos)
		Place Value		
		05-E		Names 10 tens as a set of 100
		06-E		Names sets of hundreds to 900
		07-F	K	Demonstrates with objects and names the number of hundreds, tens and ones in numerals through 3 places
		08-F		Expands 3-place numerals
		Addition		
		03-E		Adds tens (sums to 90)
		04-E	K	Increases 2-place numbers by 10
		05-E		Adds 2-place numbers without regrouping
		06-F	K	Demonstrates the principle of regrouping in 2-place numbers
		Subtraction		
		03-E		Subtracts tens (sums to 90)
		04-E	K	Decreases 2-place numbers by 10
		05-E		Subtracts 2-place numbers without regrouping
		06-F	K	Demonstrates the principle of regrouping in 2-place numbers
		Multiplication		
		01-F		Combines given equivalent sets and names the number of the new set
		Division		
		01-F		Separates a set of objects into subsets of a given size, and names the number of subsets
		02-F		Separates a set of objects into a given number of subsets, and names the number in each set
		Basic Facts		
		01-E	K	Names addition facts (sums to 10)
		02-E	K	Names subtractraction facts (sums to 10)

I	M

Money

03-F K Identifies and states value in cents of a penny, nickel, dime, quarter, half dollar and dollar

Time and Temperature

04-E Identifies days with ordinal number names to thirty-first
05-F K States time after the hour on a clock (5-minute intervals)
06-F K* States relationships: minutes to hour, days to week, weeks to month, months to year

Length

04-F K* Measures and uses symbols for meters (m), and centimeters (cm)

Weight and Mass

02-E K Weighs with non-standard units on a balance scale

Geometric Figures

09-E Demonstrates line symmetry in a given shape (by folding)
10-E Identifies faces, edges and corners of 3-D objects
11-E K Identifies objects by 2 or 3 properties
12-F Constructs and describes a repeating pattern of geometric shapes

Statistical Graphs and Tables

05-E Constructs a simple pictograph
06-E K Interprets a simple pictograph
07-F Constructs a simple bar graph
08-F K Interprets a bar graph

Coordinate Graphs

02-F Shows locations on grids as blocks over and up

Common Fractions

03-F Identifies and demonstrates one-tenth of a region or object
04-F K Identifies parts of a region (halves, thirds, fourths, tenths)

Number Sentences

03-E Writes number sentences using the symbols =, > and <
04-E K Chooses the number sentence which describes a problem situation (sums to 10)
05-F K Solves number sentences with a missing number in any position (addition and subtraction facts)

Estimation and Rounding

01-F Rounds 2-place numbers to the nearer ten

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MATHEMATICS

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Student Record for Level G and H Objectives - Grade 3

I	M	

Place Value

I	M	Objective	K	Description
		09-G		Names 10 hundreds as 1000
		10-G		Demonstrates with objects 4-place numerals
		11-G		Names 10 thousands as 10,000

Addition

I	M	Objective	K	Description
		07-G	K	Adds 2-place numbers with regrouping
		08-G		Adds hundreds (sums to 900)
		09-G		Adds 3-place numbers without regrouping
		10-G	K	Demonstrates the regrouping of 3-place numerals
		11-H		Adds 3-place numbers with regrouping

Mastery of basic facts 01-E and 03-G is required before the next assessment can be administered.

Subtraction

I	M	Objective	K	Description
		07-G	K	Subtracts 2-place numbers with regrouping
		08-G		Subtracts hundreds (sums to 900)
		09-G		Subtracts 3-place numbers without regrouping
		10-G	K	Demonstrates the regrouping of 3-place numerals
		11-H		Subtracts 3-place numbers with regrouping

Mastery of basic facts 02-E and 04-G is required before the next assessment can be administered.

Multiplication

I	M	Objective	K	Description
		02-H		Demonstrates with objects the multiplication facts of 1, 2, 3, 4, 5
		03-H		Multiplies multiples of 10, 100, and 1000 by one-digit numbers (1, 2, 3, 4, 5)
		04-H	K	Multiplies 2- and 3-place factors by 2, 3, 4, 5 with no regrouping
		05-H	K	Multiplies 2- and 3-place factors by one-digit factors (2, 3, 4, 5) with regrouping

Division

I	M	Objective	K	Description
		03-H		Demonstrates with objects the division facts of 1, 2, 3, 4, 5
		04-H		Divides multiples of 10, 100, and 1000 by one-digit divisors (1, 2, 3, 4, 5) (no remainders)
		05-H	K	Divides 2-place numbers by one-digit divisors (1, 2, 3, 4, 5) (with or without remainders)

I	M

Basic Facts

- 03-G K Names addition facts (sums to 18)
- 04-G K Names subtraction facts (sums to 18)
- 05-H K Names multiplication facts of 0, 1, 2, 3, 4, 5
- 06-H K Names division facts of 1, 2, 3, 4, 5

Money

- 04-H K* Selects coins to equal a given value
- 05-H K* Makes change (adding up)
- 06-H Uses dollar symbol ($)
- 07-H K* Adds and subtracts money

Time and Temperature

- 07-H Reads time notation (2:35 as "two thirty-five")
- 08-H K* Reads and writes time (am, pm, 2:35)

Length

- 05-G Describes uses of the kilometer (km)
- 06-G Renames kilometers to meters

Capacity

- 03-H K* Measures and records capacity in liters (L) and milliliters (mL)

Weight and Mass

- 03-H K* Weighs and records grams (g) or kilograms (kg)

Geometric Figures

- 13-G Identifies and describes shapes having line symmetry
- 14-G K Identifies congruent shapes by matching

Statistical Graphs and Tables

- 09-G K* Names information from a table
- 10-G K Interprets a simple circle graph
- 11-H Tabulates data into a table
- 12-H Constructs a pictograph from data gathered and tabulated

Common Fractions

- 05-H K Demonstrates one-half, one-third, and one-fourth of sets
- 06-H States the meaning of each term of a common fraction
- 07-H Reads and write symbols for unit fractions using regions (1/2, 1/3, 1/4, 1/10)
- 08-H K Names and writes common fractions <1 shown on a given region (denominators of 2, 3, 4, 6, 8, 10)

Estimation and Rounding

- 02-G Rounds 3-place numbers to the nearer ten or hundred

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MATHEMATICS

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Student Record for Level I and J Objectives - Grade 4

| I | M |

Numeration

28-I K Reads and writes 4- or 5-place numerals

Place Value

12-I K States the place and value of any digit in 4- or 5-place numerals
13-I Expands 4- and 5-place numerals
14-I Identifies the value of the first position to the right of the decimal point as one-tenth of the ones place
15-I Identifies the value of the second position to the right of the decimal point as one-tenth of the tens place and one-hundredth of the ones place

Addition

Mastery of basic facts 01-E and 03-G is required before the next assessment can be administered

12-I K* Adds through 4-place numbers with regrouping

Subtraction

Mastery of basic facts 02-E and 04-G is required before the next assessment can be administered

12-I K* Subtracts through 4-place numbers with regrouping

Multiplication

06-I K Multiplies 2- and 3-place factors by one-digit factors (6, 7, 8, 9) with regrouping

Division

06-I Divides multiples of 10 greater than 100 by one-digit divisors (6, 7, 8, 9) (no remainders)
07-J K Divides 3-place numbers by one-digit divisors with 2-place quotients (with or without remainders)
08-[illegible] K Divides 3-place numbers by one-digit divisors with 3-place quotients (with or without remainders)

Basic Facts

[illegible] Names multiplication facts of 6, 7, 8, 9
[illegible] K Names division facts of 6, 7, 8, 9

[illegible]y

08-J K* Multiplies using money

Time and Temperature

09-J K* States time on clock to minute (2:43)
10-J K* States the relationship of seconds to minutes and minutes to seconds

Length

07-I K Measures in millimeters (mm)
08-I Renames meters through millimeters
09-J K* Measures perimeters of plane figures

Area and Volume

01-I Distinguishes between a plane shape and its region
02-I Identifies shapes which can fit together to cover a surface
03-J K Finds and records areas of plane regions by counting square units

I	M			
		Geometric Figures		
		15-J		Classifies and identifies polygones with 4, 5, 6, 8 line segments
		Statistical Graphs and Tables		
		13-I	K	Constructs a bar graph from data gathered and tabulated
		14-J		Interprets information from a line graph
		15-J		Constructs graphs using decimal fractions
		Coordinate Graphs		
		03-I	K	Identifies the location for a given ordered pair and writes the ordered pair for a given location on a coordinate graph (first quadrant)
		04-I		Graphs pairs of addends for a given sum on a coordinate graph (first quadrant)
		Common Fractions		
		09-I	K	Identifies and demonstrates two-thirds and three-fourths of sets
		10-I	K	Names and writes common fractions < 1 shown on a given set (denominators of 2, 3, 4, 6, 8, 10)
		11-I	K	Identifies fractional names for one
		12-I		Identifies the "numerator" and "denominator" and states the meaning of any given common fraction
		13-J	K	Identifies equivalent names for fractions ≤ 1
		14-J	K	Demonstrates the meaning of any common fraction ≥ 1
		15-J	K	Writes fractions > 1 as mixed numerals and mixed numerals as fractions
		Decimal Fractions		
		01-I	K	Demonstrates decimal fractions through hundredths
		02-I	K	Reads and writes decimal fractions through hundredths
		03-I		Writes common fractions for decimal fractions and decimal fractions for common fractions (tenths, hundredths)
		04-J	K*	Adds and subtracts decimal fractions through hundredths with regrouping
		05-J	K*	Orders decimal fractions through hundredths
		Number Sentences		
		06-J	K	Solves number sentences with a missing number in any position (Multiplication and division facts)
		Factors and Multiples		
		01-I		Identifies factors in a multiplication or division number sentence
		02-I		Names multiples of whole numbers to 9
		03-J		Names common multiples of two whole numbers to 16
		04-J		Names all factors of whole numbers to 50
		05-J		Names common factors of two whole numbers to 50
		06-J		Names prime numbers to 50
		07-J	K	Names the greatest common factor of two or more whole numbers to 50
		Estimation and Rounding		
		03-I		Rounds 4-place numbers to the nearer ten, hundred, or thousand
		04-I		Estimates sums or differences
		Positive and Negative Numbers		
		01-J		Uses positive and negative numbers in a game situation

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MATHEMATICS

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Student Record for Level K and L Objectives - Grade 5

I	M	Code		Objective
		Addition		
		13-K		Adds with regrouping
		Subtraction		
		13-K		Subtracts with regrouping
		Multiplication		
		07-K	K	Multiplies 2- and 3-place factors by 10 and multiples of 10 (including 100)
				Mastery of basic facts 05-H and 07-J is required before the next assessment can be administered
		08-L	K*	Multiplies 2-, 3-, or 4-place factors by 2-place factors
		Division		
		09-K		Divides 3- and 4-place numbers by multiples of 10 with 2- and 3-place quotients (with or without remainders)
				Mastery of basic facts 06-H and 08-J is required before the next assessment can be administered
		Time and Temperature		
		11-K	K	Adds and subtracts using time
		12-L	K*	Names and records Celsius temperature (positive and negative)
		Length		
		10-L	K	Measures and records length using decimal notation
		Area and Volume		
		04-K	K*	Computes the area of rectangles (l x w = A)
		05-K		Uses exponential symbols for metric area units (cm^2)
		Geometric Figures		
		16-K		Identifies the reflection of a figure
		17-K		Draws the reflection of a given figure
		18-K	K	Locates the lines of symmetry in shapes
		Statistical Graphs and Tables		
		16-K		Determines averages for given data

I	M	

Common Fractions

16-K	K	States fractions and mixed numerals in simplest form (i.e. lowest terms)
17-K	K	Orders pairs of fractional numbers using >, <, =
18-K	K	Demonstrates with objects the addition of fractions with like denominators (including mixed numbers)
19-K	K	Adds fractions with like denominators (including mixed numbers)
20-K	K	Demonstrates with objects the subtraction of fractions with like denominators (including mixed numbers)
21-K	K	Subtracts fractions with like denominators (including mixed numbers)
22-L		Identifies fractional names for whole numbers
23-L		Multiplies a whole number times a unit fraction

Decimal Fractions

06-K		Demonstrates decimal fractions through thousandths
07-K		Reads and writes decimal fractions through thousandths
08-K	K	Writes decimal fractions for common fractions (denominators of ten, one hundred, and one thousand)
09-K		Adds and subtracts decimal fractions (through thousandths)
10-L	K*	Writes common fractions for decimal fractions through thousandths
11-L	K	Orders decimal fractions through thousandths
12-L		Multiplies a whole number times a decimal fraction through thousandths
13-L	K*	Multiplies a decimal fraction times a decimal fraction

Ratio and Percent

01-L	K	Writes the ratio of two quantities as a fraction
02-L		Identifies a pair of equal ratios as a proportion

Number Sentences

07-L	K	Solves number sentences involving parentheses and more than one operation

Estimation and Rounding

05-K	K	Rounds whole numbers to any given place
06-K		Rounds mixed numbers to the nearer whole number
07-K		Estimates products or quotients
08-L		Rounds decimal fractions to the nearer whole number
09-L	K*	Rounds decimal fractions to the nearer whole number, tenth and hundredth

Exponents and Scientific Notation

01-K	K	Uses exponents to describe repeated factors
02-K	K	Converts exponential notation to whole numbers

Positive and Negative Numbers

02-L		Uses symbols for positive and negative numbers
03-L	K	Orders positive and negative numbers

1979-80

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MATHEMATICS

√I for Introduced
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Student Record for Level M and N Objectives - Grade 6

I	M			

Multiplication

09-N Multiplies multiples of 100 or 1000 by 3- or more place factors (including multiples of 100, 1000)
10-N Multiplies 3- or more place factors by 3- or more place factors

Division

Mastery of basic facts 06-H and 08-J is required before the next assessment can be administered

10-N K* Uses standard algorithm for dividing by 2-place divisors

Length

11-M K Changes to equivalent linear measures (milli through kilo)
12-M K* Measures the radius, diameter, and circumference of a circle

Weight and Mass

04-M Relates the metric ton to the kilogram
05-N Identifies the use of milligrams (mg)
06-N K Changes to equivalent metric measures (milli through kilo)

Area and Volume

06-M K Computes the area of a triangle
07-M K Computes the area of a quadrilateral (trapezoid, parallelogram)

Geometric Figures

19-M K* Constructs a circle and identifies its circumference, diameter, radius, and center
20-M Distinguishes between lines and line segments
21-M K Describes lines: horizontal, vertical, parallel, and perpendicular
22-M Distinguishes among quadrilaterals: rectangle, square, parallelogram, rhombus, and trapezoid
23-N Describes rays and angles
24-N K Identifies congruent angles by matching
25-N Measures angles using a protractor
26-N K Constructs an angle of a given measure

Statistical Graphs and Tables

17-M Determines scale for data
18-M K Constructs graphs for two variables

Coordinate Graphs

05-M K Locates the point for given coordinates and names the coordinates of a given point in any of the four quadrants
06-M Constructs graphs in four quadrants

I	M			
		Common Fractions		
		24-M		Demonstrates the meaning of multiplication for a unit fraction times a unit fraction
		25-M		Multiplies fractions (less than 1)
		26-M	K	Multiplies fractions (including mixed numbers)
		Decimal Fractions		
		14-N	K*	Divides a smaller whole number by a larger whole number or a decimal fraction through thousandths by a whole number
		15-N	K	Writes decimal fractions for common fractions
		Ratio and Percent		
		03-M		Solves for a missing term in a proportion
		04-N	K	Writes a ratio with a denominator of 100 as a percent (%) and a percent as a ratio with a denominator of 100
		Number Sentences		
		08-N		Solves addition number sentences with positive and negative numbers
		Factors and Multiples		
		08-M	K	Names the least common multiple of two or more numbers to 16
		09-M	K	Writes the prime factorization of any number through 2 places
		Positive and Negative Numbers		
		04-N		Adds negative numbers
		05-N		Adds positive and negative numbers

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Student Record for Level O and P Objectives - Grade 7

✓I for Introduced
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I	M				
		Numeration			
		29-O		Writes word names for numerals through 4-places	
		30-O	K	Writes numerals through billions	
		Place Value			
		16-O		Expands decimal fractions	
		17-O		Expands numerals using exponents (whole numbers)	
		Division			
		11-O		Divides by 3- or more place divisor	
		Length			
		13-O		Computes the circumference of a circle	
		Capacity			
		04-P		Estimates and verifies capacities by measuring in liters and milliliters	
		05-P	K	Changes to equivalent metric measures (milli through kilo)	
		Geometric Figures			
		27-O		Identifies and uses notation for a point, segment, ray, line, and angle	
		28-O		Distinguishes among open, closed, simple, and non-simple curves	
		29-O		Distinguishes between concave and convex polygons	
		30-O		Distinguishes among interior, exterior, and curve itself	
		31-O		Determines the number of diagonals of a polygon	
		32-O	K	Identifies similar and congruent shapes	
		33-P		Uses a given scale to interpret a scale drawing	
		34-P		Constructs a scale drawing given dimensions	
		35-P	K	Distinguishes among acute, right, obtuse, and straight angles	
		36-P	K	Identifies complementary, supplementary, vertical, and adjacent angles	
		37-P		Determines lines of symmetry in a triangle	
		38-P	K	Classifies triangles by comparing lengths of the sides	
		39-P	K	Classifies triangles by angle measure	
		Statistical Graphs and Tables			
		19-P		Interprets scale for a pictograph	
		20-P	K*	Interprets information from statistical graphs (pictograph, bar graph, line graph, circle graph)	
		21-P	K	Constructs a bar graph using percent	
		22-P		Constructs a circle graph using fractions	
		Coordinate Graphs			
		07-P		Graphs the solution set of a mathematical sentence containing one variable	

214

(cont.) Levels O and P Objectives - Grade 7

I	M

Common Fractions

27-P K Names equivalent fractions with a given denominator
28-P Names least common denominators (LCD)
29-P K Adds common fractions with unlike demoninators
30-P K Subtracts common fractions with unlike denominators
31-P Multiplies 3 or more common fractions
32-P K Divides common fractions
33-P Uses a combination of operations with common fractions

Decimal Fractions

16-O Divides a whole number by a decimal fraction
17-O Divides a decimal fraction by a decimal fraction
18-O K Divides decimal fractions (including mixed decimal fractions)
19-P Reads and writes decimal fractions less than thousandths
20-P Uses a combination of operations with decimal fractions

Ratio and Percent

05-P K* Writes a decimal (less than 1) as a percent and a percent (less than 100%) as a decimal
06-P Writes a percent as a fraction in simplest form
07-P Writes a common fraction as a percent
08-P K Finds a percent (greater than 1% but less than 100%) of a number

Number Sentences

09-O Uses combinations of operations with whole numbers
10-O Solves one-step number sentences using decimal fractions
11-P Names the solution set for an equation
12-P Solves one-step number sentences using common fractions
13-P Writes the mathematical sentence for a word sentence

Factors and Multiples

10-P Names all factors of a number
11-P Applies rules of divisibility for 2, 3, 5, and 10
12-P Writes the prime factorization of a number using exponents

Estimation and Rounding

10-O Estimates products and quotients using very large or very small decimals, common fractions, or whole numbers

1979-80

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MATHEMATICS

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Student Record for Level Q and R Objectives - Grade 8

I | M

Capacity

06-Q States the relationship of a liter to a cubic decimeter to a kilogram

Area and Volume

08-Q K Computes the area of a circle
09-Q Computes the surface area of a right prism
10-Q Computes the surface area of a right circular cylinder
11-Q Finds and records the volume of a rectangular prism by counting cubic units
12-Q K Computes the volume of a right prism
13-Q Uses exponential symbols for metric volume units (cm^3)
14-Q Computes the volume of a right circular cylinder

Geometric Figures

40-Q Demonstrates translations, reflections, rotations, and dilations
41-Q Identifies angles formed by lines intersected by a transversal
42-Q Identifies congruent angles formed by parallel lines intersected by a transversal
43-Q K Distinguishes among drawings of solid shapes
44-Q Uses a straightedge and compass to copy a line segment
45-Q Uses a straightedge and compass to copy an angle
46-Q K Uses a straightedge and compass to bisect a line segment and an angle
47-Q Uses a straightedge and compass to construct a perpendicular to a line through a point on the line
48-Q Uses a straightedge and compass to construct a perpendicular to a line through a point not on the line
49-Q Uses a straightedge and compass to construct a line parallel to a given line through a point not on the line

Statistical Graphs and Tables

23-Q K Constructs a circle graph using percent
24-Q Constructs a circle graph using measurement data
25-Q Constructs a frequency table
26-R K Finds mean, median, and mode

Coordinate Graphs

08-Q Graphs inequalities using decimal and common fractions
09-R Graphs the solution set of a number sentence using positive and negative numbers
10-R K Distinguishes among axes, origin, quadrants, and ordered pairs

Common Fractions

34-Q Classifies fractions as terminating or repeating

Ratio and Percent

I	M	Objective		Description
		09-Q		Writes a decimal (greater than 1) as a percent and a percent (greater than 100%) as a decimal
		10-Q		Writes a decimal (less than 0.01) as a percent and a percent (less than 1%) as a decimal
		11-Q		Finds a percent (less than 1% or greater than 100%) of a number
		12-Q	K	Uses a proportion to find the percent one number is of another number
		13-Q		Uses a proportion to find the number of which a given number is a given percent
		14-R		Writes probabilities of events as ratios

Number Sentences

I	M	Objective		Description
		14-Q		Writes the mathematical sentence for a verbal inequality
		15-Q		Determines the solution set for an inequality
		16-R		Solves equations and inequalities containing positive and negative numbers and one variable by addition
		17-R		Solves equations containing positive and negative numbers and one variable by multiplication
		18-R		Solves equations containing positive and negative numbers and one variable by addition and multiplication

Exponents and Scientific Notation

I	M	Objective		Description
		03-Q	K	Simplifies the product of two or more numbers in exponential form
		04-Q		Simplifies the quotient of two numbers in exponential form
		05-Q		Writes the power of a power in exponential notation
		06-R	K	Raises negative numbers to powers
		07-R		Changes scientific notation to customary notation
		08-R	K	Writes a given number using scientific notation
		09-R		Finds the square roots of perfect squares
		10-R	K	Approximates the square roots of numbers which are not perfect squares
		11-R	K	Uses a table to name the square and square root of a number

Positive and Negative Numbers

I	M	Objective		Description
		06-Q		Names additive inverses for positive and negative numbers
		07-Q		Names equivalent forms for positive and negative numbers
		08-Q	K	Multiplies positive and negative numbers
		09-Q		Names reciprocals for positive and negative numbers
		10-Q	K	Divides positive and negative numbers
		11-Q	K	Adds positive and negative numbers
		12-Q	K	Subtracts positive and negative numbers
		13-Q	K	Simplifies expressions using two or more operations and positive and negative numbers

1979-80

DATA COLLECTION INSTRUMENTS

4th and 6th GRADE
STUDENT QUESTIONNAIRE

1. DIRECTIONS: We are trying to find out what girls and boys your age think about math. Below are some statements about math. There are no right or wrong answers to these statements—we just want you to answer the way you feel. If you agree with the statement or think it is true, put a circle around the word "yes." If you do not agree or think that it is not true, put a circle around the word "no." Try to circle either "yes" or "no" for every statement, but if you are not sure of your answer, you may circle "don't know". If you do not understand a question, ask me about it.

EXAMPLE:

I like baseball. YES NO DON'T KNOW

In this example, the student circled "no" because he/she does not like baseball.

a. You need a lot of luck to do well in math.	YES	NO	DON'T KNOW
b. Women need to know a lot of math.	YES	NO	DON'T KNOW
c. There is only one correct way to do a math problem.	YES	NO	DON'T KNOW
d. It is important to know math to get a good job.	YES	NO	DON'T KNOW
e. The best part of my school day is doing math.	YES	NO	DON'T KNOW
f. If I had my choice, I would not take any more math.	YES	NO	DON'T KNOW
g. I enjoy trying to solve a math problem.	YES	NO	DON'T KNOW
h. I like to help others with math problems.	YES	NO	DON'T KNOW
i. Boys are better at math than girls.	YES	NO	DON'T KNOW
j. Men make better scientists and engineers than women.	YES	NO	DON'T KNOW
k. I will work a long time to understand a math problem.	YES	NO	DON'T KNOW
l. It scares me to have to take math.	YES	NO	DON'T KNOW
m. You need to study hard to do well in math.	YES	NO	DON'T KNOW

n. When I cannot figure out an answer to a math problem, I get upset. YES NO DON'T KNOW

o. I worry about failing math. YES NO DON'T KNOW

p. Men need to know a lot of math. YES NO DON'T KNOW

q. Whenever I take a math test, I know I will pass it. YES NO DON'T KNOW

r. It takes me a long time to understand math. YES NO DON'T KNOW

s. I am smart in math. YES NO DON'T KNOW

t. I don't like to ask questions in math class. YES NO DON'T KNOW

u. I understand math as well as I understand other subjects. YES NO DON'T KNOW

v. When I do a math problem, I am sure that I have done it correctly. YES NO DON'T KNOW

w. When I grow up, I would like to have a job that uses math. YES NO DON'T KNOW

x. I think math is fun. YES NO DON'T KNOW

y. I am more nervous when I take a math test than I am when I take a test in my other subjects. YES NO DON'T KNOW

2. Which of the following people do you think use math in their jobs?

teacher . . . . YES NO DON'T KNOW

bus driver . . . . YES NO DON'T KNOW

doctor . . . . YES NO DON'T KNOW

nurse . . . . YES NO DON'T KNOW

scientist. . . . . YES NO DON'T KNOW

carpenter. . . . . YES NO DON'T KNOW

bank teller. . . . . YES NO DON'T KNOW

baker . . . . YES NO DON'T KNOW

fireman. . . . . YES NO DON'T KNOW

3. When you have trouble with a math problem, what do you usually do? Put a circle around the number of the answer that describes what you usually do. Choose only one answer.

   1. try it another way
   2. ask a friend for help
   3. ask the teacher for help
   4. come back to it later
   5. ask a friend for the answer
   6. give up
   7. write down any answer, even if I don't think it's the right one

4. How often do you need help doing your math homework? Put a circle around the number of the answer that is true for you. Choose only one answer.

   1. Very often
   2. Sometimes
   3. Hardly ever
   4. I never need help
   5. I never have math homework

5. If you need help with math, who usually helps you?

my teacher	YES	NO	DON'T KNOW
my mother or step-mother	YES	NO	DON'T KNOW
my father or step-father	YES	NO	DON'T KNOW
a friend	YES	NO	DON'T KNOW
a tutor.	YES	NO	DON'T KNOW
an adult other than my teacher, tutor, or parents.	YES	NO	DON'T KNOW
an older sister or brother	YES	NO	DON'T KNOW

6. How does your teacher teach math?

The teacher teaches the whole class at the same same time	YES	NO	DON'T KNOW
We have math groups	YES	NO	DON'T KNOW
We do work sheets or dittoes while the teacher walks around and checks on our work	YES	NO	DON'T KNOW

7. If your class has math groups, how good are the students in your math group? Put a circle around the number of the answer you would pick. Choose only one answer.

1. Very good in math
2. Average in math
3. Not good in math
4. My class does not have math groups
8. Don't know

8. How important are the following things in your math class? Put a circle around <u>one</u> number for <u>each</u> of the things listed.

	Always Important	Sometimes Important	Not Important
Memorizing facts or rules. . .	1	2	3
Getting the right answer to every problem	1	2	3
Figuring out the answer to new problems.	1	2	3
Solving problems in your head.	1	2	3
Doing homework every night . .	1	2	3
Keeping a neat notebook . . .	1	2	3
Answering questions in class .	1	2	3
Asking questions in class. . .	1	2	3
Showing all the steps you took to arrive at your answer. . .	1	2	3

9. Have any of your teachers ever done any of the following things?

	Yes	No	Don't Know
Said that girls are <u>not</u> good at doing math	1	2	8
Told the class that math is important if you want to do certain kinds of work when you grow up	1	2	8
Said that boys are better at math than girls are	1	2	8
Said that math was more important than reading or language arts	1	2	8

10. How often do you do the following things? Put a circle around <u>one</u> number for <u>each</u> of the things listed.

	Often	Sometimes	Never
Use a hand calculator.	1	2	3
Use a computer at home	1	2	3
Use a computer at school	1	2	3
Use a recipe to cook	1	2	3
Make a model car, airplane, train, boat, etc.	1	2	3
Sew, knit, or crochet.	1	2	3
Visit a science or technology museum.	1	2	3
Play with a home chemistry set . .	1	2	3
Do math problems or brain twisters for fun	1	2	3
Do crossword puzzles	1	2	3
Do jigsaw puzzles.	1	2	3
Play games involving strategy like "Dungeons and Dragons," Chess, or Checkers.	1	2	3
Play football, baseball or soccer.	1	2	3

Thank you. That completes the questionnaire.

K-8 Parent Questionnaire

DIRECTIONS: To begin, I will read some statements about math. For each statement, please tell me whether you "strongly agree", "agree", "disagree", or "strongly disagree" depending on how the statement best describes your feelings. There are no right or wrong answers. We want you to respond to each statement the way you feel.

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
1. It is important to know math to get a good job.	1	2	3	4	8
2. Most people do not use math in their jobs.	1	2	3	4	8
3. Boys are better at math than girls.	1	2	3	4	8
4. Men make better scientists and engineers than women.	1	2	3	4	8
5. A woman needs a career just as much as a man does.	1	2	3	4	8
6. I have a good mind for math.	1	2	3	4	8
7. Teachers are always right in their evaluations of my child's math abilities.	1	2	3	4	8
8. I will question a teacher if I disagree with his/her evaluation of my child's math abilities.	1	2	3	4	8
9. Men make better math teachers than women.	1	2	3	4	8
10. Students should take honors or advanced math classes only if they think they can get an A or a B.	1	2	3	4	8
11. Students should take as much math as possible, regardless of their career goals.	1	2	3	4	8

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
12. Just because a student is bright doesn't mean he/she can handle advanced math classes.	1	2	3	4	8

Now I would like to ask you about your child's experience with math. From now on, each time I ask about your child, I will be referring to (name of child).

13. Tell me, does your child ever bring home math homework or study for a math test at home?

    1. Yes
    2. No (skip to Question 24)
    8. Don't know (Skip to Question 24)

14. How many times a week does your child bring home math homework?

    1. Every day (5 days a week)
    2. 3-4 days a week
    3. 1-2 days a week
    8. Don't know

15. Does your child do his/her homework at the same time every day?

    1. Yes
    2. No
    8. Don't know

16. Where does he/she usually do homework (e.g., in his/her room, in front of a television, etc.)?

    ____

    ____

17. On the average, about how much time does your child spend studying math at home each week?

    1. Less than one-half hour
    2. Between one-half hour and one hour
    3. Between one hour and one and one-half hours
    4. More than one and one-half hours
    8. Don't know

18. Is your child generally frustrated by his/her math homework or does he/she find it easy to do?

1. Frustrated
2. Easy to do
3. Doesn't find it easy to do but not frustrated either
8. Don't know

19. Does your child ever ask for help with his/her math homework or in studying for a math test?

1. Yes
2. No (skip to Question 24)

20. Who in the household usually helps him/her with math homework and/or study for math tests? (Check all that apply.)

1. Yourself
2. Your husband/wife
3. Another relative (e.g., sibling or grandparent)
4. No one (skip to Question 24)
5. Other (specify): ____________________

21. Is there any particular reason that this (these) individual(s) help(s) your child as opposed to another member of the household, and, if so, why? (Circle all that apply.)

1. Individual is better at math
2. Individual is better at working with child
3. Individual is the only one available at the time to work with child
4. No particular reason
5. Other (specify): ____________________

22. How many times a week does someone in your household help your child do math homework and/or study for a math test?

1. Every day (5 days a week)
2. 3-4 days a week
3. 1-2 days a week
4. Less than 1 day a week
8. Don't know

23. Compared to other subjects, how much help does your child need in studying math? Would you say that:

1. more help is needed in math
2. less help is needed in math
3. about the same
8. don't know

24. Do you know whether or not your child's teacher places children in groups for purposes of math instruction?

1. Yes
2. No (skip to Question 29)
8. Don't know (skip to Question 29)

25. In which math group is your child placed?

1. Above average or high group
2. Average group
3. Below average or low group
8. Don't know (skip to Question 29)

26. Has your child ever moved from one group to another in math?

1. Yes
2. No
8. Don't know

27. Were you told why?

1. Yes
2. No

28. Please explain: ______________________________

____

29. How satisfied are you with your child's placement in math class?

1. Satisfied (skip to Question 31)
2. Dissatisfied
3. Don't know (skip to Question 31)

30. Why are you dissatisfied?

____

____

____

31. How would you personally rate your child's performance in math? Would you say he/she is: (Circle one.)

1. Outstanding
2. Above average
3. Average
4. Below average
8. Don't know

32. In thinking about your child's math education so far, how well do you think he/she has been prepared:

	Well Prepared	Somewhat Prepared	Not Well Prepared	Don't Know
1. To add, subtract, multiply, and divide	1	2	3	8
2. To do word problems	1	2	3	8
3. To understand the importance of mathematics in everyday life	1	2	3	8

33. In your opinion, has your child ever had any outstanding math teachers or teachers who inspired him/her in math?

1. Yes
2. No (skip to Question 35)
8. Don't know (skip to Question 35)

34. What was it that made this (these) individual(s) an outstanding or inspiring math teacher: (Probe: was very patient in working with the child, was very enthusiastic, etc.)

____

____

____

35. In your opinion, has your child ever had any bad math teachers or teachers who turned him/her off to math?

1. Yes
2. No (skip to Question 37)
8. Don't know (skip to Question 37)

36. What was it that made this (these) individual(s) a bad or uninspiring math teacher? (Probe: would not explain new material satisfactorily, was sarcastic, etc.)

____

____

____

37. Did your child show a very early interest in computers and/or in how things work mathematically or mechanically?

1. Yes
2. No

38. Do you or anyone else in your household do anything special at home to foster your child's interest in math and/or science? If so, please describe.

____

____

____

39. Has your child participated in a special math program for the gifted?

1. Yes
2. No (skip to Question 41)
8. Don't know (skip to Question 41)

40. Please describe: ____

____

41. Looking ahead, what kinds of math do you think your child will need to take to prepare him/her for his/her future career? (Circle one.)

1. Basic math required for working in an office or small business
2. Enough math to qualify for admission to college
3. Enough math to be able to pursue a career in math or science
8. Don't know

42. How far in school would you like your child to get? (Circle one.)

1. High school graduation
2. Vocational, trade, or business school after high school
3. Some college, including a two-year degree, but less than four years of college
4. Finish college (four- and five-year degree)
5. Master's degree or equivalent
6. Ph.D., M.D., or other advanced professional degree
8. Don't know

43. What kind of work do you think your child will be doing at age 30? **(Interviewer: Record the response in the space provided and enter the appropriate code where specified.)**

______________________________ 2-digit code

Your response to the next set of questions is voluntary. Your answers will allow us to classify all the information we have obtained through the survey.

44. What is the highest level of education that you completed? (Circle one.)

1. Less than high school graduation
2. High school graduation
3. Vocational, trade, or business school after high school
4. Some college, including a two-year degree but less than four years of college
5. Finished college (four- or five-year degree)
6. Master's degree or equivalent
7. Ph.D., M.D., or other advanced professional degree
9. Refused to answer

45. What is the highest level math course you took in high school?

Highest level math course: ____________________________

46. Overall, how would you rate your performance in math when you were in high school? Would you way you were: (Circle one.)

1. Outstanding
2. Above average
3. Average
4. Below average
8. Don't know/Refused to answer

(INTERVIEWER: If the respondent indicated in Question 44 that he/she attended college, ask Questions 47-50. Otherwise, skip to Question 51.)

47. You mentioned earlier that you attended college. What was your major?

Major: ______________________________

48. Did you take any math courses in college?

1. Yes
2. No (skip to Question 51)
9. Refused to answer (skip to Question 51)

49. What was the highest level math course you took in college?

Highest level math course: ______________________________

50. Overall, how would you rate your performance in math in college? Would you say you were: (Circle one.)

1. Outstanding
2. Above average
3. Average
4. Below average
8. Don't know/Refused to answer

51. Are you currently working?

1. Yes
2. No (skip to Question 54)
9. Refused to answer (skip to Question 54)

52. What do you do? (Interviewer: Record the response in the space provided and then enter the appropriate 2-digit code where specified.)

______________________________ ___ ___

2-digit code

53. How important is math in your job?

1. Very important
2. Somewhat important
3. Not important
9. Refused to answer

54. What is the highest level of education that your husband/wife completed? (Circle one.)

1. Less than high school graduation
2. High school graduation
3. Vocational, trade, or business school after high school
4. Some college, including a two-year degree but less than four years of college
5. Finished college (four- or five-year degree)
6. Master's degree or equivalent
7. Ph.D., M.D., or other advanced professional degree
8. Don't know/Refused to answer
9. Not applicable (skip to Question 59)

(INTERVIEWER: If the respondent indicated that his/her spouse attended college, ask Question 55. Otherwise, skip to Question 56.)

55. What was his/her major area of study?

Major: ______________________________

56. Does your husband/wife currently work?

1. Yes
2. No (skip to Question 59)
9. Not applicable (skip to Question 59)
99. Refused to answer (skip to Question 59)

57. What does he/she do? **(Interviewer: Record the response in the space provided and enter the appropriate 2-digit code where specified.)**

______________________________ ___ ___ 2-digit code

58. How important is math in his/her job?

1. Very important
2. Somewhat important
3. Not important
8. Don't know
9. Refused to answer

59. The last question concerns your family's total income. Your response is voluntary but will help us in classifying the responses of all study participants. Would you mind telling me your total family income from all sources in 1985? (Circle one.) (INTERVIEWER: Only read response categories if the respondent hesitates in answering the question.)

1. Less than $ 8,000
2. $8,000 to $14,999
3. $15,000 to $19,999
4. $20,000 to $24,999
5. $25,000 to $29,999
6. $30,000 to $39,999
7. $40,000 to $49,999
8. $50,000 or more
9. Don't know/Refused to answer

That completes the interview. Thank you very much for your time and assistance.

4th and 6th GRADE

TEACHER QUESTIONNAIRE
SECTION 1

Directions: We are trying to find out what teachers such as yourself think about mathematics and mathematics instruction. Below are a number of statements about mathematics and the study of mathematics. There are no right or wrong answers to these statements—we want you to answer the way you feel. For each statement, you are to indicate whether you "strongly agree", "agree", "disagree", or "strongly disagree", depending on how the statement best describes your feelings, by circling the number which corresponds to each response. If you are unsure of your answer, you may circle "don't know", but try to circle one of the other responses first.

		Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
1.	Students should take honors or advanced mathematics classes only if they think they can get an A or a B.	1	2	3	4	8
2.	There is only one correct way for students to do a mathematics problem.	1	2	3	4	8
3.	Students should take as much mathematics as possible, regardless of their career goals.	1	2	3	4	8
4.	Just because a student is bright doesn't mean he/she can handle advanced mathematics topics.	1	2	3	4	8
5.	I enjoy teaching mathematics.	1	2	3	4	8
6.	In my experience, boys are better at mathematics than girls.	1	2	3	4	8
7.	Boys need to know more mathematics than girls.	1	2	3	4	8
8.	Of all the subjects I can teach, I feel most comfortable teaching mathematics.	1	2	3	4	8

9. Please rate the importance of each of the following goals for students who are learning mathematics. For each goal, circle the number that most closely matches your view of its importance.

	Very Important	Somewhat Important	Not Important
Develop a systematic approach to solving problems	1	2	3
Know mathematical facts and principles	1	2	3
Understand the logical structure of mathematics	1	2	3
Develop an attitude of inquiry	1	2	3
Develop an awareness of the importance of mathematics in everyday life	1	2	3
Become interested in mathematics	1	2	3
Develop an awareness of the importance of mathematics in keeping career options open	1	2	3
Perform computations with speed and accuracy	1	2	3

10. To which of the following levels of students do you typically (i.e., over the last two years) teach mathematics? (Circle one.)

1. High
2. Average
3. Low
4. Mixed levels
5. Other (specify): ______________________________

11. What do you expect or would you expect of high mathematics groups that you would not expect of low mathematics groups (or vice versa) in classroom performance, test performance, or completion of homework assignments? Please be specific regarding what you perceive to be differences in capabilities, observed performance, and instructional needs.

12. What considerations do you make or would you make in preparing quizzes and tests for high versus low mathematics groups? Please be specific regarding the types of questions you might ask (e.g., computations or word problems) as well as the format of questions (e.g., multiple choice, true/false, constructed response, etc.).

13. When a student falls below grade level, as established by the ISM curriculum, what do you usually do to help bring him/her back on grade level? (Circle all that apply.)

  1. Bring this fact to the attention of the student (aside from doing so on report cards)
  2. Bring this fact to the attention of the student's parent(s) (aside from doing so on report cards)
  3. Review earlier objectives which lead up to the one(s) he/she is unable to master
  4. Assign the student additional work on the problem objective(s)
  5. Work with the student on a one-to-one basis during classroom hours
  6. Work with the student on a one-to-one basis outside of classroom hours
  7. Work with the student as part of a group of students who are all working below grade level
  8. Have the student work with a group of students who have already mastered the objective(s)
  9. Move on to another set of objectives that the student may be able to master
  10. Transfer the student to another class or group
  11. Assess the student more often to try to bring him/her back to grade level
  12. Other (specify): ______________________________

14. Are there any characteristics of the ISM program that you believe are particularly beneficial to specific groups of students (e.g., underachievers, overachievers, or students of a particular sex or ethnic/racial group)? (Please be as specific as possible in linking particular characteristics to particular groups of students.)

____

____

____

____

15. Are there any characteristics of the ISM program that you believe significantly inhibit student progress through the K-8 mathematics curriculum? (Please be as specific as possible.)

____

____

____

____

The following questions are for classification purposes only. Your answers will be grouped with those of other respondents and reported in aggregate form only. While your responses are voluntary, this information will be very helpful to us.

16. How many years have you taught mathematics?

_____ years

17. How many years have you taught mathematics in MCPS?

_____ years

18. What is the highest level of education you have completed? (Circle one.)

1. Baccalaureate degree
2. Master's degree
3. Studies beyond a Master's degree
4. Doctorate degree

19. What was (were) your major(s):

As an undergraduate student: ______________________________

As a graduate student: ______________________________

20. How many mathematics courses did you take in college?

_______ courses

21. How many courses in the teaching of mathematics did you take in college?

_______ courses

22. Have you had any MCPS in-service training in teaching mathematics?

1. Yes
2. No

That completes Section 1 of the questionnaire. Please turn to Section 2.

TEACHER QUESTIONNAIRE
SECTION 2

The questions in this section are student-specific and concern your assessments of the student's overall academic ability in general and his/her mathematics ability in particular. Please complete one form for each student identified.

Student's ID Number (see cross-referenced list of students' names and ID numbers): __________________________________

If you do not remember this student, check this box ☐. You are finished with this student questionnaire. Please proceed to the next student questionnaire on your list.

1. Below are pairs of adjectives that describe various characteristics that the student in question may possess. This student may possess each such characteristic to a greater or lesser extent. For each pair of adjectives, please indicate where, on the continuum, you think the student falls by circling the appropriate number.

   EXAMPLE: If you were asked to describe a student's height on a continuum ranging from tall (5) to short (1) and the student is of average height, you would circle the number "3" on the scale.

Insightful	5	4	3	2	1	Pedantic
Never prepared	5	4	3	2	1	Always prepared
Laid-back	5	4	3	2	1	Anxious
Careless	5	4	3	2	1	Careful
Studious	5	4	3	2	1	Never opens a book
Competitive	5	4	3	2	1	Cooperative
Well-behaved	5	4	3	2	1	Out of control

2. How would you rate this student's overall academic ability? (Circle one.)

   1. Outstanding
   2. Somewhat above average
   3. Average
   4. Somewhat below average
   5. Significantly below average
   8. Don't know (not enough information to evaluate)

3. How would you rate this student's <u>mathematics</u> ability? (Circle one.)

1. Gifted
2. Outstanding
3. Somewhat above average
4. Average
5. Somewhat below average
6. Significantly below average
8. Don't know (not enough information to evaluate)

4. How does/did this student perform in the ISM program? (Circle <u>one</u>.)

1. Above grade level
2. On grade level
3. Below grade level
8. Don't know/don't remember

5. Based on your knowledge of this student, do you think that when he/she enters high school he/she will be capable of pursuing: (Circle <u>one</u>.)

1. a college preparatory mathematics curriculum (e.g., Geometry through Calculus)
2. a general mathematics curriculum (e.g., Mathematics 9, Consumer Mathematics, Related Mathematics, etc.)
3. a vocational mathematics curriculum (e.g., business mathematics)
8. don't know

6. What is the highest level of education you expect him/her to complete? (Circle <u>one</u>.)

1. Less than high school graduation
2. High school graduation
3. Vocational, trade, or business school after high school
4. Some college, including a two-year degree, but less than four years of college
5. Finish college (four- or five-year degree)
8. Don't know

7. Is there anything else you would like to add about this student?

____

____

____

That completes Section 2 of the questionnaire. Please complete a separate form for each of the students identified on the enclosed list. Thank you for your time and assistance.

8th and 12th GRADE

STUDENT QUESTIONNAIRE

1. DIRECTIONS: We are trying to find out what students your age think about math. Below are a number of statements about math. For each statement, you are to indicate whether you "strongly agree," "agree," "disagree," or "strongly disagree," by putting a circle around the number which corresponds to each response. For example, if you strongly agree, put a circle around the "1;" if you agree, put a circle around the "2," etc. There are no right or wrong answers. Respond to each statement the way you feel. If you are unsure of your answer, you may circle "8" for "don't know", but try to circle one of the other responses first. If you do not understand a question, ask me about it.

EXAMPLE:	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
I enjoy baseball more than any other sport.	1	2	3	4	8

In this example, the student circled "3" because he/she likes another sport more than baseball.

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
a. You need a lot of luck to do well in math.	1	2	3	4	8
b. Women need to know a lot of math.	1	2	3	4	8
c. There is only one correct way to do a math problem.	1	2	3	4	8
d. It is important to know math to get a good job.	1	2	3	4	8
e. A student who does not take a lot of advanced level math courses will be able to enter the same careers as the student who does.	1	2	3	4	8
f. I can get along well in every-day life without using math.	1	2	3	4	8
g. The best part of my school day is doing math.	1	2	3	4	8
h. If I had my choice, I would not take any more math.	1	2	3	4	8

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
i. I enjoy trying to solve a math problem.	1	2	3	4	8
j. I like to help others with math problems.	1	2	3	4	8
k. Boys are better at math than girls.	1	2	3	4	8
l. Men make better scientists and engineers than women.	1	2	3	4	8
m. I will work a long time to understand a math problem.	1	2	3	4	8
n. I think math is fun.	1	2	3	4	8
o. A woman needs a career just as much as a man does.	1	2	3	4	8
p. My friends get good grades in math.	1	2	3	4	8
q. My friends are interested in math.	1	2	3	4	8
r. It scares me to have to take math.	1	2	3	4	8
s. I get very tense whenever I have to do math problems.	1	2	3	4	8
t. Math teachers are good teachers.	1	2	3	4	8
u. I worry about failing math.	1	2	3	4	8
v. Men need to know a lot of math.	1	2	3	4	8
w. Whenever I have to take a math test, I know I will pass it.	1	2	3	4	8
x. It takes me a long time to understand math.	1	2	3	4	8
y. I have a good mind for math.	1	2	3	4	8
z. I don't like to ask questions in math class.	1	2	3	4	8

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
aa. I'm a good student in most of my classes.	1	2	3	4	8
bb. When I do a math problem, I am sure that I have done it correctly.	1	2	3	4	8
cc. I would like to have a job that uses a lot of math.	1	2	3	4	8
dd. I am more nervous when I take a math test than I am when I take a test in my other subjects.	1	2	3	4	8

2. Which of the following people do you think use math in their jobs? Circle the number next to each of the people who you think use math in their jobs.

   1. teacher
   2. bus driver
   3. engineer
   4. doctor
   5. nurse
   6. scientist
   7. carpenter
   8. bank teller
   9. baker
   10. firefighter

3. When you have trouble with a math problem, what do you usually do? Circle the number next to the answer that best describes what you usually do.

   1. try it another way
   2. ask a friend for help
   3. ask the teacher for help
   4. come back to it later
   5. ask a friend for the answer
   6. give up
   7. write down any answer, even if I don't think it's the right one

4. How often do you need help doing your math homework? Circle the number next to the one answer that is true for you.

   1. very often
   2. sometimes
   3. hardly ever
   4. I never need help
   5. I never have math homework

5. If you need help with math, who usually helps you? Circle the number next to each of the people that usually help you.

1. my teacher
2. my mother or step-mother
3. my father or step-father
4. a friend
5. a tutor
6. an adult other than my teacher, tutor, or parents
7. an older sister or brother
8. no one

6. Is anyone in your family really good in math? Circle the number next to each of the people who you think are really good in math.

1. my mother or step-mother
2. my father or step-father
3. my sister
4. my brother
5. an adult other than my parents or step-parents
6. no one
8. don't know

7. How important are each of the following things in your math class? Circle the number corresponding to the answer of your choice.

	Very Important	Somewhat Important	Not Important
Getting the right answer to every problem	1	2	3
Showing why my answer is true	1	2	3
Applying facts, rules, or theorems to new problems	1	2	3
Doing homework every night.	1	2	3
Keeping a neat notebook	1	2	3
Answering questions in class.	1	2	3
Asking questions in class	1	2	3
Showing all the steps I took to arrive at my answer	1	2	3

8. Have any of your teachers ever done any of the following things and, if so, how often? Circle <u>one</u> number for <u>each</u> of the things listed.

	Happened Often	Happened A Few Times	Never Happened	Don't Know/ Don't Remember
Made negative comments about girls as math learners	1	2	3	8
Made positive comments about girls as math learners	1	2	3	8
Provided encouragement to you or other students who are worried about doing well in math	1	2	3	8
Discouraged you or other students from thinking that math is a subject in which boys do better than girl . .	1	2	3	8
Made students aware of the importance of math in keeping their career options open.	1	2	3	8

9. Have you ever had any math teachers who were truly great and/or who inspired you to take more math? Please describe what made them great or how they inspired you. Do <u>not</u> write the names of the teachers.

10. Have you ever had any math teachers who were really bad and/or who turned you off to math? Please describe what made them bad or how they turned you off. Do <u>not</u> write the names of the teachers.

11A. Has any one person tried to influence you to consider a career such as engineering, computer science, or medicine which uses a lot of math or science? If so, who (e.g., a teacher, your guidance counselor, your mother, your father, etc.)? Do not write the names of these individuals.

____

____

____

11B. What did this person do or say to try to influence you?

____

____

____

12A. Has any person tried to influence you to not consider a career which uses math or science? If so, who? Do not write the names of these individuals.

____

12B. What did this person do or say to try to influence you?

____

____

13. Have you ever discussed any of the following kinds of things with your parents/guardians or school staff? If so, please circle the number corresponding to each person with whom you discussed each thing.

	Mother/ Female Guardian	Father/ Male Guardian	Guidance Counselor	Math Teacher	No One
Your grades or test scores in math .	1	2	3	4	5
The math courses you need for high school graduation	1	2	3	4	5
Your ability to take advanced level math or science courses.	1	2	3	4	5
How much math you need for college or vocational/technical school . . .	1	2	3	4	5
What math courses you should take to prepare you for a job. . . .	1	2	3	4	5
What kinds of jobs you would be good at	1	2	3	4	5

14. Please indicate how important each of the following factors were to you in your decision to take a math course this year. Circle the number corresponding to the answer of your choice. If you are not taking math this year, answer this question for the last math class you took.

	Very Important	Somewhat Important	Not Important
I liked the teacher.	1	2	3
My friends planned to take it.	1	2	3
My parents wanted me to take it. . . .	1	2	3
It was the math course that followed the one I took last year. . .	1	2	3
I needed the course for college or the job I plan to have.	1	2	3
I needed to take another math course in order to graduate from high school.	1	2	3
I thought the course would be easy . .	1	2	3
I thought the course would help to improve my SAT score in math	1	2	3
My counselor recommended that I take it.	1	2	3
I thought the course would be interesting.	1	2	3

15. What math course(s) are you taking this semester? (Please be specific, e.g., algebra 2 with trigonometry, geometry, math 8, pre-algebra, algebra I, none, etc.)

____

16. What math course(s) did you take last semester? (Please be specific, e.g., algebra 2 with trigonometry, geometry, math 8, pre-algebra, algebra I, none, etc.)

____

17. Did you ever take a math course in summer school?

1. Yes
2. No (skip to Question 20)

18. Why? (Circle one.)

1. I wanted to make up a course that I had failed during the school year (skip to Question 20).
2. I wanted to be able to take a higher level course the following school year.
3. I wanted to have a lighter courseload during the school year.
4. I wanted to have room for another subject in my schedule during the school year.
5. Other (specify): ______________________________

19. Do you think you learned as much in summer school as you would have in a course taught over a full school year?

1. Yes
2. No
8. Don't Know

20. Have you taken the SAT or PSAT?

1. Yes
2. No (skip to Question 24)

21. Did you prepare for the math portion of the SAT or PSAT by doing any of the following things? (Circle all that apply.)

1. Took a special course on the test and on how to prepare for taking it
2. Was instructed by a tutor for the test
3. Got help from a parent or other relative
4. Studied for the test on my own using a special manual or guide on the SAT
5. Reviewed old math textbooks and/or class notes on my own
6. Did nothing special to prepare (skip to Question 24)
7. Other (specify): ______________________________

22. If you took a special course on the test and on how to prepare for taking it, was this course offered by: (Circle one.)

1. Your school
2. Another Montgomery County Public School
3. A private organization or person

23. How much time did you spend preparing for the math portion of the SAT or PSAT?

1. Spent no time preparing to take the SAT or PSAT
2. Less than one week
3. One to two weeks
4. Three to four weeks
5. More than four weeks

24. How often do you do the following things? Circle one number for each of the things listed.

	Often	Sometimes	Never
Use a hand calculator	1	2	3
Use an adding machine	1	2	3
Use a computer at home.	1	2	3
Use a computer at school.	1	2	3
Operate a cash register	1	2	3
Use a recipe	1	2	3
Make a model car, airplane, train, boat, etc.	1	2	3
Sew, knit, or crochet	1	2	3
Visit a science or technology museum.	1	2	3
Use a home chemistry set.	1	2	3
Do math problems or brain twisters for fun. .	1	2	3
Do crossword puzzles.	1	2	3
Do jigsaw puzzles	1	2	3
Play games involving strategy, like "Dungeons and Dragons", Chess, or Checkers.	1	2	3
Play football, baseball, or soccer	1	2	3

25. Do you think you will attend school (e.g., college or vocational school) or go to work full-time right after high school? (Circle one.)

1. attend school
2. go to work
3. both
8. don't know

26. As things stand now, how far in school do you think you will get? (Circle one.)

1. Less than high school graduation
2. High school graduation only
3. Vocational, trade, or business school
4. Some college, including a two-year degree, but less than four years of college
5. Finish college (four- or five-year degree)
6. Master's degree or equivalent
7. Ph.D., M.D., or other advanced professional degree
8. Don't know

27. What kind of work do you expect to be doing when you are 30 years old?

____

Thank you. That completes the questionnaire.

9-12 Parent Questionnaire

DIRECTIONS: To begin, I will read some statements about mathematics. For each statement, please tell me whether you "strongly agree", "agree", "disagree", or "strongly disagree" depending on how the statement best describes your feelings. There are no right or wrong answers. We want you to respond to each statement the way you feel.

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
1. It is important to know math to get a good job.	1	2	3	4	8
2. Most people do not use math in their jobs.	1	2	3	4	8
3. Boys are better at math than girls.	1	2	3	4	8
4. Men make better scientists and engineers than women.	1	2	3	4	8
5. A woman needs a career just as much as a man does.	1	2	3	4	8
6. I have a good mind for math.	1	2	3	4	8
7. Teachers are always right in their evaluations of my child's math abilities.	1	2	3	4	8
8. I will question a teacher if I disagree with his/her evaluation of my child's math abilities.	1	2	3	4	8
9. Men make better math teachers than women.	1	2	3	4	8
10. Students should take honors or advanced math classes only if they think they can get an A or a B.	1	2	3	4	8

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
11. Students should take as much math as possible, regardless of their career goals.	1	2	3	4	8
12. Just because a student is bright doesn't mean he/she can handle advanced math classes.	1	2	3	4	8

Now I would like to ask you a few questions about the kind of help you or someone else in your household give your child (name) with math. From now on, each time I ask about your child, I will be referring to (name of child).

13. Tell me, does your child ever bring home math homework or study for a math test at home?

1. Yes
2. No (skip to Question 24)
8. Don't know (skip to Question 24)

14. How many times a week does your child bring home math homework?

1. Every day (5 days a week)
2. 3 - 4 days a week
3. 1 - 2 days a week
8. Don't know

15. Does your child do his/her homework at the same time every day?

1. Yes
2. No
8. Don't know

16. Where does he/she usually do homework (e.g., in his/her room, in front of a television, etc.)?

____

____

17. On the average, about how much time does your child spend studying math at home each <u>week</u>?

1. Less than one-half hour
2. Between one-half hour and one hour
3. Between one hour and one and one-half hours
4. More than one and one-half hours
8. Don't know

18. Is your child generally frustrated by his/her math homework or does he/she find it easy to do?

1. Frustrated
2. Easy to do
3. Doesn't find it easy to do but not frustrated either

19. Does your child ever ask for help with his/her math homework or in studying for a math test?

1. Yes
2. No (skip to Question 24)

20. Who in the household usually helps him/her with math homework and/or study for math tests? (Circle <u>all</u> that apply.)

1. Yourself
2. Your husband/wife
3. Another relative (e.g., sibling or grandparent)
4. No one (skip to Question 24)
5. Other (specify): ______________________________

21. Is there any particular reason that this (these) individual(s) help(s) your child as opposed to another member of the household and, if so, why? (Circle <u>all</u> that apply.)

1. Individual is better at math
2. Individual is better at working with the child
3. Individual is the only one available at the time to work with child
4. No particular reason
5. Other (specify): ______________________________

22. How many times a week does someone in your household help your child do math homework and/or study for a math test?

1. Every day
2. 3-4 days a week
3. 1-2 days a week
4. Less than 1 day a week
8 Don't know

23. Compared to other subjects, how much help does your child need in studying math? Would you say that:

    1. more help is needed in math
    2. less help is needed in math
    3. about the same
    8. don't know

Now, I would like to ask a few questions about your child's math performance.

24. In thinking of all the math courses your child has taken, how well do you believe he/she has been prepared for the career of his/her choice? (Read response options. Circle one.)

    1. Prepared with enough basic math skills to work in an office or small business
    2. Prepared with enough math to qualify for admission to college
    3. Prepared with enough math to be able to pursue a career in math or science
    8. Don't know

25. How would you personally rate your child's performance in math? Would you say he/she is: (Circle one.)

    1. Outstanding
    2. Above average
    3. Average
    4. Below average
    8. Don't know

26. Did your child show a very early interest in computers and/or in how things work mathematically or mechanically?

    1. Yes
    2. No

27. Do you or anyone else in your household do anything special at home to foster your child's interest in math and/or science? If so, please describe.

____

____

____

28. Has your child participated in special math programs for the gifted?

1. Yes
2. No (skip to Question 30)
8. Don't know (skip to Question 30)

29. Please describe: ______________________________

____

____

30. Has your child ever taken a mathematics course in summer school?

1. Yes
2. No (skip to Question 33)

31. Why?

1. Child wanted to make up a course that he/she had failed during the school year (skip to Question 33)
2. Child wanted to be able to take a higher level course the following school year
3. Child wanted to have a lighter courseload during the school year
4. Child wanted to have room for another subject in his/her schedule during the school year
5. Other (specify): ______________________________

32. Do you think your child learned as much in summer school as he/she would have in a course taught over a full school year?

1. Yes
2. No
8. Don't know

33. If your child had already satisfied all of the minimum requirements for high school graduation and was able to add more courses into his/her schedule, which one subject would you like him/her to take more of?

1. Mathematics
2. Science
3. English
4. Social Studies
5. Foreign Language
6. Art/Music
7. Other (specify): ____________
8. Don't know

34. How far in school would you like your child to get? (Circle one.)

1. High school graduation
2. Vocational, trade, or business school after high school
3. Some college, including a two-year degree, but less than four years of college
4. Finish college (four- or five-year degree)
5. Master's degree or equivalent
6. Ph.D., M.D., or other advanced professional degree
8. Don't know

35. What kind of work do you think your child will be doing at age 30? **(Interviewer: Record the response in the space provided and enter the appropriate 2-digit code where specified.)**

____

__ __ 2-digit code

36. In thinking about your child's plans after high school, how important do you think it is that he/she studies math?

1. Very important
2. Somewhat important
3. Not important
8. Don't know

37. In thinking about your child's math education, how well do you think he/she has been prepared:

	Well Prepared	Somewhat Prepared	Not Well Prepared	Don't Know
1. to add, subtract, multiply, and divide	1	2	3	8
2. to do word problems	1	2	3	8
3. to understand the importance of math in everyday life	1	2	3	8
4. to pursue a career requiring a lot of math	1	2	3	8

38. Have you or your child ever been dissatisfied with his/her placement in a math class or with his performance or grade in math?

1. Yes
2. No (skip to Question 44)
8. Don't know (skip to Question 44)

39. What was the problem?

____

____

____

40. Did you or he/she discuss it with anyone in the school?

1. Yes
2. No (skip to Question 44)
8. Don't know (skip to Question 44)

41. With whom did you or your child discuss it?

1. Teacher
2. Guidance counselor
3. Principal
4. Other (specify): ______________________
8. Don't know

42. What was the outcome of this discussion?

____

____

____

43. Were you and/or your child satisfied with the outcome?

1. Yes
2. No
8. Don't know

44. In your opinion, has your child ever had any outstanding math teachers or teachers who inspired him/her to go on in math?

1. Yes
2. No (skip to Question 46)
8. Don't know (skip to Question 46)

45. What was it that made this (these) individual(s) an outstanding or inspiring math teacher? (Probe: was very patient in working with the child, was very enthusiastic, etc.)

____

____

____

46. In your opinion, has your child ever had any bad math teachers or teachers who turned him/her off to math?

1. Yes
2. No (skip to Question 48)
8. Don't know (skip to Question 48)

47. What was it that made this (these) individual(s) a bad or uninspiring math teacher? (Probe: would not explain new material satisfactorily, was sarcastic, etc.)

____

____

____

Your responses to the next group of questions is voluntary. Your answers will allow us to classify all the information we have obtained through the survey.

48. What is the highest level of education that you completed? (Circle one.)

1. Less than high school graduation
2. High school graduation
3. Vocational, trade, or business school after high school
4. Some college, including a two-year degree, but less than four years of college
5. Finished college (four- or five-year degree)
6. Master's degree or equivalent
7. Ph.D., M.D., or other advanced professional degree
9. Refused to answer

49. What is the highest level math course you took in high school?

Highest level math course: _______________

50. Overall, how would you rate your performance in math when you were in high school? Would you way you were: (Circle one.)

1. Outstanding
2. Above average
3. Average
4. Below average
8. Don't know/Refused to answer

(INTERVIEWER: If the respondent indicated in Question 48 that he/she attended college, ask Questions 51-54. Otherwise, skip to Question 55.)

51. You mentioned earlier that you attended college. What was your major?

Major: ______________________

52. Did you take any math courses in college?

1. Yes
2. No (skip to Question 55)
9. Refused to answer (skip to Question 55)

53. What was the highest level math course you took in college?

Highest level math course: ______________________

54. Overall, how would you rate your performance in math in college? Would you say you were: (Circle one.)

1. Outstanding
2. Above average
3. Average
4. Below average
8. Don't know/Refused to answer

55. Are you currently working?

1. Yes
2. No (skip to Question 58)
9. Refused to answer (skip to Question 58)

56. What do you do? **(Interviewer: Record the response in the space provided and enter the 2-digit code where specified.)**

______________________ ___ ___ 2-digit code

57. How important is math in your job?

1. Very important
2. Somewhat important
3. Not important
9. Refused to answer

58. What is the highest level of education that your husband/wife completed? (Circle one.)

1. Less than high school graduation
2. High school graduation
3. Vocational, trade, or business school after high school
4. Some college, including a two-year degree, but less than four years of college
5. Finished college (four- or five-year degree)
6. Master's degree or equivalent
7. Ph.D., M.D., or other advanced professional degree
8. Don't know/refused to answer
9. Not applicable (skip to Question 63)

(INTERVIEWER: If the respondent indicated that his/her spouse attended college, ask Question 59. Otherwise, skip to Question 60.)

59. What was his/her major area of study?

Major: ______________________________

60. Does your husband/wife currently work?

1. Yes
2. No (skip to Question 63)
9. Not applicable (skip to Question 63)
99. Refused to answer (skip to Question 63)

61. What does he/she do? **(Interviewer: Record the response in the space provided and enter the appropriate 2-digit code where specified.)**

______________________________ ___ ___
2-digit code

62. How important is math in his/her job?

1. Very important
2. Somewhat important
3. Not important
8. Don't know/Refused to answer

63. The last question concerns your family's total income. Your response is voluntary but will help us in classifying the responses of all study participants. Would you mind telling me your total family income from all sources in 1985? (Circle one.) (**INTERVIEWER: Only read response categories if the respondent hesitates in answering the question.**)

1. Less than $ 8,000
2. $ 8,000 to $14,999
3. $15,000 to $19,999
4. $20,000 to $24,999
5. $25,000 to $29,999
6. $30,000 to $39,999
7. $40,000 to $49,999
8. $50,000 or more
9. Don't know/Refused to answer

That completes the interview. Thank you very much for your time and assistance.

8th and 12th GRADE

TEACHER QUESTIONNAIRE
SECTION I

Directions: We are trying to find out what teachers such as yourself think about mathematics and mathematics instruction. Below are a number of statements about mathematics and he study of mathematics. There are no right or wrong answers to these statements--we want you to answer the way you feel. For each statement, you are to indicate whether you "strongly agree", "agree", "disagree", or "strongly disagree", depending on how the statement best describes your feelings, by circling the number which corresponds to each response. If you are unsure of your answer, you may circle "don't know", but try to circle one of the other responses first.

		Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
1.	Students should take honors or advanced mathematics classes only if they think they can get an A or a B.	1	2	3	4	8
2.	There is only one correct way for students to do a mathematics problem.	1	2	3	4	8
3.	Students should take as much mathematics as possible, regardless of their career goals.	1	2	3	4	8
4.	Just because a student is bright doesn't mean he/she can handle advanced mathematics classes.	1	2	3	4	8
5.	In my experience, boys are better at mathematics than girls.	1	2	3	4	8
6.	Boys need to know more mathematics than girls.	1	2	3	4	8

7. What mathematics courses do you normally teach? (Be specific, i.e., algebra 2 with trigonometry, applications of mathematics, etc.)

____

____

Question 8 pertains only to the teaching of general mathematics courses (e.g., math 8 skills, math 9, related mathematics, applications of mathematics, consumer mathematics, algebra I part 1, algebra I part 2, and business mathematics). If you do not normally teach any of these courses (i.e., within the past two years), please skip to Question 9.

8. In thinking of the general mathematics courses you teach, please rate the importance of each of the following goals for students who are learning mathematics.

	Very Important	Somewhat Important	Not Important
Develop a systematic approach to solving problems	1	2	3
Know mathematical facts, principles, and algorithms	1	2	3
Understand the logical structure of mathematics	1	2	3
Develop an attitude of inquiry	1	2	3
Develop an awareness of the importance of mathematics in everyday life	1	2	3
Become interested in mathematics	1	2	3
Develop an awareness of the importance of mathematics in keeping career options open	1	2	3
Perform computations with speed and accuracy	1	2	3
Understand the nature of proof	1	2	3

Question 9 pertains <u>only</u> to the teaching of college preparatory mathematics courses (algebra I, geometry, algebra 2, calculus, etc.). If you do <u>not</u> normally teach any of these courses (i.e., within the past two years), please skip to Question 10.

9. In thinking of the **college preparatory mathematics courses** you teach, please rate the importance of each of the following goals for students who are learning mathematics.

	Very Important	Somewhat Important	Not Important
Develop a systematic approach to solving problems	1	2	3
Know mathematical facts, principles, and algorithms	1	2	3
Understand the logical structure of mathematics	1	2	3
Develop an attitude of inquiry	1	2	3
Develop an awareness of the importance of mathematics in everyday life	1	2	3
Become interested in mathematics	1	2	3
Develop an awareness of the importance of mathematics in keeping career options open	1	2	3
Perform computations with speed and accuracy	1	2	3
Understand the nature of proof	1	2	3

Answer Questions 10 and 11 only if you normally (i.e., within the past two years) teach <u>both</u> general and college preparatory mathematics courses. If you do <u>not</u> normally teach both types of courses, please skip to Question 12.

10. What special considerations do you make in planning homework assignments for general mathematics versus college preparatory mathematics classes? Please be specific regarding special or different needs that you think the various types of classes have.

____

____

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____

11. What considerations do you make in preparing quizzes and tests for general mathematics versus college preparatory mathematics classes? Please be specific regarding types of questions you might ask (e.g., computations or applications of theorems and postulates) as well as the format of the questions (e.g., multiple choice, true/false, constructed response).

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Questions 12 through 14 pertain to teaching ISM objectives (i.e., the K-8 mathematics curriculum). If these questions do not apply to you, please skip to Question 15.

12. When a student falls below grade level, as established by the ISM curriculum, what do you usually do to help bring him/her back on grade level? (Circle all that apply.)

   1. Bring this fact to the attention of the student (aside from doing so on report cards)
   2. Bring this fact to the attention of the student's parent(s) (aside from doing so on report cards)
   3. Review earlier objectives which lead up to the one(s) he/she is unable to master
   4. Assign the student additional work on the problem objective(s)
   5. Work with the student on a one-to-one basis during classroom hours
   6. Work with the student on a one-to-one basis outside of classroom hours
   7. Work with the student as part of a group of students who are all working below grade level
   8. Have the student work with a group of students who have already mastered the objective(s)
   9. Move on to another set of objectives that the student may be able to master
   10. Transfer the student to another class or group
   11. Assess the student more often to try to bring him/her back to grade level
   12. Other (specify): ____________________

13. Are there any characteristics of the ISM program that you believe are particularly beneficial to specific groups of students (e.g., underachievers, overachievers, or students of a particular sex or ethnic/racial group)? (Please be as specific as possible in linking particular characteristics to particular groups of students.)

____

____

____

14. Are there any characteristics of the ISM program that you believe significantly inhibit student progress through the K-8 mathematics curriculum? (Please be as specific as possible.)

____

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____

____

The following questions are for classification purposes only. Your answers will be grouped with those of other respondents and reported in aggregate form only. While your responses are voluntary, this information will be very helpful to us.

15. How many years have you taught mathematics?

    __________ years

16. How many years have you taught mathematics in MCPS?

    __________ years

17. What is the highest level of education you have completed? (Circle <u>one</u>.)

    1. Baccalaureate degree
    2. Master's degree
    3. Studies beyond a Master's degree
    4. Doctorate degree

18. As an undergraduate or graduate student did you major in.

    1. Mathematics
    2. Mathematics education
    3. Other (specify): ______________________________

19. How many mathematics courses did you take in college?

    ______ courses

20. How many courses in the teaching of mathematics did you take in college?

    ______ courses

21. Have you had any MCPS in-service training in teaching mathematics?

    1. Yes
    2. No

That completes Section 1 of the questionnaire. Please turn to Section 2.

TEACHER QUESTIONNAIRE
SECTION 2

The questions in this section are student-specific and concern your assessments of the student's overall academic ability in general and his/her mathematics ability in particular. Please complete one form for each student identified.

Student's ID Number (see cross-referenced list of students' names and ID numbers): ____________________

If you do not remember this student, check this box ☐. You are finished with this student questionnaire. Please proceed to the next student questionnaire on your list.

1. Below are pairs of adjectives that describe various characteristics that the student in question may possess. This student may possess each such characteristic to a greater or lesser extent. For each pair of adjectives, please indicate where, on the continu\ you think the student falls by circling the appropriate number.

   EXAMPLE: If you were asked to describe a student's height on a continuum ranging from tall (5) to short (1) and the student is of average height, you would circle the number "3" on the scale.

Insightful	5	4	3	2	1	Pedantic
Never prepared	5	4	3	2	1	Always prepared
Laid-back	5	4	3	2	1	Anxious
Careless	5	4	3	2	1	Careful
Studious	5	4	3	2	1	Never opens a book
Competitive	5	4	3	2	1	Cooperative
Well-behaved	5	4	3	2	1	Out of control

2. How would you rate this student's overall academic ability? (Circle one.)

   1. Outstanding
   2. Somewhat above average
   3. Average
   4. Somewhat below average
   5. Significantly below average
   8. Don't know (not enough information to evaluate)

3. How would you rate this student's mathematics ability? (Circle one.)

1. Gifted
2. Outstanding
3. Somewhat above average
4. Average
5. Somewhat below average
6. Significantly below average
8. Don't know (not enough information to evaluate)

4. Does he/she usually work above, on, or below comparable students in his/her grade?

1. Above
2. On
3. Below

5. What is the highest level mathematics course you think he/she is capable of taking at the high school level? (Be specific, e.g., algebra 1, algebra 2 with trigonometry, calculus, etc.)

Highest mathematics course: ______________________________

6. Based on your current knowledge of this student's mathematics ability, which of the following do you think he/she would be capable of pursuing at the postsecondary level? (Circle one.)

1. Mathematics major
2. Majors which require a high degree of mathematics concentration (e.g., engineering, the physical sciences, etc.)
3. Majors which require only limited mathematics (e.g., social sciences, humanities)
4. Do not think the student has the capability to study any college level mathematics
8. Don't know

7. What is the highest level of education you expect him/her to complete? (Circle one.)

1. Less than high school graduation
2. High school graduation
3. Vocational, trade, or business school after high school
4. Some college, including a two-year degree, but less than four years of college
5. Finish college (four- or five-year degree)
8. Don't know

8. Is there anything else you would like to add about this student?

That completes Section 2 of the questionnaire. Please complete a separate form for each of the students identified on the enclosed list. Thank you for your time and assistance.

MATHEMATICS REPORT CARD GRADE AND ISM WORKING LEVEL
ABSTRACT FORM

School I.D. No: ____________

Student I.D. No.: ____________

Student's Name: ____________

Current Grade: ____________

School Year	Grading Period: 2nd Reporting Period	ISM Working Level[b]	End-of-Year Average[c]	ISM Working Level[b,d]
1985-86[a]	______	______	______	______
1984-85	______	______	______	______
1983-84	______	______	______	______
1982-83	______	______	______	______
1981-82	______	______	______	______
1980-81	______	______	______	______

---

[a] For the 1985-86 school year, record the first semester average and ISM working level code for that grading period only.

[b] Use the following ISM working level codes: 1=above grade level, 2=on grade level, or 3=below grade level.

[c] Be sure you record the end-of-year average instead of the 2nd semester average. Record this grade for all school years except 1985-86.

[d] If no end-of-year ISM level is indicated, use 4th reporting period information.

Note: If the student repeated a grade, use the last (most recent) year's grades and ISM working levels.

COUNSELOR QUESTIONNAIRE

Directions: Below are a number of statements about students and mathematics. There are no right or wrong answers to these statements -- we want you to answer the way you feel. For each statement, you are to indicate whether you "strongly agree", "agree", "disagree", or "strongly disagree" depending on how the statement best describes your feelings by circling the number which corresponds to each response. If you are unsure of your answer, you may circle "don't know", but try to circle one of the other responses first.

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
1. Students should take as much mathematics as possible, regardless of their career goals.	1	2	3	4	8
2. All students should go to college.	1	2	3	4	8
3. Students should take honors classes only if they think they can get an A or a B.	1	2	3	4	8
4. Just because a student is bright doesn't mean he/she can handle advanced mathematics classes.	1	2	3	4	8
5. Women make better mathematics teachers than men.	1	2	3	4	8
6. Men make better scientists and engineers than women.	1	2	3	4	8
7. Students are under too much pressure to succeed academically.	1	2	3	4	8
8. Female students don't take mathematics and science courses as seriously as male students.	1	2	3	4	8

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
9. Male students are more career oriented than female students.	1	2	3	4	8
10. Girls are better students than boys.	1	2	3	4	8
11. Boys need to study more mathematics than girls.	1	2	3	4	8

12. Please indicate the level of importance of each of the following factors in counseling students about what mathematics courses they should take. (Circle the number corresponding to the answer which best reflects your thinking.)

	Very Important	Somewhat Important	Not Important
Prior grades in mathematics	1	2	3
Mathematics achievement test scores (i.e., CAT scores)	1	2	3
Performance in the ISM program	1	2	3
Overall academic performance	1	2	3
Study habits	1	2	3
Career aspirations	1	2	3
Overall courseload	1	2	3
Mathematics teacher's recommendations	1	2	3
Your personal observations about the student (Please specify): ________	1	2	3
Other (specify):			
____________________	1	2	
____________________	1	2	

13. What do you believe are the major determinants of a student's decision to enroll in a mathematics course (e.g. peer pressure, parental pressure, etc.)? Does this vary for any particular groups of students?

14. Based on your discussions with students and teachers, how would you advise a student who asked your opinion about taking a new mathematics course (i.e., not one that had been previously failed) in summer school?

15. County-wide, there are differences in the mathematics performance and achievement of minority and non-minority students. In particular, white and Asian students outperform black and Hispanic students. Similarly, differences are found in the mathematics performance of male and female students on the SAT, with males outperforming females. From your experience, what factors have contributed to these differences?

Differences by race/ethnicity:

Differences by sex:

16. What special obstacles have you encountered in counseling female and/or minority students relative to taking mathematics courses? Why do you think these obstacles exist?

____

____

____

____

____

17. In your opinion, what steps ultimately need to be taken to eliminate differences in the mathematics performance and achievement of male and female students and minority and non-minority students?

____

____

____

____

The following questions are for classification purposes only. Your answers will be grouped with those of other respondents and reported in aggregate form only. While your responses are voluntary, this information will be very helpful to us.

18. How many years have you worked as a counselor?

_____________ years

19. How many years have you worked in MCPS?

_____________ years

20. What is the highest level of education you have completed? (Circle one.)

1. Baccalaureate degree
2. Master's degree
3. Studies beyond a Master's degree
4. Doctorate degree

That completes the questionnaire. Thank you for your time and assistance.

PRINCIPAL QUESTIONNAIRE

1. How are the students in this school grouped for instruction in mathematics? What criteria are used to evaluate a student's membership within a particular group? How often are students evaluated? Does this vary by grade level?

2. Aside from a student's mastery of ISM objectives, are there other criteria used to determine working level? If so, please specify.

INTERVIEWER: Ask Question 3 in J/I/M schools only.

3. What factors are considered in deciding whether or not to place sixth grade students in accelerated mathematics 7?

4. When a student falls below grade level in mathematics, what do the teachers in this school do to help bring him/her back on grade level?

____
____
____
____
____

5. Are there any characteristics of the ISM program that you believe significantly enhance or inhibit student performance in mathematics?

Characteristics that enhance: ______________________________
____
____
____

Characteristics that inhibit:

____
____
____

6. How many hours per week is ISM aide time available?

__________ hours per week

*7. What percentage of the aide's time is used exclusively for conducting ISM assessments?

__________ %

8. Aside from conducting assessments, how is the ISM aide's time used?

____
____
____

9. Have you performed any analyses to determine how many of your students would be in danger of not passing the Maryland Functional Math Test?

1. Yes
2. No (skip to Question 12A)

10. What was the outcome of this analysis (how many and what kinds of students are at risk, etc.)?

____

____

____

____

11. What, if anything, do you feel can be done to redress this problem?

____

____

____

Up to now, we've been talking about your school. Now I'd like to switch gears and discuss things at the county level.

12A. County-wide, there are differences in the mathematics performance and achievement of minority and non-minority students. In particular, white and Asian students outperform black and Hispanic students. Similarly, differences are found in the mathematics performance of male and female students on the SAT, with males outperforming females. Based on your experience, to what do you attribute these differences?

Differences by race/ethnicity: ____________________________

____

____

____

Differences by sex: ____________________________________

____

____

____

12B. What steps, if any, has this school taken to eliminate these differences in mathematics performance and achievement?

12C. In your opinion, what steps ultimately need to be taken county-wide to eliminate these differences?

Now I'd like to ask a few final questions about your mathematics teachers.

13A. Do all of the teachers in this school teach mathematics?

1. Yes
2. No

13B. Does this apply to all grade levels? If not, to which grade levels does this apply?

13C. On what basis were these individuals selected to teach mathematics?

289

13D. What is the composition of these individuals by sex and by race/ethnicity?

Number of males: ____________
Number of females: ____________
Number white: ____________
Number black: ____________
Number Hispanic: ____________
Number Asian: ____________

That completes the interview. Thank you very much for your time and assistance.

AGENDA

ADVANCED LEVEL MATH/SCIENCE COURSE STUDENTS

EIGHTH GRADE LEVEL

I. INTRODUCTION

A. Project Background

B. Procedures to Be Used

1. Audio taping of session
2. Confidentiality -- use of first names only
3. Length of discussion (1-1/2 hours)
4. Description of group

C. Participant Introduction

1. Name
2. Favorite televisi show
3. Favorite sport/hobbies

II. OPENING QUESTIONS

A. What are your favorite courses?

B. What are your least favorite courses?

C. What are your plans after high school graduation (educational/occupational)?

D. What courses do you feel will be most helpful later in life? In high school? In college? On the job?

E. If you had an extra period during the school day, what course or activity would you choose to fill it? Why?

III. MATH SPECIFIC QUESTIONS

A. Attitudes toward Mathematics/Math History

1. Do you think that some people have special talents/skills in mathematics? If yes, why do they have them? How do you think they got that way?

2. Do you believe that anyone who studies hard can get good grades in math?

3. Do you feel that students who are high achievers in math are different from high achievers in other subjects? If yes, in what way?

4. Who do you think performs better in math -- males or females? Why? What about in other subjects?

5. Are there other subjects where there is a difference between how males and females perform?

6. What do you like/dislike about math? Why?

B. Significant Others (Parents, Teachers, Guidance Counselors, Older Siblings, Friends)

1. Have you had a teacher who you felt was an excellent math teacher? How did he/she teach differently from others?

2. Have you had a teacher who you felt did not teach well? Why?

3. Where do you get your information concerning which courses you need to fulfill graduation requirements?

4. Did you complete a formal four-year high school plan?

5. Did you have a discussion about your mathematics course selections? If yes, what courses were recommended?

6. Do your friends tease each other about their grades? If they're high? If they're low?

C. Nonathletic Extracurricular Activities

1. Do you participate in any extracurricular activities? If yes, which ones? If no, why not?

2. Do you participate in any **nonathletic** extracurricular activities? If yes, which ones? If no, why not?

3. Do you think that certain students tend to participate in certain extracurricular activities?

4. (For students who do **not** participate in nonathletic extracurricular activities:) What would change your mind about participating in nonathletic extracurricular activities?

D. Gifted Student Programs (if time allows)

1. Have you participated in gifted student programs? (summer/weekend/evening?)

2. Who made the decision that you should participate?

3. How did you find out about these programs?

4. Would you recommend these programs to others? Why? Why not?

5. Would you attend other similar programs?

E. Other Questions

1. Are you taking any computer courses? Which ones? Why are you taking these courses?

IV. SCIENCE SPECIFIC QUESTIONS

A. Attitudes Towards Science

1. Do you think that most people who are good in math are also good in science? If yes, why?

2. Do you think that math and science courses are related to each other? If yes, how are they related?

B. Specific Course Questions

1. What science courses do you think you will take in high school, e.g., biology, chemistry, physics, earth science?

2. Why do you think you will take these courses?

3. Do you think you will take any advanced placement or honors level science courses? Which ones?

AGENDA

LOWER LEVEL MATH/SCIENCE COURSE STUDENTS

EIGHTH GRADE LEVEL

I. INTRODUCTION

A. Project Background

B. Procedures to Be Used

1. Audio taping of session
2. Confidentiality -- use of first names only
3. Length of discussion (1-1/2 hours)
4. Description of group

C. Participant Introduction

1. Name
2. Favorite television show
3. Favorite sport/hobbies

II. OPENING QUESTIONS

A. What are your favorite courses?

B. What are your least favorite courses?

C. What are your plans after you graduate from high school (educational and occupational)?

D. Which courses do you feel will be most helpful to you later in life? In high school? In college? On the job?

E. If you had an extra period during the school day, what course or activity would you choose to fill it? Why?

III. MATH SPECIFIC QUESTIONS

A. Attitudes toward Mathematics/Math History

1. Do you like mathematics? (Is it challenging?) Why? Why not?

2. Have you always felt this way about your math classes?

3. (For those students who liked math in lower grades but dislike it now) Do you remember why you stopped liking math?

4. Do you think that some people are good in mathematics and others are not?

5. Do you believe getting good grades in math depends on how much you study? If not, explain why.

6. Do you feel that students who get good grades in math are different from average students? If yes, in what way?

7. Who do you feel performs better in math -- males or females? Why?

8. How do you feel about the Maryland Functional Math Test? Is it hard? Easy?

9. Do your teachers talk about it?

10. Is the Maryland Functional Math Test an obstacle to getting a high school diploma?

B. Significant Others (Parents, Teachers, Guidance Counselors, Older Siblings, Friends)

1. Where do you get your information concerning which courses you need to fulfill graduation requirements?

2. Did you fill out a schedule for high school? Who explained it to you?

3. Has anyone told you which math course(s) to take in ninth grade? In high school? Who?

4. Has anyone encouraged you to take other math courses?

5. Have you had a teacher who you felt was an excellent math teacher? How did he/she teach differently from others?

6. Have you had a teacher who you felt did not teach well? Why?

7. Do your friends tease each other about their grades? If they're high? If they're low?

C. Nonathletic Extracurricular Activities

1. Do you participate in any extracurricular activities? If yes, which ones? If no, why not?

2. Do you participate in any nonathletic extracurricular activities? If yes, which ones? If no, why not?

3. Do you think that certain students tend to participate in certain extracurricular activities?

4. (For students who do not participate in nonathletic extracurricular activities) What would change your mind about participating in nonathletic extracurricular activities?

IV. SCIENCE SPECIFIC QUESTIONS

A. Attitudes toward Science

1. Do you think that most people who are good in math are also good in science? If yes, why?

2. Do you think that math and science courses are related to each other? If yes, how are they related?

B. Specific Course Questions

1. How much science do you think you'll take in high school?

2. How useful do you think high school science will be later in life?

AGENDA

ADVANCED LEVEL MATH/SCIENCE COURSE STUDENTS

ELEVENTH GRADE LEVEL

I. INTRODUCTION

A. Project Background

B. Procedures to be used

1. Audio taping of session
2. Confidentiality -- use of first names only
3. Length of discussion (1-1/2 hours)
4. Description of group

C. Participant Introduction

1. Name
2. Favorite television show
3. Favorite sport/hobbies

II. OPENING QUESTIONS

A. What are your favorite courses?

B. What are your least favorite courses?

C. What are your plans after high school graduation (educational/occupational)?

D. What kind of college are you thinking of? Do you have any idea about what you want to major in?

E. Which courses have you taken in high school that you feel will be most helpful to you in college? When you pursue a career?

F. If you had an extra period during the school day, what course or activity would you choose to fill it? Why?

III. MATH SPECIFIC QUESTIONS

A. Attitudes toward Mathematics/Math History

1. Do you think that some people have special talents/skills in mathematics?

2. Do you believe that anyone who studies hard can get good grades in math?

3. Do you feel that students who are high achievers in math are different from average students? If yes, in what way?

4. Do you think the ability to do well in math has anything to do with gender? Who do you think performs better in math -- males or females? Why?

5. In the MCPS, on the average, males score 40-50 points higher than females on the math portion of the SAT. Why do you think that happens? (PROBE FOR RACIAL DIFFERENCES WITH DIFFERENT GROUPS)

6. Have you always done well in mathematics? (In elementary school? In junior high?)

7. Why did you take higher level mathematics courses? (Interest? College requirement for proposed field of study? To help get into college?)

B. Significant Others (Parents, Teachers, Guidance Counselors, Older Siblings, Friends)

1. Did anybody tell you which math courses to take? Who?

2. Has anyone encouraged (discouraged) you to take higher level mathematics?

3. Whom do you ask for help when you have problems with your math assignments? Who has been the most helpful in the past?

4. If you didn't take math next year, how would your parents feel?

5. How would your parents have felt if you hadn't taken higher level math courses?

C. SAT/Outside Course Related Questions

1. How many times have you taken the SAT? How many times do you plan to take it?

2. Are you planning on taking achievement tests for advanced placement?

3. How are you planning to prepare for the SAT?

4. Do you feel that the math courses you've taken have adequately prepared you for the math portion of the SAT?

5. Have you taken any computer courses? Which ones? Why did you take (are you taking) these courses?

D. Nonathletic Extracurricular Activities

1. Do you participate in any extracurricular activities? If yes, which ones? If no, why not?

2. Do you participate in any nonathletic extracurricular activities? If yes, which ones? If no, why not?

3. Do you think that certain students tend to participate in certain extracurricular activities?

4. (For students who do not participate in nonathletic extracurricular activities) What would change your mind about participating in nonathletic extracurricular activities?

E. Gifted Student Programs (if time allows)

1. Have you participated in gifted student programs?

2. Who made the decision that you should participate?

3. How did you find out about these programs?

4. Would you recommend these programs to others? Why? Why not?

IV. SCIENCE SPECIFIC QUESTIONS

A. Attitudes toward Science

1. Do you think that most people who are good in math are also good in science? If yes, why?

2. Do you think that math and science courses are related to each other? If yes, how are they related?

B. Specific Course Questions

1. Are you taking or do you think you will take any advanced placement or honors level science courses? Which ones?

NOTE FOR FEMALE PARTICIPANTS

1. What do you think Montgomery County can do to encourage more females to take math and/or science courses?

2. Do you participate in extracurricular activities for fun or to look good on your college applications?

AGENDA

LOWER LEVEL MATH/SCIENCE COURSE STUDENTS

ELEVENTH GRADE LEVEL

I. INTRODUCTION

A. Project Background

B. Procedures to Be used

1. Audio taping of session
2. Confidentiality -- use of first names only
3. Length of discussion (1-1/2 hours)
4. Description of group

C. Participant Introduction

1. Name
2. Favorite television show
3. Favorite sport/hobbies

II. OPENING QUESTIONS

A. What are your favorite courses?

B. What are your least favorite courses?

C. What are your plans after high school graduation (educational or occupational)?

D. Which courses have you taken in high school that you feel will be most helpful to you after you have graduated? In college or other post-secondary schools? On the job?

E. If you had an extra period during the school day, what course or activity would you choose to fill it? Why?

III. MATH SPECIFIC QUESTIONS

A. Attitudes toward Mathematics/Math History

1. Do you like mathematics? Why? Why not?

2. Have you always felt this way about your math classes? In elementary school? In junior high? In high school?

3. (For those students who liked math in lower grades but dislike it now) Do you remember why you stopped liking math?

4. How would you feel if you had to take an additional year of math as a requirement for high school graduation?

5. Do you think that some people are good in mathematics and others are not?

6. Do you believe getting good grades in math depends on how much you study? If not, explain why.

7. Do you feel that students who get good grades in math are different from average students? If yes, in what way?

8. Who do you feel performs better in math -- males or females? Why?

9. Did any of your friends have difficulty in passing the Maryland Functional Math Test? If yes, why do you think they had so much difficulty? Did they eventually pass?

B. Significant Others (Parents, Teachers, Guidance Counselors, Older Siblings, Friends)

1. Did anybody tell you which math courses to take? Who?

2. Do your friends have any influence on the courses you take? How/Why?

3. Has anyone encouraged (discouraged) you to take higher level mathematics? Who?

4. Whom do you ask for help when you have problems with your math assignments? Who has been the most helpful in the past?

5. Have you had a teacher who you felt was an excellent math teacher? How did he/she teach differently from others?

C. Nonathletic Extracurricular Activities

1. Do you participate in any extracurricular activities? If yes, which ones? If no, why not?

2. Do you participate in any **nonathletic** extracurricular activities? If yes, which ones? If no, why not?

3. Do you think certain students participate in certain extracurricular activities?

4. (For students who do **not** participate in nonathletic extracurricular activities) What would change your mind about participating in nonathletic extracurricular activities?

D. Other Questions

1. Have you taken any computer courses? Which ones? Why are you taking (have you taken) these courses?

IV. SCIENCE SPECIFIC QUESTIONS

A. Attitudes toward Science

1. Do you think that most people who are good in math are also good in science? If yes, why?

2. Do you think that math and science courses are related to each other? If yes, how are they related?

B. Specific Course Questions

1. How much science are you taking in high school?

2. How useful do you think high school science will be later in life?

APPENDIX TO CHAPTER 4:

COURSE ENROLLMENT, GRADES, AND CAT PERFORMANCE
BY GENDER AND RACIAL/ETHNIC GROUP

TABLE A-4.1

Highest Course Taken by Students in the Class of 1986: by Gender and Racial/Ethnic Group

Highest Mathematics Course Taken	% Asian Females	% Asian Males	% White Females	% White Males	% Black Females	% Black Males	% Hisp. Females	% Hisp. Males
Calculus	33	32	12	16	4	3	6	7
Elem. Functions & Anal. Geom.	20	19	12	12	4	6	4	14
Adv. Algebra	18	14	20	18	15	12	16	10
Alg. 2 & Trig (accelerated)	4	3	3	3	1	1	3	3
Trigonometry	5	6	4	4	3	4	3	4
Algebra 2	11	9	17	14	13	15	16	11
Geometry	5	7	11	12	16	17	15	14
Algebra 1	4	6	9	7	17	13	15	11
Alg. 1, Pt. 1 (1st yr. of slow-paced course)	0	0 *	1	1	1	2	1	2
General Math	2	3	12	13	25	29	21	25
No. of Students	249	235	2,593	2,327	390	354	110	132

* Percentage is less that half of one percent.

TABLE A-4.2

Grade in Highest Course Taken by Students in the Class of 1986: by Gender and Racial/Ethnic Group

Highest Mathematics Course Taken	Avg. Grade Asian Females	Avg. Grade Asian Males	Avg. Grade White Females	Avg. Grade White Males	Avg. Grade Black Females	Avg. Grade Black Males	Avg. Grade Hisp. Females	Avg. Grade Hisp. Males
Calculus	3.01	2.80	2.86	2.70	2.88	2.17	2.79	2.56
Elem. Functions & Anal. Geom.	2.38	2.29	2.56	2.29	2.43	2.12	*	2.37
Adv. Algebra	2.17	1.85	2.36	2.12	1.96	1.91	2.39	1.85
Alg. 2 & Trig (accelerated)	2.44	2.00	2.13	1.96	*	*	*	*
Trigonometry	1.83	1.50	1.86	1.57	1.62	1.62	*	1.60
Algebra 2	1.70	2.00	1.88	1.64	1.53	1.34	2.06	1.50
Geometry	1.50	1.71	1.52	1.52	1.33	1.39	1.29	1.22
Algebra 1	2.56	1.67	1.63	1.57	1.49	1.49	1.76	1.53
Alg. 1, Pt. 1 (1st yr. of slow-paced course)	---	*	1.16	1.46	1.20	1.38	*	*
General Math	*	1.71	2.10	1.93	1.83	1.77	1.74	1.85
No. of Students	249	235	2,593	2,327	390	354	110	132

* Number of students in this group less than 5. Average grade not printed because of instability of the score for such a small group.

TABLE A-4.3

Stanine Scores of Students in the Class of 1986 on the Eleventh Grade CAT Mathematics Section, by Gender and Racial/Ethnic Group

Stanine	% of Asian Females	% of Asian Males	% of White Females	% of White Males	% of Black Females	% of Black Males	% of Hispanic Females	% of Hisp. Males
9 (highest)	35	38	18	22	3	5	7	15
8	13	12	13	11	3	3	6	6
7	18	12	20	19	12	10	10	10
6	16	16	25	22	21	21	21	17
5	10	12	16	14	24	23	30	20
4	7	7	7	9	25	25	14	19
3	0.4	4	2	2	10	11	8	8
2	0.4	0	0.2	1	2	1	3	2
1	0.4	0	0.1	0.3	1	1	0	3
No. of Students	255	244	2,790	2,523	441	416	125	155

APPENDIX TO CHAPTER 6:

RESPONSES TO STUDENT QUESTIONNAIRES

TABLE A-6.1

Students' Responses to Attitudinal Statements: Grades 4 and 6

Statement	Fourth Grade, N=277			Sixth Grade, N=323		
	Yes	Don't Know	No	Yes	Don't Know	No
You need a lot of luck to do well in math	20	6	74	10	6	84
Women need to know a lot of math	34	25	42	35	29	36
There is only one correct way to do a math problem	26	8	66	18	5	77
It is important to know math to get a good job	91	5	4	90	4	5
The best part of the school day is doing math	49	7	44	32	8	60
If I had my choice, I would not take any more math	20	7	73	18	14	69
I enjoy trying to solve a math problem	65	5	31	49	10	41
I like to help others with math problems	76	7	17	66	11	23
Boys are better at math than girls	15	16	70	14	20	67
Men make better scientists and engineers than women	33	16	51	23	20	57
I will work a long time to understand a math problem	49	6	45	50	13	37
It scares me to have to take math	7	6	87	8	3	89
You need to study hard to do well in math	86	4	10	77	7	16
When I cannot figure out an answer to a math problem, I get upset	28	3	69	39	5	56

NOTE: Numbers are percentages of students who picked each answer choice.

TABLE A-6.1 (Cont.)

Students' Responses to Attitudinal Statements: Grades 4 and 6

Statement	Fourth Grade, N=277 Yes	Don't Know	No	Sixth Grade, N=323 Yes	Don't Know	No
I worry about failing math	55	4	41	53	7	41
Men need to know a lot of math	53	20	27	54	23	24
Whenever I take a math test, I know I will pass it	35	22	44	26	29	45
It takes me a long time to understand math	21	5	74	17	8	74
I am smart in math	64	21	15	51	31	18
I don't like to ask questions in math class	32	8	59	35	6	59
I understand math as well as I understand other subjects	72	7	21	68	6	26
When I do a math problem, I am sure that I have done it correctly	38	20	42	27	23	50
When I grow up, I would like to have a job that uses math	44	19	37	34	26	41
I think math is fun	70	6	24	57	14	30
I am more nervous when I take a math test than I am when I take a test in my other subjects	35	7	58	38	6	56

NOTE: Numbers are percentages of students who picked each answer choice.

TABLE A-6.2

Students' Responses to Attitudinal Statements: Grades 8 and 12

Statement	Eighth Grade, N=319					Twelfth Grade, N=586				
	SA	A	DK	D	SD	SA	A	DK	D	SD
You need a lot of luck to do well in math	1	7	3	50	38	2	10	2	46	39
Women need to know a lot of math	8	32	18	28	14	7	39	14	31	9
There is only one correct way to do a math problem	3	8	1	51	36	4	13	2	52	29
It is important to know math to get a good job	37	55	1	6	1	18	50	4	24	4
A student who does not take a lot of advanced level math courses will be able to enter the same careers as a student who does	2	30	15	40	15	4	21	7	49	19
I can get along well in every-day life without using math	3	11	7	48	30	4	22	3	50	21
The best part of the school day is doing math	7	20	8	37	29	4	13	6	45	34
If I had my choice, I would not take any more math	[illegible]	11	6	50	30	12	21	7	41	18
I enjoy trying to solve a math problem	7	39	6	36	11	8	48	4	33	7
I like to help others with math problems	10	59	6	21	4	11	51	5	28	6
Boys are better at math than girls	3	4	14	32	48	3	8	19	41	29
Men make better scientists and engineers than women	3	9	10	31	48	4	11	14	33	38
I will work a long time to understand a math problem	9	43	8	35	5	8	48	4	35	5
I think math is fun	13	42	7	26	12	8	40	6	33	12
A woman needs a career just as much as a man does	59	34	2	3	2	61	31	2	5	1

SA=Strongly Agree, A=Agree, DK=Don't Know, D=Disagree, SD=Strongly Disagree

TABLE A-6.2 (Cont.)

Students' Responses to Attitudinal Statements: Grades 8 and 12

Statement	Eighth Grade, N=319					Twelfth Grade, N=586				
	SA	A	DK	D	SD	SA	A	DK	D	SD
My friends get good grades in math	11	55	17	15	3	12	56	14	17	2
My friends are interested in math	4	24	22	38	12	6	31	22	36	5
It scares me to have to take math	2	6	3	55	34	4	13	4	50	29
I get very tense whenever I have to do math problems	4	13	4	55	24	4	20	4	51	22
Math teachers are good teachers	14	41	19	19	7	11	44	21	19	5
I worry about failing math	23	25	2	27	23	17	33	3	31	16
Men need to know a lot of math	15	46	12	21	6	11	42	13	29	6
Whenever I take a math test, I know I will pass it	14	25	13	37	11	6	29	13	44	8
It takes me a long time to understand math	4	17	4	59	17	10	29	4	49	8
I have a good mind for math	13	58	10	17	2	10	47	9	27	7
I don't like to ask questions in math class	8	23	3	47	19	7	27	3	47	16
I'm a good student in most of my classes	20	65	4	10	1	21	63	4	11	3
When I do a math problem, I am sure that I have done it correctly	5	34	10	46	5	3	31	11	51	4
I would like to have a job that uses math	6	22	18	31	23	5	18	10	40	26
I am more nervous when I take a math test than I am when I take a test in my other subjects	14	19	4	50	14	13	24	4	47	12

NOTE: Numbers are percentages of students who picked each answer choice.

SA=Strongly Agree, A=Agree, DK=Don't Know, D=Disagree, SD=Strongly Disagree

TABLE A-6.3

Students' Perceptions Regarding Which Professions Use Mathematics: Grades 4 and 6

	Fourth Grade, N=277			Sixth Grade, N=323		
Profession Uses Math	Yes	Don't Know	No	Yes	Don't Know	No
Teacher	99	0 *	1	97	1	[illegible]
Bus Driver	33	15	52	38	13	49
Doctor	65	12	23	68	13	19
Nurse	55	16	29	66	14	20
Scientist	78	5	17	82	7	11
Carpenter	65	12	24	87	2	11
Bank Teller	95	3	2	96	2	2
Baker	58	12	30	71	8	21
Firefighter	31	20	49	27	19	54

* Percentage is less than half of one percent.

NOTE: Numbers are percentages of students who picked each answer choice.

TABLE A-6.4

Students' Perceptions Regarding Which Professions Use Mathematics: Grades 8 and 12

	Eighth Grade, N=319		Twelfth Grade, N=586	
Profession Uses Math	Yes	No	Yes	No
Teacher	92	8	92	9
Bus Driver	32	68	32	68
Engineer	88	12	96	4
Doctor	76	24	71	29
Nurse	61	37	63	37
Scientist	90	10	95	5
Carpenter	84	16	88	12
Bank Teller	96	4	96	4
Baker	72	28	67	33
Firefighter	27	73	29	71

NOTE: Numbers are percentages of students who picked each answer choice.

TABLE A-6.5

What Students Do When They Have Trouble With Mathematics Problems: Grades 4, 6, 8, and 12

Solution to Problem	% Students Grade 4	% Students Grade 6	% Students Grade 8	% Students Grade 12
Try another way to solve it	16	19	23	27
Come back to it later	22	25	20	22
Ask the teacher for help	46	33	35	23
Ask a friend for help	11	15	13	18
Ask a friend for the answer	1	0 *	4	2
Give up	0 *	3	1	4
Make up an answer	4	1	4	5
Number of students	277	323	202	417

* Percentage is less than half of one percent.

TABLE A-6.6

Frequency That Students Need Help With Mathematics Homework: Grades 4, 6, 8, and 12

How Often Help Is Needed	% Students Grade 4	% Students Grade 6	% Students Grade 8	% Students Grade 12
Very Often	6	7	10	18
Sometimes	48	52	52	57
Hardly Ever	38	39	34	18
Never	8	1	4	2
Never Have Mathematics Homework	1	0 *	1	5
Number of Students	277	323	317	577

* Percentage is less than half of one percent.

TABLE A-6.7

Persons Who Usually Help Students with Math Homework: Grades 4, 6, 8, and 12

Persons Who Help	% Students Grade 4	% Students Grade 6	% Students Grade 8	% Students Grade 12
Teacher	87	78	62	65
Mother	74	64	29	11
Father	64	57	36	18
Friend	48	56	46	57
Tutor	14	8	2	8
Some Other Adult	32	28	9	8
Older Sister or Brother	51	44	33	18
Number of Students	277	323	317	582

NOTE: Percentages add to more than 100 because students could indicate all the people who helped them with homework.

TABLE A-6.8

Methods Used by Teachers to Teach Mathematics: Grades 4 and 6

Methods Used by Teachers	% Students Grade 4	% Students Grade 6
Whole class instruction	59	80
Teaches to mathematics groups	63	41
Uses work sheets and dittos and walks around, checking students' work	46	48
Number of students	277	323

NOTE: Percentages add to more than 100 because students could indicate all the methods used by teachers.

TABLE A-6.9

Capabilities of Other Students in Students' Mathematics Groups: Grades 4 and 6

Capability of Students	% Students Grade 4	% Students Grade 6
Very Good	47	42
Average	34	37
Not Good	3	3
Don't Know	17	18
Number of Students	203	182

TABLE A-6.10

Persons in the Family Who Are Good in Mathematics: Grades 8 and 12

Persons Good in Math	% Students Grade 8	% Students Grade 12
Mother	30	15
Father	54	42
Sister	28	22
Brother	26	24
Some Other Adult	9	14
No One in Family	7	17
Don't Know	10	10
Number of Students	316	582

NOTE: Percentages add to more than 100 because students could indicate all the people who were good in math.

TABLE A-6.11

Importance of Various Factors in Mathematics Class: Grades 4 and 6

Factor	Fourth Grade, N=276			Sixth Grade, N=323		
	Always Import.	Sometimes Important	Not Import.	Always Import.	Sometimes Important	Not Import.
Memorizing facts or rules	79	20	1	68	30	2
Getting the right answer to every problem	55	39	6	49	44	8
Figuring out the answer to new problems	62	34	5	61	35	4
Solving problems in your head	35	52	13	18	63	18
Doing homework every night	87	10	3	76	19	5
Keeping a neat notebook	50	30	20	48	31	21
Answering questions in class	49	46	4	36	60	4
Asking questions in class	38	55	8	46	49	5
Showing all steps in finding the answer	49	44	8	52	41	7

NOTE: Numbers are percentages of students who picked each answer choice.

TABLE A-6.12

Importance of Various Factors in Mathematics Class: Grades 8 and 12

Factor	Eighth Grade, N=316			Twelfth Grade, N=579		
	Very Import.	Somewhat Important	Not Import.	Very Import.	Somewhat Important	Not Import.
Getting the right answer to every problem	48	49	4	49	44	8
Showing why the answer is true	53	37	10	61	35	4
Applying facts, rules or theorems to new problems	50	37	13	18	63	18
Doing homework every night	71	26	4	76	19	5
Keeping a neat notebook	37	45	18	48	31	21
Answering questions in class	32	55	13	36	60	4
Asking questions in class	50	43	7	46	49	5
Showing all steps in finding the answer	54	36	10	52	41	7

NOTE: Numbers are percentages of students who picked each answer choice.

TABLE A-6.13

Statements Made by Students' Teachers: Grades 4 and 6

Statements Made by Teachers	Fourth Grade, N=277 Yes	Don't Know	No	Sixth Grade, N=322 Yes	Don't Know	No
Girls are not good at math	5	6	89	2	5	93
Math is important for certain kinds of jobs	78	8	14	78	9	13
Boys are better at math than girls	6	5	88	3	6	91
Math is more important than reading or language arts	11	13	76	9	13	78

TABLE A-6.14

Statements Made by Students' Teachers: Grades 8 and 12

Statements Made by Teachers	Eighth Grade, N=317 Often	Few Times	Never	Don't Know	Twelfth Grade, N=322 Often	Few Times	Never	Don't Know
Negative comments about girls as math learners	3	7	17	74	3	15	64	19
Positive comments about girls as math learners	3	24	26	47	4	27	43	27
Provided encouragement to students worried about doing well in math	39	40	12	10	33	50	11	6
Discouraged students from thinking that math is a subject in which boys do better than girls	4	10	16	70	4	14	62	20
Made students aware of the importance of math in keeping their career options open	42	36	13	9	38	42	11	10

NOTE: Numbers are percentages of students who picked each answer choice.

TABLE A-6.15

Frequency Students Participate in Various Activities: Grades 4 and 6

Activities	Fourth Grade, N=276			Sixth Grade, N=323		
	Often	Sometimes	Never	Often	Sometimes	Never
Use a hand calculator	2	30	68	3	48	49
Use a computer at home	12	[illegible]	69	13	23	65
Use a computer at school	22	[illegible]	26	15	63	22
Use a recipe to cook	12	37	51	23	37	39
Make a model car, boat, airplane, train, etc.	17	35	48	13	37	51
Sew, knit, or crochet	13	30	57	9	36	55
Visit a science or technology museum	9	60	31	7	65	28
Play with a home chemistry set	8	23	69	7	17	76
Do math problems or brain twisters for fun	26	52	23	20	50	30
Do crossword puzzles	35	55	10	29	61	9
Do jigsaw puzzles	21	53	26	21	59	20
Play strategy games such as chess, checkers, or "Dungeons and Dragons"	46	44	10	46	46	9
Play football, baseball, or soccer	54	30	16	56	30	14

NOTE: Numbers are percentages of students who picked each answer choice.

TABLE A-6.16

Frequency Students Participate in Various Activities: Grades 8 and 12

Activities	Eighth Grade, N=312			Twelfth Grade, N=581		
	Often	Sometimes	Never	Often	Sometimes	Never
Use a hand calculator	13	61	26	38	56	6
Use an adding machine	3	20	77	12	27	61
Use a computer at home	15	27	59	12	24	65
Use a computer at school	13	49	38	15	32	54
Operate a cash register	3	14	83	29	22	49
Use a recipe to cook	23	52	26	24	49	27
Make a model car, boat, airplane, train, etc.	12	33	55	7	24	69
Sew, knit, or crochet	7	41	52	5	29	66
Visit a science or technology museum	6	59	34	5	55	40
Play with a home chemistry set	5	16	80	1	7	91
Do math problems or brain twisters for fun	13	50	37	7	41	51
Do crossword puzzles	24	61	15	16	58	26
Do jigsaw puzzles	18	60	22	11	52	37
Play strategy games such as chess, checkers, or "Dungeons and Dragons"	30	54	16	16	55	28
Play football, baseball, or soccer	57	36	7	42	36	22

NOTE: Numbers are percentages of students who picked each answer choice.

TABLE A-6.17

Persons With Whom Students Discussed Aspects of Mathematics: Grades 8 and 12

Aspect of Mathematics	Persons With Whom Students Talked				
	Mother	Father	Guidance Counselor	Math Teacher	No one
Eighth Grade					
Grades or test scores	67	49	11	40	9
Math courses needed for high school graduation	42	35	41	29	13
Ability to take advanced math or science course	40	32	25	40	21
Math needed for college or technical school	32	35	22	20	31
Math courses needed to prepare for a job	35	32	20	19	34
Kinds of jobs student would be skilled at	57	48	16	7	24
Twelfth Grade					
Grades or test scores	59	45	24	55	13
Math courses needed for high school graduation	26	22	64	19	19
Ability to take advanced math or science course	26	26	32	36	35
Math needed for college or technical school	21	19	45	17	37
Math courses needed to pre-prepare for a job	16	21	29	20	44
Kinds of jobs studend would be skilled at	50	42	32	7	27

NOTE: Numbers are percentages of students who picked each answer choice.

TABLE A-6.18

Importance of Various Factors in Students' Decisions to Take Mathematics Courses: Grades 8 and 12

	Eighth Grade, N=317			Twelfth Grade, N=580		
Factor	Very Import.	Somewhat Important	Not Import.	Very Import.	Somewhat Important	Not Import.
Liked the teacher	41	36	27	38	32	30
Friends planned to take course	13	42	46	9	33	59
Parents wanted them to take course	35	46	19	22	42	36
Followed previous math course	45	44	11	46	39	15
Needed the course for college or for a planned job	59	28	13	46	29	25
Needed another math course in order to graduate	52	25	23	28	16	55
Thought the course would be easy	9	34	57	7	29	64
Thought course would improve SAT score in math	49	31	20	26	29	45
Counselor recommended the course	27	49	24	18	40	42
Thought course would be interesting	35	47	18	31	42	27

NOTE: Numbers are percentages of students who picked each answer choice.

TABLE A-6.19

Reasons Why Students Took a Mathematics Course in Summer School: Grades 8 and 12

Reason	% Students Grade 8	% Students Grade 12
Wanted to make up course failed during school year	23	38
Wanted to take higher level course next year	47	44
Wanted a lighter course load during school year	4	0
Wanted room for another subject in next school year schedule	0	2
Other	26	17
Number of students who took math in summer school	49	113

TABLE A-6.20

Ways Students Prepared for the Mathematics Portion of the SAT: Grades 8 and 12

Type of Preparation	% Students Grade 8	% Students Grade 12
Took a special prep course outside the school system	1	6
Took a prep course in a County high school	3	8
Was instructed by a tutor for the test	1	1
Received help from a parent or other relative	3	1
Studied on my own	60	62
Had no preparation	31	22
Number of students	93	396

TABLE A-6.21

Amount of Time Students Prepared for The SAT: Grades 8 and 12

Amount of Time Spent Preparing	% Students Grade 8	% Students Grade 12
No time preparing	11	6
Less than one week	27	27
One to two weeks	38	26
Three to four weeks	11	22
More than four weeks	13	18
Number of students	82	330

TABLE A-6.22

Post-High School Plans: Grades 8 and 12

Post High School Plans	% Students Grade 8	% Students Grade 12
Attend a college or vocational school	65	57
Work full time	3	9
Attend school and work	22	29
Don't know	10	5
Number of students	314	580

TABLE A-6.23

Planned Employment of Students by Age 30: Grades 8 and 12

Planned Employment By Age 30	% Students Grade 8	% Students Grade 12
Math or science profession	35	25
Other professional position	45	41
Manager or administrator	7	22
Sales, clerical, or crafts	5	8
Other	8	4
Number of students	283	477

APPENDIX TO CHAPTER 7:

RESPONSES TO PARENT QUESTIONNAIRES

TABLE A-7.1

Parents' Responses to Attitudinal Statements: Grades 4 and 6

Statement	Fourth Grade, N=136					Sixth Grade, N=126				
	SA	A	DK	D	SD	SA	A	DK	D	SD
It is important to know math to get a good job	42	53	2	3	1	43	53	1	3	0
Most people do not use math in their jobs	0	22	5	64	9	2	25	6	52	16
Boys are better at math than girls	2	26	5	58	10	4	26	6	58	6
Men make better scientists and engineers than women	2	24	3	60	12	4	30	4	54	7
A woman needs a career as much as a man does	37	60	1	3	0	35	59	2	5	0
I have a good mind for math	18	65	1	15	2	17	60	2	21	1
Teachers are always right in their evaluations of my child's math abilities	5	38	2	50	5	2	47	6	39	6
I will question a teacher if I disagree with his/her evaluation of my child's math abilities	18	71	2	9	0	20	65	6	10	0
Men make better math teachers than women	1	15	4	68	12	2	10	10	68	10
Students should take honors or advanced math classes only if they think they can get an A or B	2	26	4	60	9	1	28	6	60	6
Students should take as much math as possible, regardless of their career goals	17	62	4	16	2	18	57	3	22	0
Just because a student is bright doesn't mean he/she can handle advanced math classes	7	74	2	15	2	4	66	6	25	0

NOTE: Numbers are percentages of parents who picked each answer choice.

SA=Strongly Agree, A=Agree, DK=Don't Know, D=Disagree, SD=Strongly Disagree

TABLE A-7.2

Parents' Responses to Attitudinal Statements: Grades 8 and 12

Statement	Eighth Grade, N=133					Twelfth Grade, N=248				
	SA	A	DK	D	SD	SA	A	DK	D	SD
It is important to know math to get a good job	44	51	0	5	0	42	50	0*	8	0*
Most people do not use math in their jobs	2	24	2	64	9	0*	23	4	60	13
Boys are better at math than girls	5	27	6	49	13	2	20	7	58	13
Men make better scientists and engineers than women	2	24	6	55	14	0*	26	2	57	14
A woman needs a career as much as a man does	36	56	1	8	0	39	52	1	8	0
I have a good mind for math	15	65	1	19	1	12	64	2	19	4
Teachers are always right in their evaluations of my ch.ˉd's math abilities	2	47	5	41	5	2	38	4	48	9
I will question a teacher if I disagree with his/her evaluation of my child's math abilities	18	65	5	12	1	16	73	3	8	0
Men make better math teachers than women	1	14	9	65	12	0*	11	8	66	15
Students should take honors or advanced math classes only if they think they can get an A or B	4	24	6	58	8	1	25	3	61	10
Students should take as much math as possible, regardless of their career goals	16	65	2	17	1	17	54	2	26	1
Just because a student is bright doesn't mean he/she can handle advanced math classes	7	70	7	17	0	10	73	1	17	0

* Percentage is less than half of one percent.

NOTE: Numbers are percentages of parents who picked each answer choice.

SA=Strongly Agree, A=Agree, DK=Don't Know, D=Disagree, SD=Strongly Disagree

TABLE A-7.3

Parents' Reports of Whether Their Children Bring Home Mathematics Homework: Grades 4, 6, 8, and 12

Homework Brought Home	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Yes	93	96	93	93
No	7	3	4	7
Don't Know	1	1	3	0 *
Number of Parents	136	124	133	248

* Percentage is less than half of one percent.

TABLE A-7.4

Frequency That Students Bring Home Mathematics Homework: Grades 4, 6, 8, and 12

Number of Times Per Week	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Every Day	6	24	25	21
3-4 Days a Week	41	45	43	30
1-2 Days a Week	48	24	25	30
Don't Know	5	7	7	20
Number of Parents	126	120	123	230

TABLE A-7.5

Parents' Responses Regarding Whether Children Do Mathematics Homework The Same Time Every Day: Grades 4, 6, 8, and 12

Homework Done The Same Time Every Day	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Yes	71	63	65	49
No	29	35	35	46
Don't Know	0	3	0	6
Number of Parents	126	121	124	229

TABLE A-7.6

Amount of Time Children Spend Studying Mathematics at Home each Week: Grades 4, 6, 8, and 12

Time Spent Studying	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Less than one-half hour	14	6	7	3
Between one-half hour and one hour	28	23	10	12
Between one hour and one and one-half hours	14	17	15	7
More than one and one-half hours	41	50	57	55
Don't know	3	4	11	23
Number of parents	126	121	124	230

TABLE A-7.7

Children's Attitudes Toward Mathematics Homework: Grades 4, 6, 8, and 12

Children's Attitudes	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Homework is frustrating	18	14	16	29
Homework is easy to do	60	53	52	36
Homework isn't easy but isn't frustrating either	22	33	32	36
Number of parents	126	121	124	228

TABLE A-7.8

Parents' Responses Regarding Whether Their Children Ask For Help With Mathematics Homework or Studying For Tests: Grades 4, 6, 8, and 12

Children Ask for Help	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Yes	87	83	79	72
No	13	17	21	28
Number of Parents	124	120	123	230

TABLE A-7.9

Persons in the Family Who Help the Children with Mathematics: Grades 4, 6, 8 and 12

Persons Who Help	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Both Parents	29	12	14	10
Mother	38	34	24	19
Father	21	39	39	39
Another Relative	26	30	30	34
Friends	na	na	na	5
Tutor	na	na	na	5
Number of Parents	110	101	97	164

NOTE: Percentages add to more than 100 because respondents could choose more than one response.

na: Question not asked on grades 4, 6, and 8 survey.

TABLE A-7.10

Reasons for Particular Person Helping Children with Mathematics: Grades 4, 6, 8, and 12

Reason Person Helps	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Person better at mathematics than other members of household	21	42	65	70
Person better at working working with the child	14	11	5	7
Person only one who is available	55	40	26	18
No particular reason	17	6	4	11
Number of parents	110	100	95	158

NOTE: Percentages add to more than 100 because respondents could indicate all reasons why people helped.

TABLE A-7.11

Frequency That Students are Helped at Home with Mathematics Homework: Grades 4, 6, 8, and 12

Number of Times Per Week	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Every day	5	5	3	2
3-4 days a week	13	6	7	5
1-2 days a week	52	41	46	42
Less than 1 day a week	30	45	40	48
Don't know	1	3	3	4
Number of parents	110	100	94	159

TABLE A-7.12

Parents' Perceptions of Amount of Help Children Need to Study Mathematics Versus Other Subjects: Grades 4, 6, 8, and 12

Amount of Help Needec Compared to Other Subjs.	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
More help needed	32	32	46	47
Less help needed	36	30	28	19
About the same amount of help needed	32	37	26	30
Don t know	1	1	1	4
Number of parents	110	100	94	158

TABLE A-7.13

Parents' Responses Regarding Whether Children Are Placed In Instructional Groups for Mathematics: Grades 4, 6, and 8

Placement in Groups	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8
Yes	56	56	24
No	14	10	24
Don't Know	30	35	53
Number of Parents	135	126	132

TABLE A-7.14

Parents' Reports of Childrens' Mathematics Group Placement: Grades 4, 6, and 8

Mathematics Group Placement	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8
Above average or high group	55	56	50
Average group	33	30	28
Below average or low group	7	4	19
Don't know	5	10	3
Number of parents	76	70	32

TABLE A-7.15

Parental Satisfaction with Children's Placement in Mathematics Class: Grades 4, 6, and 8

Satisfied	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8
Yes	86	90	83
No	12	10	13
Don't Know	2	0	3
Number of Parents	66	60	30

TABLE A-7.16

Parents' Assessment of Children's Performance in Mathematics: Grades 4, 6, 8, and 12

Rating of Performance	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Outstanding	17	13	20	7
Above Average	35	45	42	33
Average	43	32	26	47
Below Average	4	11	10	12
Don't Know	2	0	2	1
Number of Parents	136	126	131	247

TABLE A-7.17

Parents' Perceptions of How Prepared Children Are in Mathematics Skills: Grades 4 and 6

	Fourth Grade, N=136				Sixth Grade, N=126			
Skill	WP	SP	DK	NP	WP	SP	DK	NP
Add, subtract, multiply, and divide	66	29	0	5	76	20	1	3
Solve word problems	40	44	4	11	52	37	2	8
Understand the importance of math in everyday life	43	39	1	17	47	36	6	11

NOTE: Numbers are percentages of parents who picked each answer choice.

WP=Well Prepared, SP=Somewhat Prepared, DK=Don't Know, NP=Not Well Prepared

TABLE A-7.18

Parents' Perceptions of How Prepared Children Are in Mathematics Skills: Grades 8 and 12

	Eighth Grade, N=133				Twelfth Grade, N=248			
Skill	WP	SP	DK	NP	WP	SP	DK	NP
Add, subtract, multiply, and divide	85	10	2	4	84	14	1	2
Solve word problems	59	27	6	8	61	30	4	5
Understand the importance of math in everyday life	53	28	4	15	64	32	1	4
Pursue a career in math	na	na	na	na	39	37	2	23

NOTE: Numbers are percentages of parents who picked each answer choice.

WP=Well Prepared, SP=Somewhat Prepared, DK=Don't Know, NP=Not Well Prepared

na: Not asked on this survey.

TABLE A-7.19

Parents' Reports Regarding Whether Their Children Had Ever Had An Outstanding Mathematics Teacher: Grades 4, 6, 8, and 12

Outstanding Mathematics Teacher	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Yes	38	50	37	34
Don't Know	21	16	19	11
No	42	34	44	56
Number of Parents	136	125	132	248

NOTE: Numbers are percentages of parents who picked each answer choice.

TABLE A-7.20

Parents' Reports Regarding Whether Their Children Had Ever Had A Really Bad Mathematics Teacher: Grades 4, 6, 8, and 12

Really Bad Mathematics Teacher	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Yes	18	21	21	31
Don't Know	10	11	16	12
No	72	68	63	57
Number of Parents	136	126	131	246

NOTE: Numbers are percentages of parents who picked each answer choice.

TABLE A-7.21

Parents' Reports of Childrens' Early Interest in Mathematics, Mechanical Objects or Computers: Grades 4, 6, 8, and 12

Child Had Early Interest	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Yes	68	70	59	43
No	32	30	41	57
Number of Parents	135	126	128	243

NOTE: Numbers are percentages of parents who picked each answer choice.

TABLE A-7.22

Parents' Perceptions of How Much Mathematics Children Will Need for Careers: Grades 4, 6, and 8

Preparation Needed for Career	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8
Don't know	4	8	9
Basic mathematics skills to work in an office or small business	8	6	11
Enough mathematics to qualify for admission to college but not for career in math or science	43	45	44
Enough mathematics to be able to pursue a career in math or science	44	41	36
Number of parents	136	126	132

NOTE: Numbers are percentages of parents who picked each answer choice.

TABLE A-7.23

Twelfth Grade Parents' Perceptions of How Prepared Children Are for Various Careers

How Well Prepared in Mathematics	% Parents
Don't know	2
Prepared with basic mathematics skills to work in an office or small business	25
Prepared with enough mathematics to qualify for admission to college but not for career in mathematics or science	50
Prepared with enough mathematics to be able to pursue a career in mathematics or science	23
Number of parents	247

NOTE: Numbers are percentages of parents who picked each answer choice.

TABLE A-7.24

Parents' Reports Regarding Whether Child Has Ever Participated in A Special Mathematics Program for the Gifted: Grades 4, 6, 8, and 12

Participation in Special Program	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Yes	14	21	28	19
Don't Know	5	6	5	2
No	81	72	67	79
Number of Parents	135	126	132	248

NOTE: Numbers are percentages of parents who picked each answer choice.

TABLE A-7.25

Parents' Reports of How Far in School They Would Like Their Children to Get: Grades 4, 6, 8, and 12

How Far In School	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Don't Know	2	2	3	2
High School	1	1	2	2
Vocational School	0	0	2	3
Some College	2	4	1	5
Finish College	47	49	54	41
Master's Degree	16	18	15	26
Ph.d. or M.D.	33	27	24	21
Number of Parents	134	125	129	247

NOTE: Numbers are percentages of parents who picked each answer choice.

TABLE A-7.26

Kind of Work Parents Think Their Children Will be Doing at Age 30: Grades 4, 6, 8, and 12

Kind of Work	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Science, Mathematics, Engineering Profession	36	32	38	28
Other Profession	46	56	52	38
Management or Administration	13	2	4	15
Clerical, Crafts, Services, Sales	3	6	4	18
Housewife	1	1	0	1
Military	1	1	0	0
Laborers	0	1	2	1
Number of Parents	100	84	99	201

TABLE A-7.27

Twelfth Grade Parents' Opinions of the Importance of Studying Mathematics in Their Childrens' Lives Beyond High School

Importance of Mathematics	% of Parents
Very Important	63
Somewhat Important	30
Not Important	6
Don't Know	1
Number of Parents	248

TABLE A-7.28

Mother's Highest Level of Education Completed: Grades 4, 6, 8, and 12

Level of Education	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Less Than HS Graduation	9	14	8	9
High School Graduation	23	24	25	27
Vocational School	2	4	2	4
Some College	13	16	18	19
Finished College	34	23	32	23
Master's Degree	17	17	11	11
Ph.D. or M.D.	2	2	5	6
Number of Parents	133	121	132	239

TABLE A-7.29

Father's Highest Level of Education Completed: Grades 4, 6, 8, and 12

Level of Education	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Less Than HS Graduation	8	5	5	7
High School Graduation	14	19	19	20
Vocational School	4	3	2	2
Some College	13	14	11	12
Finished College	26	22	31	19
Master's Degree	18	20	17	21
Ph.D. or M.D.	17	17	16	19
Number of Parents	133	113	124	227

TABLE A-7.30

Mother's Highest Level Mathematics Course Taken in High School: Grades 4, 6, 8, and 12

Highest Mathematics Taken	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Calculus	14	16	8	7
Pre-Calculus	3	2	2	1
Advanced Algebra	20	18	20	20
Algebra 2	24	24	12	16
Geometry	17	15	29	17
Algebra 1	13	13	23	24
General Mathematics	10	13	8	15
Number of Parents	64	55	66	124

TABLE A-7.31

Father's Highest Level Mathematics Course Taken in High School: Grades 4, 6, 8, and 12

Highest Mathematics Taken	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Calculus	26	22	26	27
Pre-Calculus	11	6	4	3
Advanced Algebra	32	39	30	33
Algebra 2	18	6	4	9
Geometry	13	11	13	12
Algebra 1	0	11	17	15
General Mathematics	0	6	6	1
Number of Parents	38	36	47	78

TABLE A-7.32

Mother's Performance in High School Mathematics: Grades 4, 6, 8, and 12

Performance In Mathematics	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Outstanding	20	15	21	17
Above Average	27	27	24	27
Average	37	43	47	47
Below Average	14	11	8	9
Don't Know	2	4	0	0
Number of Parents	86	81	78	148

TABLE A-7.33

Father's Performance in High School Mathematics: Grades 4, 6, 8, and 12

Performance In Mathematics	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Outstanding	38	29	27	22
Above Average	19	31	25	33
Average	36	36	48	39
Below Average	6	2	0	6
Don't Know	0	2	0	0
Number of Parents	47	42	52	85

TABLE A-7.34

Mother's Major in College: Grades 4, 6, 8, and 12

Major in College	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Mathematics, Science, Engineering, etc.	10	9	6	4
Medicine, Biological Sciences	17	20	17	19
Law	0	0	3	2
Computer Science	4	0	4	2
Business	18	23	14	12
Social Sciences	25	25	39	36
Education	8	13	12	14
Foreign Language	4	2	4	2
Art, Architecture	8	6	1	5
Agriculture, Home Economics	7	2	1	3
Number of Parents	84	64	78	130

TABLE A-7.35

Father's Major in C ,llege: Grades 4, 6, 8, and 12

Major in College	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Mathematics, Science, Engineering, etc.	38	31	33	31
Medicine, Biological Sciences	12	11	7	13
Law	1	5	1	3
Computer Science	1	1	3	1
Business	19	16	15	16
Social Sciences	19	28	36	29
Education	0	3	2	3
Foreign Language	1	0	1	1
Art, Architecture	8	5	0	1
Agriculture, Home Economics	2	0	1	1
Number of Parents	96	80	87	152

TABLE A-7.36

Mother's Highest Level Mathematics Course Taken in College:
Grades 4, 6, 8, and 12

Highest Level of Mathematics	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Mathematics Major	4	0	0	0
Applied Mathematics	19	11	25	17
Calculus, Pre-Calculus	46	61	44	49
Accounting	4	6	6	0
College Mathematics	4	6	0	9
Business Mathematics	0	6	6	0
High School Mathematics	23	11	19	26
Number of Parents	26	18	16	35

TABLE A-7.37

Father's Highest Level Mathematics Course Taken in College:
Grades 4, 6, 8, and 12

Highest Level of Mathematics	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Mathematics Major	0	5	0	0
Applied Mathematics	14	15	19	15
Calculus, Pre-Calculus	43	55	54	60
Accounting	4	5	2	0
College Mathematics	7	5	4	6
Business Mathematics	4	0	0	0
High School Mathematics	29	15	23	19
Number of Parents	28	20	26	47

TABLE A-7.38

Mother's Rating of Mathematics Performance in College: Grades 4, 6, 8, and 12

Performance in Mathematics	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Outstanding	32	7	10	13
Above Average	27	33	35	28
Average	37	50	52	50
Below Average	5	3	3	9
Number of Parents	41	30	29	46

TABLE A-7.39

Father's Rating of Mathematics Performance in College: Grades 4, 6, 8, and 12

Performance in Mathematics	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Outstanding	24	18	14	13
Above Average	29	43	36	46
Average	38	36	44	37
Below Average	9	4	6	4
Number of Parents	34	28	36	54

TABLE A-7.40

Mother's Current Occupation: Grades 4, 6, 8, and 12

Occupation	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Math/Science Professional	18	13	14	11
Other Professional	24	28	33	27
Management or Administration	13	14	20	19
Sales	10	8	5	9
Clerical	13	5	9	16
Craftsperson	5	8	7	3
Laborer, Service Worker	15	25	11	13
Self-employed	2	0	0	1
Number of Parents	93	79	97	179

' BLE A-7.41

Father's Current Occupation: Grades 4, 6, 8, and 12

Occupation	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Math/Science Professional	26	18	29	27
Other Professional	21	24	29	18
Management or Administration	23	21	17	22
Sales	3	6	4	6
Clerical	1	6	4	1
Craftsperson	14	16	15	15
Laborer, Service Worker	12	7	3	9
Self-employed	2	2	1	1
Number of Parents	120	103	112	211

TABLE A-7.42

Importance of Mathematics in Mother's Job: Grades 4, 6, 8, and 12

Importance of Mathematics	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Very Important	50	46	30	33
Somewhat Important	24	33	38	34
Not Important	26	21	32	33
Number of Parents	92	78	96	181

TABLE A-7.43

Importance of Mathematics in Father's Job: Grades 4, 6, 8, and 12

Importance of Mathematics	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Very Important	55	58	47	52
Somewhat Important	30	27	36	33
Not Important	16	15	17	15
Number of Parents	122	100	112	210

TABLE A-7.44

Parents' Reports of Total Family Income: Grades 4, 6, 8, and 12

Income	% Parents Grade 4	% Parents Grade 6	% Parents Grade 8	% Parents Grade 12
Less than $ 8,000	1	2	0	1
$8,000 to $14,999	3	3	5	3
$15,000 to $19,999	4	8	4	4
$20,000 to $24,999	6	6	5	7
$25,000 to $29,999	10	2	8	5
$30,000 to $39,999	13	10	17	9
$40,000 to $49,999	8	14	9	10
$50,000 or More	35	29	39	45
Refused to Answer	21	26	14	16
Number of Parents	136	126	133	248

APPENDIX TO CHAPTER 8:

RESPONSES TO TEACHER AND COUNSELOR QUESTIONNAIRES

TABLE A-8.1

Background Characteristics of Teachers: Grades 4, 6, 8, and 12

Background Characteristic	% Teachers Grade 4	% Teachers Grade 6	% Teachers Grade 8	% Teachers Grade 12
Racial/Ethnic Group				
Asian	1	1	0	1
Black	9	8	3	8
Hispanic	0	0	0	1
White	90	91	97	90
Gender				
Female	90	76	70	53
Male	10	24	30	47
Years Teaching Experience in Montgomery County				
1- 5	24	14	22	19
6-15	38	42	51	40
16 or More	39	44	27	41
Level of Education Completed				
Bachelor's degree	27	14	27	17
Master's degree	24	37	24	22
Studies beyond a Master's degree	49	49	49	60
Number of Mathematics Courses Taken in College				
0-1	20	13	3	0
2	24	25	3	1
3	17	20	0	2
4-7	31	34	35	11
8 or More	8	4	60	86
Number of Teachers	88	89	37	166

TABLE A-8.2

Background Characteristics of Guidance Counselors: Junior High/Middle and High School

Background Characteristic	% Junior High/Middle	% High School
Racial/Ethnic Group		
Asian	0	0
Black	36	18
Hispanic	0	1
White	64	81
Gender		
Female	71	51
Male	29	49
Years of Experience in Montgomery County		
2-10	28	13
11-16	28	34
17 or More	44	53
Level of Education Completed		
Bachelor's degree	0	0
Master's degree	14	7
Studies beyond a Master's degree	86	93
Number of counselors	14	68

TABLE A-8.3

Teachers' Perceptions About Mathematics: Grades 4, 6, 8, and 12

Perceptions	% Teachers Grade 4	% Teachers Grade 6	% Teachers Grade 8	% Teachers Grade 12
Students should take honors or advanced mathematics classes only if they think they can get an A or B	40	34	49	48
Students should take as much mathematics as possible, regardless of their career goals	69	64	71	73
Just because a student is bright doesn't mean he/she can handle advanced mathematics classes.	91	88	94	86
In my experience, boys are better at mathematics than girls	8	8	6	10
Boys need to know more mathematics than girls	1	0	0	4
I enjoy teaching mathematics	94	100	na	na
Of all the subjects I can teach, I feel most comfortable teaching mathematics	48	58	na	na
Number of teachers	87	85	37	162

na: Question not asked on this survey.

NOTE: Numbers in table are percentages of teachers who strongly agreed or agreed with the statement.

TABLE A-8.4

Junior High/Middle and High School Counselors' Perceptions About Mathematics

	% Counselors Jr. High/Middle	% Counselors High School
Studencs should take as much mathematics as possible, regardless of their career goals	71	91
Just because a student is bright doesn't mean he/she can handle advanced mathematics classes	78	83
Students are under too much pressure to succeed academically	29	31
Students should take honors classes only if they think they can get an A cr a B	21	44
Number of counselors	14	68

NOTE: Numbers in table are percentages of counselors who strongly agreed or agreed with the statement.

TABLE A-8.5

Factors Junior High/Middle and High Schools Counselors Consider Very Important in Counseling Students About Mathematics Courses To Take

Factor	% Counselors Jr. High/Middle	% Counselors High School
Student's study habits	60	68
Student's prior grades in mathematics	57	74
Mathematics teacher's recommendations	54	61
Personal observations about student	44	56
Student's career aspirations	43	48
Student's mathematics achievement test scores (i.e., CAT scores)	43	31
Student's performance in the ISM program (K-8 curriculum)	43	11
Student's overall academic performance	21	26
Student's overall course load	14	35
Number of counselors	14	68

TABLE A-8.6

Junior High Middle and High School Counselors' Perceptions of the Major Determinants of Students' Decisions to Enroll in Mathematics Courses

Major Determinant	% Counselors Jr. High/Middle	% Counselors High School
Parental expectations, influence, or pressure	57	53
Student's level of interest and motivation in the course	43	19
Teacher recommendations	29	12
Student's career goals and/or college admission requirements	21	44
Student's success in previous mathematics course	21	24
Peer pressure	21	22
Counselor recommendations	7	9
Graduation requirements	7	9
Number of counselors	14	68

NOTE: Numbers in table represent responses to open-ended questions.

TABLE A-8.7

Percentage of Junior High/Middle and High School Guidance Counselors Who Agreed with Various Gender-related Statements About Mathematics or Science, or Who Stated They Did Not Know

Gender-related Statement	Junior High/Middle, n=14		High School, n=68	
	% Agree	% Don't know	% Agree	% Don't know
Girls are better students than boys	7	7	16	8
Female students don't take mathematics and science courses as seriously as male students	7	7	13	13
Male students are more career oriented than female students	14	0	4	4
Men make better scientists and engineers than women	0	0	2	24
Women make better mathematics teachers than men	0	8	3	31
Boys need to study more mathematics than girls	0	0	0	5

NOTE: "Agree" includes counselors who agreed and strongly agreed.

TABLE A-8.8

Reasons Provided by Junior High/Middle and High School Counselors for Differences in Mathematics Performance by Students' Gender

Reasons Provided for Differences	% Counselors Jr. High/Middle	% Counselors High School
Females think that mathematics is a subject better suited for males	57	47
Males receive more support from their families to study mathematics	21	13
Mathematics teachers treat male and female students differently	21	13
Males are more interested in mathematics and science oriented careers	14	16
Males are better at mathematics than females	0	7
Number of counselors	14	68

NOTE: Percentages in this table based on answers to open-ended questions.

TABLE A-8.9

Reasons Provided by Junior High/Middle and High School Counselors for Differences in Mathematics Performance and Achievement Between White and Non-Asian Minority Students

Reasons Provided for Differences	% Counselors Jr. High/Middle	% Counselors High School
Differences in parental influence	50	43
Teachers have lower expectations for black and Hispanic students	50	34
Students' lower socio-economic status is related to performance and achievement	36	24
Black and Hispanic students have deficiencies in their early mathematics preparation	14	13
Black and Hispanic students lack information regarding the importance of mathematics	7	3
Number of counselors	14	68

NOTE: Percentages in this table based on answers to open-ended questions.

TABLE A-8.10

Steps Junior High/Middle and High School Counselors Would Take To Eliminate Differences in Mathematics Performance and Achievement Related to Students' Gender and Racial/Ethnic Group

Steps Counselors Would Take	% Counselors Jr. High/Middle	% Counselors High School
More encouragement of students by teachers, counselors, and principals	21	19
Ensure that teachers have similar expectations for all students	14	21
Strengthen students' elementary school mathematics preparation	21	16
Ensure that all students are aware of the utility of mathematics	14	8
Challenge all students	7	7
Provide tutorial help to students in need of help	14	6
Number of counselors	14	68

TABLE A-8.11

Actions Taken by Teachers When Students Fall Below Grade Level in the K-8 Mathematics Curriculum: Grades 4, 6, and 8

Actions Taken	% Teachers Grade 4	% Teachers Grade 6	% Teachers Grade 8
Review earlier objectives which lead up to the one(s) the student is unable to master	94 *	90 *	74 *
Work with the student as part of a group of students who are all working below grade level	91 *	81 *	65 *
Work with the student on a one-to-one basis <u>during</u> classroom hours	86 *	89 *	53 *
Bring this fact to the attention of the student's parent(s) (aside from doing so on report cards)	78 *	60 *	41 *
Bring this fact to the attention of the student (aside from doing so on report cards)	77	79	71
Assign the student additional work on the problem objective(s)	63	63	44
Assess the student more often to try to bring him/her back to grade level	60	54	38
Move on to another set of objectives that the student may be able to master	60	48	44
Have the student work with a group of students who have already mastered the objective(s)	51	40	35
Work with the student on a one-to-one basis <u>outside</u> of classroom hours	49 *	70 *	71 *
Transfer the student to another class or group	20	25	24
Number of teachers	86	84	34

* Difference among teachers in the three grades is statistically significant.

NOTE: Teachers could pick as many of these items as they wished.

TABLE A-8.12

Teachers' Perceptions of Learning Goals in Mathematics: Grades 4 and 6

Learning Goal	% Teachers Grade 4	% Teachers Grade 6
Develop a systematic approach to problem-solving	[illegible]	89
Know mathematical facts, principles, and algorithms	89	91
Understand the logical structure of mathematics	74	68
Develop an attitude of inquiry	84	84
Develop an awareness of the importance of mathematics in everyday life	91	84
Become interested in mathematics	60	64
Develop an awareness of the importance of mathematics in keeping career options open	59	67
Perform computations with speed and accuracy	55	63
Number of teachers	87	85

NOTE: Numbers in table are percentages of teachers who rated goals very important.

TABLE A-8.13

Teachers' Perceptions of Learning Goals in Mathematics for General Mathematics and College Preparatory Students: Grades 8 and 12

Learning Goal	General Mathematics Grade 8	College Prep Grade 8	General Mathematics Grade 12	College Prep Grade 12
Develop a systematic approach to problem-solving	91	96	91	96
Know mathematical facts, principles, and algorithms	72	70	63 *	86 *
Understand the logical structure of mathematics	50 *	87 *	40 *	91 *
Develop an attitude of inquiry	56 *	87*	57 *	89 *
Develop an awareness of the importance of mathematics in everyday life	81	70	80 *	59 *
Become interested in mathematics	53	78	34 *	55 *
Develop an awareness of the importance of mathematics in keeping career options open	69	87	56 *	76 *
Perform computations with speed and accuracy	52	73	39 *	56 *
Understand the nature of proof	9 *	70 *	11 *	68 *
Number of teachers	32	23	122	152

* Difference in teachers' responses for general mathematics and college preparatory students is statistically significant.

NOTE: Numbers of teachers are somewhat smaller than the total sample of teachers since not all teachers taught both college preparatory and general mathematics classes.

TABLE A-8.14

Mathematics Areas in Which Teachers Expect More of High-Performing Students Than They Do of Low-Performing Students: Grades 4 and 6

Mathematics Area	% Teachers Grade 4	% Teachers Grade 6
Logical thinking and conceptualization	47	44
Grasping information quickly	36	32
Test accuracy and performance	27	19
Motivation and dedication to work	19	20
Class participation	18	18
Completion of homework	17	20
Performance on creative assignments and challenging activities	14	16
Amount of teacher direction needed	13	20
Retention of information	10	16
Number of teachers	88	89

NOTE: Percentages represent those teachers who wrote in responses to open-ended questions.

TABLE A-8.15

Considerations Teachers Use When Preparing Quizzes and Tests for High-Performing Versus Low-Performing Students: Grades 4 and 6

Consideration	% Teachers Grade 4	% Teachers Grade 6
More word problems, conceptual questions, application and synthesis for higher groups, vs. basic skills questions for lower groups	51	52
More questions involving several steps for higher groups	17	15
Consideration of students' reading ability for lower groups	10	5
Consideration of general ability level of each group	9	11
Use of free response questions for higher groups	7	8
More material covered on tests for higher group	5	9
Use same format regardless of level of student	3	10
Number of teachers	88	89

NOTE: Percentages represent those teachers who wrote in responses to open-ended questions.

TABLE A-8.16

Considerations Teachers Use When Preparing Quizzes and Tests for General Versus College Preparatory Mathematics Students: Grades 8 and 12

Consideration	% Teachers Grade 8	% Teachers Grade 12
More word problems, conceptual questions, application and synthesis for college prep, vs. basic skills and single step questions for general mathematics students	32	39
Same considerations apply to both levels	8	2
More material covered on tests for college prep mathematics classes	3	11
Questions for general mathematics classes are related directly to classroom problems	3	10
More quizzes for general mathematics classes	3	8
Don't expect students in general mathematics classes to do proofs completely	3	7
Number of teachers	37	166

NOTE: Percentages represent those teachers who wrote in responses to open-ended questions.

TABLE A-8.17

Considerations Teachers Use When Preparing Homework for General Versus College Preparatory Mathematics Students: Grades 8 and 12

Consideration	% Teachers Grade 8	% Teachers Grade 12
More word problems, conceptual questions, application and synthesis for college prep, vs. basic skills questions for general mathematics students	35	41
Shorter/fewer assignments for general mathematics classes	19	22
No difference in assignments	5	2
More class time is provided for completing homework in general mathematics classes	3	16
Number of teachers	37	166

NOTE: Percentages represent those teachers who wrote in responses to open-ended questions.

TABLE A-8.18

Percentage of Students Rated Positively by Teachers on Classroom Behaviors or Characteristics: Grades 4, 6, 8, and 12

Classroom Behavior/ Characteristic	% Students Grade 4	% Students Grade 6	% Students Grade 8	% Students Grade 12
Insightful	35	38	40	33
Prepared	44	64	62	48
Anxious	25	28	35	28
Careful	35	50	56	50
Studious	42	52	60	40
Well Behaved	64	75	74	82
Number of Students	158	155	146	265

TABLE A-8.19

Teachers' Ratings of Students' Overall Ability: Grades 4, 6, 8, and 12

Rating of Overall Ability	% Students Grade 4	% Students Grade 6	% Students Grade 8	% Students Grade 12
Outstanding	13	17	15	10
Above Average	27	34	45	32
Average	36	29	29	35
Somewhat Below Average	20	12	7	18
Significantly Below Average	4	7	4	6
Number of Students	157	151	145	253

TABLE A-8.20

Teachers' Ratings of Students' Mathematics Ability: Grades 4, 6, 8, and 12

Rating of Mathematics Ability	% Students Grade 4	% Students Grade 6	% Students Grade 8	% Students Grade 12
Gifted	3	11	6	2
Outstanding	17	14	25	12
Above Average	25	30	30	26
Average	31	23	29	31
Somewhat Below Average	21	17	9	22
Significantly Below Average	3	6	3	7
Number of Students	155	155	146	263

TABLE A-8.21

Teachers' Ratings of Students' Performance in the K-8 Mathematics Curriculum: Grades 4, and 6

Performance in the K-8 Curriculum	% Students Grade 4	% Students Grade 6
Above Grade Level	21	37
On Grade Level	50	26
Below Grade Level	27	30
Don't Know	3	7
Number of Students	158	160

TABLE A-8.22

Teachers' Ratings of Students' Performance Compared to Other Students in Their Grade: Grades 8 and 12

Performance Compared to Others in the Same Grade	% Students Grade 8	% Students Grade 12
Above Grade Level	46	30
On Grade Level	27	26
Below Grade Level	26	43
Don't Know	1	2
Number of Students	147	267

TABLE A-8.23

Teachers' Expectations of the Amount of Mathematics Students Are Capable of Taking in High School: Grades 4, and 6

Amount of Mathematics	% Students Grade 4	% Students Grade 6
College Preparatory Mathematics	52	54
General Mathematics	27	29
Vocational, Consumer, Business Mathematics	5	4
Don't Know	16	13
Number of Students	158	160

TABLE A-8.24

Teachers' Expectations of the Amount of Mathematics Students Are Capable of Taking in College: Grades 8, and 12

Amount of Mathematics	% Students Grade 8	% Students Grade 12
Mathematics major	16	9
Majors requiring a lot of mathematics	39	26
Majors requiring only limited mathematics	33	40
No mathematics at the college level	8	21
Don't know	4	5
Number of students	147	267

TABLE A-8.25

Teachers' Expectations of the Level of Education Students Are Capable of Completing: Grades 4, 6, and 8

Level of Education	% Students Grade 4	% Students Grade 6	% Students Grade 8	% Students Grade 12
Less Than High School	2	1	1	1
High School Graduation	16	13	4	11
Vocational or Trade School	6	6	5	12
Some College	12	9	19	18
College Degree	50	54	64	55
Don't Know	15	18	5	5
Number of Students	158	160	147	267

TABLE A-8.26

Teachers' Ratings of Fourth Grade Students' Insight by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	26.785	1	26.785	43.514	.000
Level of Participation	26.785	1	26.785	43.514	.000
Main Effects	3.481	4	.870	1.414	.232
Gender	.066	1	.066	.107	.744
Racial/Ethnic Group	3.277	3	1.092	1.775	.155
2-way Interactions	.676	3	.225	.366	.777
Gender Racial/Ethnic Gp.	.676	3	.225	.366	.777
Explained	30.942	8	3.868	6.283	.000
Residual	88.640	144	.616		
Total	119.582	152	.787		

TABLE A-8.27

Teachers' Ratings of Sixth Grade Students' Insight by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	53.644	1	53.644	73.488	.000
Level of Participation	53.644	1	53.644	73.488	.000
Main Effects	5.204	4	1.301	1.782	.136
Gender	.417	1	.417	.571	.451
Racial/Ethnic Group	4.548	3	1.516	2.077	.106
2-way Interactions	5.801	3	1.934	2.649	.051
Gender Racial/Ethnic Gp.	5.801	3	1.934	2.649	.051
Explained	64.649	8	8.081	11.070	.000
Residual	105.845	145	.730		
Total	170.494	153	1.114		

TABLE A-8.28

Teachers' Ratings of Eighth Grade Students' Insight by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	23.958	1	23.958	28.769	.000
Level of Participation	23.958	1	23.958	28.769	.000
Main Effects	4.910	4	1.228	1.474	.215
Gender	.765	1	.765	.919	.340
Racial/Ethnic Group	3.918	3	1.306	1.568	.201
2-way Interactions	1.663	3	.554	.666	.575
Gender Racial/Ethnic Gp.	1.663	3	.554	.666	.575
Explained	30.530	8	3.816	4.583	.000
Residual	94.933	114	.833		
Total	125.463	122	1.028		

TABLE A-8.29

Teachers' Ratings of Twelfth Grade Students' Insight by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	58.661	1	58.661	69.208	.000
Level of Participation	58.661	1	58.661	69.208	.000
Main Effects	7.502	4	1.875	2.213	.069
Gender	.240	1	.240	.283	.595
Racial/Ethnic Group	7.300	3	2.433	2.871	.037
2-way Interactions	.373	3	.124	.147	.932
Gender Racial/Ethnic Gp.	.373	3	.124	.147	.932
Explained	66.535	8	8.317	9.812	.000
Residual	183.930	217	.848		
Total	250.465	225	1.113		

TABLE A-8.30

Teachers' Ratings of Fourth Grade Students' Preparation for Class by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	19.731	1	19.731	17.049	.000
Level of Participation	19.731	1	19.731	17.049	.000
Main Effects	19.353	4	4.838	4.181	.003
Gender	4.067	1	4.067	3.514	.063
Racial/Ethnic Group	13.394	3	4.465	3.858	.011
2-way Interactions	.735	3	.245	.212	.888
Gender Racial/Ethnic Gp.	.735	3	.245	.212	.888
Explained	39.819	8	4.977	4.301	.000
Residual	166.652	144	1.157		
Total	206.471	152	1.358		

TABLE A-8.31

Teachers' Ratings of Sixth Grade Students' Preparation for Class by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	34.425	1	34.425	34.766	.000
Level of Participation	34.425	1	34.425	34.766	.000
Main Effects	36.442	4	9.110	9.201	.000
Gender	25.501	1	25.501	25.753	.000
Racial/Ethnic Group	14.350	3	4.783	4.831	.003
2-way Interactions	7.666	3	2.555	2.581	.056
Gender Racial/Ethnic Gp.	7.666	3	2.555	2.581	.056
Explained	78.532	8	9.817	9.914	.000
Residual	143.578	145	.990		
Total	222.110	153	1.452		

TABLE A-8.32

Teachers' Ratings of Eighth Grade Students' Preparation for Class by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	20.192	1	20.192	17.110	.000
Level of Participation	20.192	1	20.192	17.110	.000
Main Effects	10.167	4	2.542	2.154	.079
Gender	1.029	1	1.029	.872	.352
Racial/Ethnic Group	9.478	3	3.159	2.677	.050
2-way Interactions	6.439	3	2.146	1.819	.148
Gender Racial/Ethnic Gp.	6.439	3	2.146	1.819	.148
Explained	36.799	8	4.600	3.898	.000
Residual	134.535	114	1.180		
Total	171.333	122	1.404		

TABLE A-8.33

Teachers' Ratings of Twelfth Grade Students' Preparation for Class by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	28.951	1	28.951	26.732	.000
Level of Participation	28.951	1	28.951	26.732	.000
Main Effects	14.012	4	3.503	3.235	.013
Gender	3.632	1	3.632	3.354	.068
Racial/Ethnic Group	10.214	3	3.405	3.144	.026
2-way Interactions	5.536	3	1.845	1.704	.167
Gender Racial/Ethnic Gp.	5.536	3	1.845	1.704	.167
Explained	48.499	8	6.062	5.598	.000
Residual	235.010	217	1.083		
Total	283.509	225	1.260		

TABLE A-8.34

Teachers' Ratings of Fourth Grade Students' Mathematics Anxiety by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	5.791	1	5.791	6.355	.013
Level of Participation	5.791	1	5 791	6.355	.013
Main Effects	10.869	4	2.717	2.982	.021
Gender	6.385	1	6.385	7.008	.009
Racial/Ethnic Group	3.418	3	1.139	1.250	.294
2-way Interactions	.604	3	.201	.221	.882
Gender Racial/Ethnic Gp.	.604	3	.201	.221	.882
Explained	17.264	8	2.158	2.368	020
Residual	131.207	144	.911		
Total	148.471	152	.977		

TABLE A-8.35

Teachers' Ratings of Sixth Grade Students' Mathematics Anxiety by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	.734	1	.734	.791	.375
Level of Participation	.734	1	.734	.791	.375
Main Effects	9.168	4	2.292	2.471	.047
Gender	4.734	1	4.734	5.104	.025
Racial/Ethnic Group	5.401	3	1.800	1 941	.126
2-way Interactions	1.509	3	.503	.542	.654
Gender Racial/Ethnic Gp.	1.509	3	.503	.542	.654
Explained	11.411	8	1.426	1.538	.149
Residual	134.492	145	.928		
Total	145.903	153	.954		

TABLE A-8.36

Teachers' Ratings of Eighth Grade Students' Mathematics Anxiety by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	5.060	1	5.060	4.843	.030
Level of Participation	5.060	1	5.060	4.843	.030
Main Effects	4.851	4	1.213	1.161	.332
Gender	1.790	1	1.790	1.713	.193
Racial/Ethnic Group	3.576	3	1.192	1.141	.336
2-way Interactions	2.934	3	.978	.936	.426
Gender Racial/Ethnic Gp.	2.934	3	.978	.936	.426
Explained	12.845	8	1.606	1.537	.152
Residual	119.122	114	1.045		
Total	131.967	122	1.082		

TABLE A-8.37

Teachers' Ratings of Twelfth Grade Students' Mathematics Anxiety by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	11.211	1	11.211	12.127	.001
Level of Participation	11.211	1	11.211	12.127	.001
Main Effects	5.448	4	1.362	1.473	.211
Gender	1.905	1	1.905	2.061	.153
Racial/Ethnic Group	3.410	3	1.137	1.229	.300
2-way Interactions	2.955	3	.985	1.066	.365
Gender Racial/Ethnic Gp.	2.955	3	.985	1.066	.365
Explained	19.614	8	2.452	2.652	.009
Residual	200.616	217	.924		
Total	220.230	225	.979		

TABLE A-8.38

Teachers' Ratings of Fourth Grade Students' Carefulness by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	19.340	1	19.340	18.886	.000
Level of Participation	19.340	1	19.340	18.886	000
Main Effects	17.126	4	4.282	4.181	.003
Gender	5.119	1	5.119	4.999	.027
Racial/Ethnic Group	10.013	3	3.338	3.259	.023
2-way Interactions	10.986	3	3.662	3.576	.016
Gender Racial/Ethnic Gp.	10.986	3	3.662	3.576	.016
Explained	47.452	8	5.931	5.792	.000
Residual	147.463	144	1.024		
Total	194.915	152	1.282		

TABLE A-8.39

Teachers' Ratings of Sixth Grade Students' Carefulness by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	60.971	1	60.971	71.159	.000
Level of Participation	60.971	1	60.971	71.159	.000
Main Effects	36.046	4	9.012	10.517	.000
Gender	18.638	1	18.638	21.752	.000
Racial/Ethnic Group	20.394	3	6.798	7.934	.000
2-way Interactions	3.782	3	1.261	1.471	.225
Gender Racial/Ethnic Gp.	3.782	3	1.261	1.471	.225
Explained	100.799	8	12.600	14.705	.000
Residual	124.240	145	.857		
Total	225.039	153	1.471		

TABLE A-8.40

Teachers' Ratings of Eighth Grade Students' Carefulness by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	24.643	1	24.643	22.400	.000
Level of Participation	24.643	1	24.643	22.400	.000
Main Effects	12.194	4	3.049	2.771	.031
Gender	3.890	1	3.890	3.536	.063
Racial/Ethnic Group	9.261	3	3.087	2.806	.043
2-way Interactions	8.332	3	2.777	2.524	.061
Gender Racial/Ethnic Gp.	8.332	3	2.777	2.524	.061
Explained	45.170	8	5.646	5.132	.000
Residual	125.416	114	1.100		
Total	170.585	122	1.398		

TABLE A-8.41

Teachers' Ratings of Twelfth Grade Students' Carefulness by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	32.308	1	32.308	28.718	.000
Level of Participation	32.308	1	32.308	28.718	.000
Main Effects	11.480	4	2.870	2.551	.040
Gender	9.830	1	9.830	8.738	.003
Racial/Ethnic Group	1.961	3	.654	.581	.628
2-way Interactions	2.247	3	.749	.666	.574
Gender Racial/Ethnic Gp.	[illegible]	3	.749	.666	.574
Explained	46.035	8	5.754	5.115	.000
Residual	244.125	217	1.125		
Total	290.159	225	1.290		

TABLE A-8.42

Teachers' Ratings of Fourth Grade Students' Studiousness by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	26.813	1	26.813	25.312	.000
Level of Participation	26.813	1	26.813	25.312	.000
Main Effects	8.629	4	2.157	2.036	.092
Gender	3.231	1	3.231	3.050	.083
Racial/Ethnic Group	4.621	3	1.540	1.454	.230
2-way Interactions	.016	3	.005	.005	.999
Gender Racial/Ethnic Gp.	.016	3	.005	.005	.999
Explained	35.458	8	4.432	4.184	.000
Residual	152.542	144	1.059		
Total	188.000	152	1.237		

TABLE A-8.43

Teachers' Ratings of Sixth Grade Students' Studiousness by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	40.985	1	40.985	44.518	.000
Level of Participation	40.985	1	40 985	44.518	.000
Main Effects	27.394	4	6.849	7.439	.000
Gender	16.018	1	16.018	17.399	.000
Racial/Ethnic Group	13.936	3	4.645	5.046	.002
2-way Interactions	2.312	3	.771	.837	.476
Gender Racial/Ethnic Gp.	2.312	3	.771	.837	.476
Explained	70.691	8	8.836	9.598	.000
Residual	133.491	145	.921		
Total	204.182	153	1.335		

TABLE A-8.44

Teachers' Ratings of Eighth Grade Students' Studiousness by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	34.068	1	34.068	31.598	.000
Level of Participation	34.068	1	34.068	31.598	.000
Main Effects	13.425	4	3.356	3.113	.018
Gender	2.960	1	2.960	2.746	.100
Racial/Ethnic Group	11.729	3	3.910	3.626	.015
2-way Interactions	5.270	3	1.757	1.629	.186
Gender Racial/Ethnic Gp.	5.270	3	1.757	1.629	.186
Explained	52.764	8	6.595	6.117	.000
Residual	122.911	114	1.078		
Total	175.675	122	1.440		

TABLE A-8.45

Teachers' Ratings of Twelfth Grade Students' Studiousness by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	58.232	1	58.232	58.046	.000
Level of Participation	58.232	1	58.232	58.046	.000
Main Effects	12.806	4	3.202	3.191	.014
Gender	9.871	1	9.871	9.839	.002
Racial/Ethnic Group	3.328	3	1.109	1.106	.348
2-way Interactions	9.642	3	3.214	3.204	.024
Gender Racial/Ethnic Gp.	9.642	3	3.214	3.204	.024
Explained	80 681	8	10.085	10.053	.000
Residual	217.695	217	1.003		
Total	298.376	225	1.326		

TABLE A-8.46

Teachers' Ratings of Fourth Grade Students' Behavior by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	19.292	1	19.292	20.822	.000
Level of Participation	19.292	1	19.292	20.822	.000
Main Effects	13.567	4	3.392	3.661	.008
Gender	8.930	1	8.930	9.638	.002
Racial/Ethnic Group	3.305	3	1.102	1.189	.317
2-way Interactions	8.260	3	2.753	2.972	.035
Gender Racial/Ethnic Gp.	8.260	3	2.753	2.972	.035
Explained	41.119	8	5.140	5.547	.000
Residual	112.111	121	.927		
Total	153.231	129	1.188		

TABLE A-8.47

Teachers' Ratings of Sixth Grade Students' Behavior by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	11.128	1	11.128	12.084	.001
Level of Participation	11.128	1	11.128	12.084	.001
Main Effects	13.749	4	3.437	3.733	.007
Gender	10.417	1	10.417	11.312	.001
Racial/Ethnic Group	4.686	3	1.562	1.696	.172
2-way Interactions	.613	3	.204	.222	.881
Gender Racial/Ethnic Gp.	.613	3	.204	.222	.881
Explained	25.490	8	3.186	3.460	.001
Residual	103.138	112	.921		
Total	128.628	120	1.072		

TABLE A ° 48

Teachers' Ratings of Eighth Grade Students' Behavior by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	10.982	1	10.982	12.381	.001
Level of Participation	10.982	1	10.982	12.381	.001
Main Effects	7.544	4	1.886	2.126	.082
Gender	2.312	1	2.312	2.606	.109
Racial/Ethnic Group	5.893	3	1.964	2.215	.090
2-way Interactions	12.259	3	4.086	4.607	.004
Gender Racial/Ethnic Gp.	12.259	3	4.086	4.607	.004
Explained	30.785	8	3.848	4.338	.000
Residual	97.568	110	.887		
Total	128.353	118	1.088		

TABLE A-8.49

Teachers' Ratings of Twelfth Grade Students' Behavior by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum as a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	14.580	1	14.580	20.859	.000
Level of Participation	14.580	1	14.580	20.859	.000
Main Effects	8.128	4	2.032	2.907	.023
Gender	4.207	1	4.207	6.018	.015
Racial/Ethnic Group	4.011	3	1.337	1.913	.129
2-way Interactions	1.611	3	.537	.768	.513
Gender Racial/Ethnic Gp.	1.611	3	.537	.768	.513
Explained	24.319	8	3.040	4.349	.000
Residual	145.386	208	.699		
Total	169.705	216	.786		

TABLE A-8.50

Teachers' Ratings of Fourth Grade Students' Overall Ability by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	62.122	1	62.122	106.138	.000
Level of Participation	62.122	1	62.122	106.138	.000
Main Effects	6.971	4	1.743	2.977	.022
Gender	2.176	1	2.176	3.718	.056
Racial/Ethnic Group	4.078	3	1.359	2.322	.079
2-way Interactions	3.194	3	1.065	1.819	.147
Gender Racial/Ethnic Gp.	3.194	3	1.065	1.819	.147
Explained	72.287	8	9.036	15.438	.000
Residual	70.821	121	.585		
Total	143.108	129	1.109		

TABLE A-8.51

Teachers' Ratings of Sixth Grade Students' Overall Ability by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	74.880	1	74.880	140.191	.000
Level of Participation	74.880	1	74.880	140.191	.000
Main Effects	4.101	4	1.025	1.920	.112
Gender	.001	1	.001	.002	.968
Racial/Ethnic Group	4.042	3	1.347	2.522	.061
2-way Interactions	4.156	3	1.385	2.593	.056
Gender Racial/Ethnic Gp.	4.156	3	1.385	2.593	.056
Explained	83.137	8	10.392	19.456	.000
Residual	59.822	112	.534		
Total	142.959	120	1.191		

TABLE A-8.52

Teachers' Ratings of Eighth Grade Students' Overall Ability by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	37.934	1	37.934	61.870	.000
Level of Participation	37.934	1	37.934	61.870	.000
Main Effects	4.602	4	1.151	1.877	.120
Gender	.477	1	.477	.778	.380
Racial/Ethnic Group	4.085	3	1.362	2.221	.090
2-way Interactions	1.768	3	.589	.961	.414
Gender Racial/Ethnic Gp.	1.768	3	.589	.961	.414
Explained	44.304	8	5.538	9.033	.000
Residual	67.444	110	.613		
Total	111.748	118	.947		

TABLE A-8.53

Teachers' Ratings of Twelfth Grade Students' Overall Ability by Gender and Racial/ Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	110.922	1	110.922	233.266	.000
Level of Participation	110.922	1	110.922	233.266	.000
Main Effects	2.766	4	.692	1.454	.217
Gender	1.103	1	1.103	2.320	.129
Racial/Ethnic Group	1.609	3	.536	1.128	.339
2-way Interactions	2.169	3	.723	1.521	.210
Gender Racial/Ethnic Gp.	2.169	3	.723	1.521	.210
Explained	115.858	8	14.482	30.456	.000
Residual	98.907	208	.476		
Total	214.765	216	.994		

TABLE A-8.54

Teachers' Ratings of Fourth Grade Students' Mathematics Ability by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	94.333	1	94.333	133.836	.000
Level of Participation	94.33-	1	94.333	133.836	.000
Main Effects	3.324	4	.831	1.179	.323
Gender	.377	1	.377	.536	.466
Racial/Ethnic Group	2.661	3	.887	1.259	.292
2-way Interactions	2.788	3	.929	1.319	.271
Gender Racial/Ethnic Gp.	2.788	3	.929	1.319	.271
Explained	100.445	8	12.556	17.814	.000
Residual	85.286	121	.705		
Total	185.731	129	1.440		

TABLE A-8.55

Teachers' Ratings of Sixth Grade Students' Mathematics Ability by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	120.150	1	120.150	159.728	.000
Level of Participation	120.150	1	120.150	159.728	.000
Main Effects	7.091	4	1.773	2.357	.058
Gender	.003	1	.003	.004	.947
Racial/Ethnic Group	6.969	3	2.323	3.088	.030
2-way Interactions	1.832	3	.611	.812	.490
Gender Racial/Ethnic Gp.	1.832	3	.611	.812	.490
Explained	129.074	8	16.134	21.449	.000
Residual	84.248	112	.752		
Total	213.322	120	1.778		

TABLE A-8.56

Teachers' Ratings of Eighth Grade Students' Mathematics Ability by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	47.906	1	47.906	61.852	.000
Level of Participation	47.906	1	47.906	61.852	.000
Main Effects	5.317	4	1.329	1.716	.152
Gender	.380	1	.380	.490	.485
Racial/Ethnic Group	5.022	3	1.674	2.161	.097
2-way Interactions	3.076	3	1.025	1.324	.270
Gender Racial/Ethnic Gp.	3.076	3	1.025	1.324	.270
Explained	56.298	8	7.037	9.086	.000
Residual	85.198	110	.775		
Total	141.496	118	1.199		

TABLE A-8.57

Teachers' Ratings of Twelfth Grade Students' Mathematics Ability by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	135.652	1	135.652	222.424	.000
Level of Participation	135.652	1	135.652	222.424	.000
Main Effects	2.476	4	.619	1.015	.401
Gender	.688	1	.688	1.128	.290
Racial/Ethnic Group	1.787	3	.596	.977	.405
2-way Interactions	.933	3	.311	.510	.676
Gender Racial/Ethnic Gp.	.933	3	.311	.510	.676
Explained	139.061	8	17.383	28.502	.000
Residual	126.856	208	.610		
Total	265.917	216	1.231		

TABLE A-8.58

Amount of Education Teachers Expect Their Fourth Grade Students to Obtain: by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	55.452	1	55.452	50.370	.000
Level of Participation	55.452	1	55.452	50.370	.000
Main Effects	18.787	4	4.697	4.266	.003
Gender	8.479	1	8.479	7.702	.006
Racial/Ethnic Group	7.871	3	2.624	2.383	.073
2-way Interactions	.932	3	.311	.282	.838
Gender Racial/Ethnic Gp.	.932	3	.311	.282	.838
Explained	75.171	8	9.396	8.535	.000
Residual	133.206	121	1.101		
Total	208.377	129	1.615		

TABLE A-8.59

Amount of Education Teachers Expect Their Sixth Grade Students to Obtain: by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	73.858	1	73.858	121.827	.000
Level of Participation	73.858	1	73.858	121.827	.000
Main Effects	4.014	4	1.003	1.655	.165
Gender	.656	1	.656	1.081	.301
Racial/Ethnic Group	3.608	3	1.203	1.984	.120
2-way Interactions	5.914	3	1.971	3.252	.024
Gender Racial/Ethnic Gp.	5.914	3	1.971	3.252	.024
Explained	83.786	8	10.473	17.275	.000
Residual	67.900	112	.606		
Total	151.686	120	1.264		

TABLE A-8.60

Amount of Education Teachers Expect Their Eighth Grade Students to Obtain: by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	26.861	1	26.861	42.744	.000
Level of Participation	26.861	1	26.861	42.744	.000
Main Effects	5.021	4	1.255	1.998	.100
Gender	.464	1	.464	.738	.392
Racial/Ethnic Group	4.388	3	1.463	2.328	.078
2-way Interactions	3.531	3	1.177	1.873	.138
Gender Racial/Ethnic Gp.	3.531	3	1.177	1 873	.138
Explained	35.413	8	4.427	7.044	.000
Residual	69.753	111	.628		
Total	105.167	119	.884		

TABLE A-8.61

Amount of Education Teachers Expect Their Twelfth Grade Students to Obtain: by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	98.146	1	98.146	180.039	.000
Level of Participation	98.146	1	98.146	180.039	.000
Main Effects	2.474	4	.618	1.135	.341
Gender	2.042	1	2.042	3.745	.054
Racial/Ethnic Group	.476	3	.159	.291	.832
2-way Interactions	1.311	3	.437	.801	.494
Gender Racial/Ethnic Gp.	1.311	3	.437	.801	.494
Explained	101.931	8	12.741	23.373	.000
Residual	119.385	219	.545		
Total	221.316	227	.975		

TABLE A-8.62

Amount of College Mathematics Teachers Feel Their Eighth Grade Students Can Complete: by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	18.894	1	18.894	36.021	.000
Level of Participation	18.894	1	18.894	36.021	.000
Main Effects	3.053	4	.763	1.455	.221
Gender	.625	1	.625	1.191	.278
Racial/Ethnic Group	2.428	3	.809	1.543	.207
2-way Interactions	3.933	3	1.311	2.499	.063
Gender Racial/Ethnic Gp.	3.933	3	1.311	2.499	.063
Explained	25.880	8	3.235	6.167	.000
Residual	57.[illegible]0	110	.525		
Total	83.580	118	.708		

TABLE A-8.63

Amount of College Mathematics Teachers Feel Their Twelfth Grade Students Can Complete: by Gender and Racial/Ethnic Group, with Level of Participation in the Curriculum As a Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	84.679	1	84.679	221.447	.000
Level of Participation	84.679	1	84.679	221.447	.000
Main Effects	1.258	4	.314	.822	.512
Gender	.520	1	.520	1.360	.245
Racial/Ethnic Group	.768	3	.256	.669	.572
2-way Interactions	1.605	3	.535	1.399	.244
Gender Racial/Ethnic Gp.	1.605	3	.535	1.399	.244
Explained	87.542	8	10.943	28.617	.000
Residual	79.537	208	.382		
Total	167.078	216	.774		