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ABSTRACT

During the past several years considerable national-level attention has been focused on the state of American public education in mathematics, science and technology. There is, among the several policy reports, substantial agreement that student achievement levels in mathematics are lower than is desirable and the opportunity to learn mathematics, science and technology is at present not fairly and evenly provided to all students. In particular, large numbers of minority youngsters and those who go to inner-city schools are below grade level in mathematics achievement by grade five. Girls, too, show disparities in interest, participation and achievement, but for different reasons. The situation for minority girls is even more complex. The goal of this study was to conduct a comprehensive review of the research and intervention literature on math, science and computer learning among girls, minority students and inner-city students in grades four through eight. Chapters concern: (1) the studies used in this report; (2) differences and similarities in participation; (3) differences and similarities in performance; (4) factors related to performance and participation; (5) intervention programs; and (6) summary and recommendations. Appendices include lists and tables of meta-analysis, a directory of intervention programs, and a bibliography of 290 references on this topic. (CW)

SEX AND ETHNIC DIFFERENCES IN MIDDLE SCHOOL MATHEMATICS, SCIENCE AND COMPUTER SCIENCE: WHAT DO WE KNOW?

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Preface

During the past several years considerable national-level attention has been focused on the state of American public education in mathematics, science and technology. There is, among the several policy reports, substantial agreement that student achievement levels in mathematics are lower than is desirable and the opportunity to learn mathematics, science and technology is at present not fairly and evenly provided to all students. In particular, large numbers of minority youngsters and those who go to inner-city schools are below grade level in mathematics achievement by grade five. Their situation does not improve much in the subsequent years of school. Substantial numbers of these students enter high school with deficits in mathematical understanding and skills and spend their high school years re-learning basic arithmetic, never having the opportunity for serious, appropriate mathematics courses. Girls, too, begin to show disparities in interest, participation and achievement during these years, but for different reasons. The situation for minority girls is even more complex.

Clearly, the years between grades four and eight represent an opportunity for intervention in the mathematics "careers" of many of these students. But determining how to intervene is a difficult task. While nationally-administered mathematics achievement tests provide strong indications of the points in childrens' lives when academic difficulty occurs, such tests as currently constructed are insufficient to tell us much about why the trouble happens and which are the critical variables.

As one part of a wide-ranging inquiry into these issues, in July 1984, the Ford Foundation asked the Educational Testing Service to undertake a comprehensive review of the research and intervention literature on math, science and computer learning among girls, minority students and inner-city students in grades four through eight. The result is this document.

The research group uncovered a substantially greater number of studies than had been expected and their task thereby became longer and fueled as much by dedication as by the promise of recompense. The findings--which factors might make a difference, how certain we are about what we know, what would improve the usefulness of future research and how to capitalize on already existing intervention efforts--should be useful to program developers, to the research community and to policy makers and funders.

Barbara Scott Nelson
Program Officer
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Sex and Ethnic Differences in Middle School

Mathematics, Science and Computer Science: What Do We Know?

Introduction

"Alarming numbers of young Americans are ill-equipped to work in, contribute to, profit from and enjoy an increasingly technological society. Far too many emerge from the Nation's elementary and secondary schools with an inadequate grounding in mathematics, science and technology." (National Science Board Commission on Precollege Education in Mathematics, Science and Technology, 1983). Among the most ill-prepared are minority girls, who tend to take fewer courses in mathematics, science, and technology than do boys.

Among college-bound seniors, for example, the proportion of Black and Hispanic females who have taken four or more years of mathematics courses is consistently 15-20% lower than that of White males; by comparison, a higher proportion of Asian students of both sexes take four or more years of mathematics (Figure 1). These gender and ethnic patterns are repeated for college-bound seniors' reports of taking four or more years of science (Figure 2), even though overall fewer than 10% of all college-bound seniors take as many as four years of physical science courses (Ramist & Arbeiter, 1983).

Not surprisingly, National Assessment high school performance data reflect these differences in course participation, with minority girls performing substantially less well on tests of physical science knowledge and on tests of mathematics than do minority students of either sex (Hueftle, Rakow & Welch, 1983; NAEP, 1983).

The reasons for these differences are not well understood. Are these gender and ethnic differences in high school science and mathematics participation and performance simply continuations of patterns established during presecondary education, or are they new patterns? If they are new patterns, when do they develop: during high school or before? What accounts for these differences? And what can be done to eliminate or minimize them? The review in this report was conducted to answer some of these questions.

Summary of Results

The major findings of this report were the following:

(1) Little recent research has been conducted that directly addresses either gender differences within ethnicity or gender-ethnicity interactions, or that examines the factors that are related to the achievement of minority girls, per se, in grades 4-8.

COLLEGE BOUND STUDENTS TAKING
4 OR MORE YEARS OF MATHEMATICS COURSES

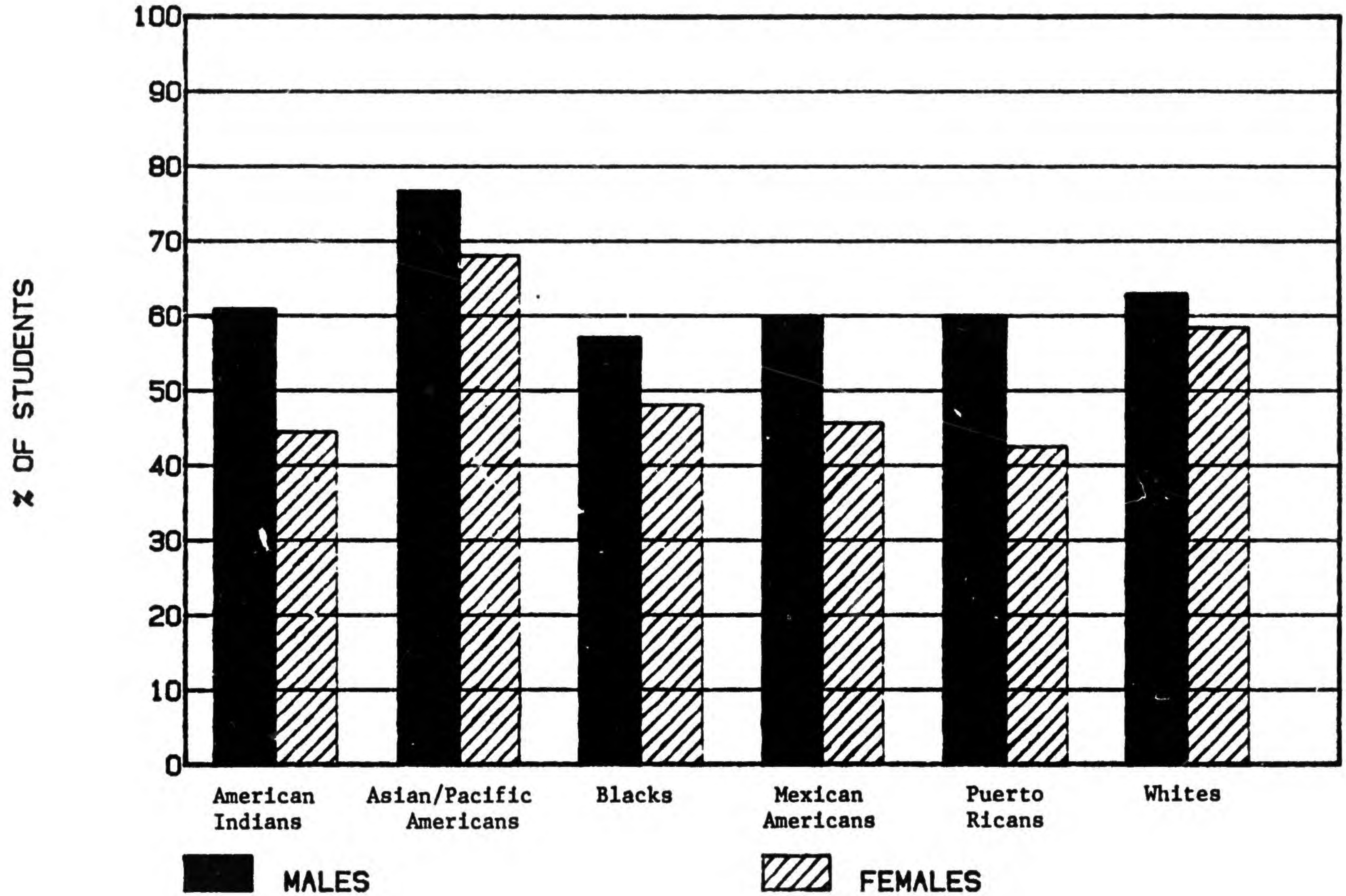


Figure 1

COLLEGE BOUND STUDENTS TAKING
4 OR MORE YEARS OF PHYSICAL SCIENCE COURSES

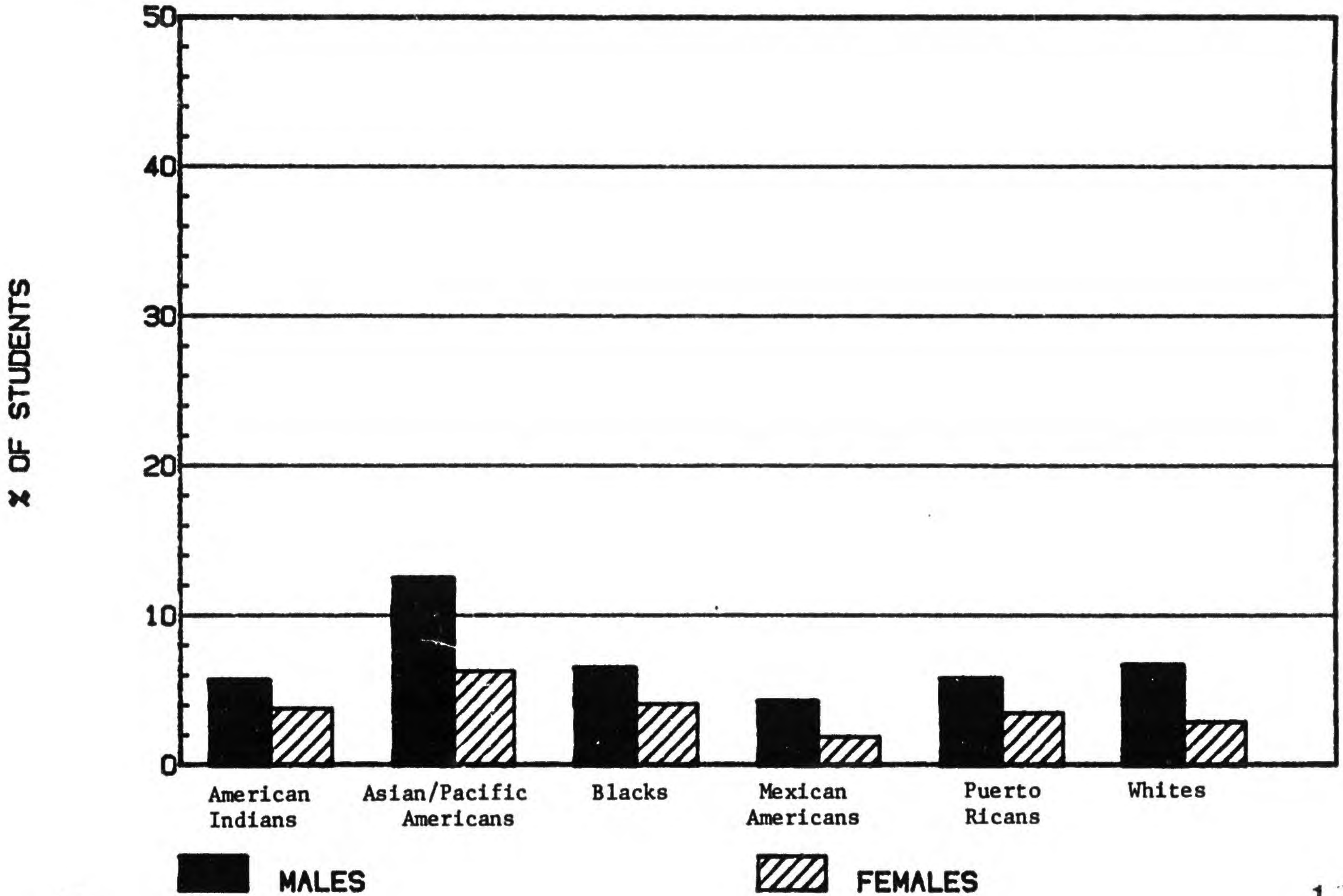


Figure 2

(2) The results of the studies that have been conducted indicate:

- o Ethnic, but not sex, differences in participation and performance in mathematics
- o Ethnic and sex differences in participation and performance in science
- o Ethnic and sex differences in participation in computers, and sex differences in performance.

(3) Virtually no empirical studies on the determinants of middle-school student participation in mathematics, science, or computer-related activities have been conducted.

(4) The primary focus of most empirical studies of factors related to participation and performance has been on affective factors rather than on policy-oriented factors.

(5) Policy-oriented factors found to directly affect performance included:

- o Student enrollment and participation in mathematics, science or technology classes
- o Adapting the language of instruction and assessment to take into account the student's language of origin, and adapting the assessment tools to take into account test domains, cultural bias, test familiarity and distractor type.

(6) Policy-oriented factors that indirectly affected performance included:

- o Out-of-school experience with mathematics, science or technology
- o Hands-on activities in science and use of "gender neutral" tasks
- o Reorganization of the classroom to permit and encourage peer learning
- o Providing opportunities for the students to develop positive expectations for their competence vis-a-vis mathematics, science and technology.

(7) The studies available for review were frequently flawed in two important ways:

- o Factors that were known to be correlated with gender or ethnicity were not held constant before conclusions regarding differences were drawn (for example, gender comparisons did not adjust for age differences between male and female students in the same grade; ethnic comparisons did not adjust for language or social class differences between ethnic groups).

- Sex and ethnic differences in achievement were erroneously attributed to factors that, although associated with either gender or ethnicity, were actually uncorrelated with achievement.

This report is organized into six chapters. The first chapter describes the methods used in identifying the studies that were reviewed and describes the limitations of the studies. The second chapter presents the findings of the review of sex and/or ethnic differences in participation in mathematics, science and computer-related courses. The third chapter presents the findings of the review of sex and/or ethnic differences in performance in these three areas. Chapter Four presents a theoretical model of determinants of participation and performance, and examines findings regarding empirical evidence for this model. Chapter Five provides an annotated listing of intervention programs for minority and/or female students. Chapter Six summarizes the existing research and offers recommendations.

Chapter 1: The Studies

In preparing this report, we reviewed over 400 articles that dealt with sex and/or ethnic differences in mathematics, science or computer course participation or performance in grades four through eight. A bibliography of these sources appears in the Appendix.

Sources and Selection Criteria

The articles, comprising both published and nonpublished material, were identified through a number of sources including a computerized search of ERIC, Psychological Abstracts, Sociological Abstracts and Dissertation Abstracts International followed by a handsearch of the following journals for articles not yet abstracted by these electronic data bases: Journal for Research in Mathematics Education, Journal of Research in Science Teaching, American Educational Research Journal, Review of Educational Research, School Science and Mathematics, Child Development, Journal of Educational Psychology, Sex Roles: A Journal of Research, Psychology of Women Quarterly, Journal of Early Adolescence, Hispanic Journal of Behavioral Psychology, and Journal of Negro Education. In addition, professionals in the field directed us to recent reports or unpublished articles that would not be found in traditional sources.

Because the enactment of Title IX in 1972 and its subsequent implementation in 1975 resulted in a significant national effort to reduce direct discrimination against females in education, we restricted our search to articles dated from 1975 to the spring of 1984, assuming that participation and performance differences directly attributable to discrimination would be less in more recent studies.

Table 1: Number of studies by focus of comparison and subject area

	Subject Area		
Focus of Comparison	Mathematics	Science	Computers
Participation			
Sex	2	2	10
Ethnic	0	1	1
Sex/Ethnic	0	0	0
Performance			
Sex	31	13	4
Ethnic	17	4	0
Sex/Ethnic	6	2	0

We identified 70 studies or data sets that addressed sex and/or ethnic differences in participation and/or performance (Table 1), 60 studies or data sets that identified variables related to participation and/or performance, and 53 studies that identified additional factors correlated with previously identified explanatory variables. For all these studies, children in grades four to eight served as all or a significant proportion of the sample, and mathematics, science or computer participation or performance was the focus of the study. Relatively few of the studies directly addressed minority females for either participation or performance. The empirical studies were supplemented with 15 meta-analyses that addressed participation or performance differences and/or factors related to these differences (Appendix A and B).

Caveats

Before discussing the findings, it is important to point out two important shortcomings of the present body of research. The first shortcoming is that of comparison group comparability; the second is that of overinterpreting correlated differences.

Group Comparability.

Studies of sex and/or ethnic differences in school-related tasks frequently use intact classrooms as their subject pool. In fact, such studies rarely have the sophistication to have a "subject pool" from which a sample is drawn; instead the entire population is used.

Sex differences. This is a particularly problematic strategy to employ in studies of sex differences, because the putative male and female "populations" may differ in their completeness, their average chronological ages, and their relevant experience with the material being tested.

It is widely known that a higher proportion of students in elementary school who participate in remedial "pull-out" programs are boys (Lerner, 1976). In conducting statewide assessments, students in pull-out programs are often exempted from the test. The effect of this practice is to eliminate the bottom of the male distribution on performance, artifically producing a higher performance average than would have otherwise been the case. Since the poorer performing males have been eliminated from the population taking the test, all girls are being compared with the better performing boys.

A second example of gender non-comparability relates to the age of girls and boys being compared. Recent data indicates that, within grade level, boys--particularly minority boys--are older than girls. For example, in the 1974, 1976 and 1977 National Assessment, nearly 10 percent more males than females were one or more years older than the modal age for the grade being assessed (Langer, Kalk & Searls, 1984). In fact, 31% of the Black male eighth grade students were older than 13, the modal age for this grade, compared with 21% of the Black females, 21% of the White males and 12% of the White females.

A third example of gender non-comparability that is particularly relevant to sex differences in computer-related measures is the extreme sex difference in voluntary computer course participation. While participation is a necessary precondition to performance in all subjects, rates of participation in mathematics and science school-related activities do not differ to the extent that participation rates in computer-related activities do. These differences in participation rates create very different pools of individuals who are clearly non-comparable vis-a-vis computer-related skills.

Ethnic differences. The most pronounced source of ethnic group non-comparability is the correlation between minority group status and socioeconomic status. While not all minority students are poor, and not all majority students are rich, there is widespread evidence that a higher proportion of Black and Hispanic children than White children come from low income homes and attend disadvantaged schools. Therefore, differences in participation and performance that may be attributed to ethnicity may in fact be due to differences in family or community socioeconomic status.

In the studies reviewed in this report, socioeconomic status is rarely directly measured or controlled. At best, the studies have utilized student self-reported or teacher-estimated parental education and occupation, which are known to be of limited validity. More valid indicators, such as family income or school resources, were uniformly absent. Since the relationship between family socioeconomic status, school resources and student performance is well established, by failing to control for socioeconomic status, many of these studies perpetuate stereotypes about ethnic superiorities and inferiorities. It is difficult, if not impossible to distinguish those differences that are a function of cultural factors from those that are a function of economic factors, when the two are not considered separately.

Another problem with ethnic comparisons is that the ethnic categories that are typically utilized in ethnic studies are broad and treat as a single group individuals from very different backgrounds. For example, the category "Hispanic" may include Mexican-Americans who have lived in the U.S. for generations, recent Mexican immigrants, Puerto Ricans, Cubans, Filipinos with Hispanic surnames, and other groups. Similarly, the category "Native American" is applied to members of widely disparate groups who may share little in common, such as Navajos, Aleuts and Hopis.

Over-Interpretation of Correlated Differences.

Noncomparability is a problem related to the identification and selection of students for study; the second shortcoming of the studies reviewed in this report is a problem of data analysis and interpretation in studies of factors related to sex and/or ethnic differences. In these studies, most explanatory variables have been either cognitive or affective and hence neither intervenable nor subject to experimental manipulation. The research designs have been correlational rather than experimental. This presents particular problems for interpreting correlations between affect and achievement, such that effect of achievement on affect is arguably as strong as the effect of affect on achievement.

All too often, studies seeking to identify explanatory factors stop far short of what would be necessary to establish causal linkages. Many studies, finding a sex or ethnic difference in the dependent variable of interest (that is, some mathematics, science or computer performance indicator), seek to identify a second sex or ethnic difference in the sample; the presence of this second difference is taken to explain the difference in the first variable. That differences on two variables are found for two subgroups in a given population, however, does not necessarily mean that the variables are correlated. Lions may be shorter than elephants, and lions may eat more meat than elephants, but this does not necessarily imply that shortness among animals is correlated with meat eating; short elephants, for example, do not eat meat.

In conducting this review of the literature, we were not able to limit ourselves to the studies that utilized truly comparable samples; otherwise we would have had no studies to examine. We were, however, able to limit ourselves to examining only those studies that identified factors for which an actual correlation--at a minimum--had been found: 39 studies that present empirical evidence for factors related to mathematics participation and performance, 17 studies that identified factors related to science participation and performance, and seven studies that identified factors related to computer participation, performance and attitudes towards computers. Studies that merely report sex or ethnic differences in possible explanatory variables have not been included.

Our initial goal was to present the results of this review separately for each ethnic group. The lack of empirical work on minority students in grades 4-8 precludes this organization of our report, however.

Chapter 2: Sex and Ethnic Differences and Similarities in Participation

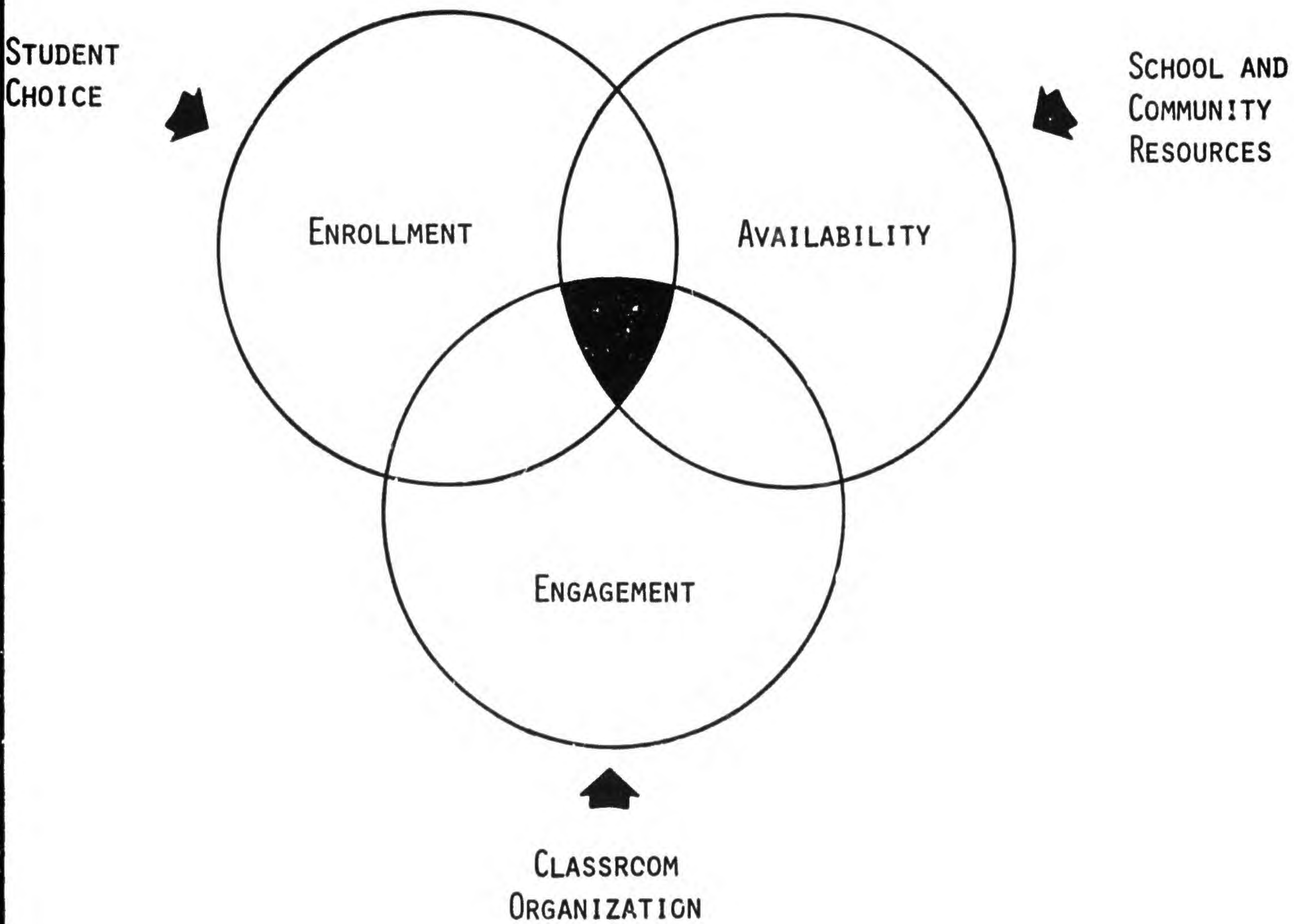
In this chapter and the next we present the findings of the literature review. The dependent variables of interest are student participation (Chapter 2) and performance (Chapter 3) in mathematics, science or computer courses. While investigating sex or ethnic differences in course participation is relatively straightforward, requiring only information about availability of courses and enrollment patterns, investigating sex or ethnic differences in performance requires that three conditions be met: (1) the courses must be available to the students, (2) the students must be enrolled in the courses, and (3) the students must be engaged in the learning taking place in the courses (Figure 3).

We assume that students in schools in which courses in mathematics, science or computers are taught will outperform students in schools in which they are not taught; if such schools are differentially available to majority or minority students--which is highly likely--or to male or female students--less likely--no inferences about sex or ethnic differences in inherent ability should be drawn. Similarly, we assume that students who actually enroll in mathematics, science or computer courses will outperform students who do not take these courses, and that if enrollment patterns differ by ethnicity or sex, again no inferences about ability should be made. Third, we assume that students who are engaged in the courses will outperform students who are not engaged, and if sex or ethnicity play a part in determining engagement, again no inferences about ability should be drawn. As a final note, we assume that if the assessment materials with which the student performance is measured place any students at relative advantage, these students will outperform the students who are placed at a relative disadvantage.

Since, in general, we cannot assume that all schools actually offer mathematics, science or computer courses, or--if they do--they are all equally good courses; that all students actually enroll in such courses; or that all students remain engaged in them after they have enrolled in them; or that assessment materials are not biased--even unintentionally so--we must acknowledge that some group differences may be accounted for by these factors. In fact, we have good reason to believe that differences between schools in the availability of courses may have important effects on ethnic differences in performance; that differences in enrollment patterns may have important effects on sex and ethnic differences in performance, and that differences in engagement patterns may account for both sex and ethnic differences in performance. That is, we must be very careful not to infer from sex or ethnic differences in performance that sex or ethnic differences in ability exist.

In this review, we did not address between-school differences in the availability of mathematics, science and computer courses, although it is clearly the case that minority students are more likely than White students to attend schools in which mathematics and science are not part of the curriculum. We did address course participation, although we found few studies that examined course participation in mathematics, science or computers at this grade level. Where differences were observed, they were associated with voluntary, extracurricular activities.

Figure 3: Conditions necessary for meaningful comparisons



Mathematics and Science Course Participation

In grades four to eight, few opportunities exist for students to determine their own participation in mathematics or science; these subjects are simply part of the uniform curriculum taught everyone. While substantial differences among schools in the amount and quality of instruction in these subjects have been observed, voluntary participation or non-participation for students within schools is rarely an option. To inquire, therefore, about sex and ethnic differences in within school participation in mathematics and science classes at the elementary and middle school level is to confront a reality of little variation in such course-taking at all. Variation is found, however, in participation in mathematics- or science-related activities. Few studies have actually examined extracurricular participation in mathematics and science activities to test for sex or ethnic differences, and we were able to locate only one recent study for mathematics and two recent studies for science that dealt with students in grades four to eight (Table 2)*.

Mathematics activities such as reading about mathematics, doing non-required mathematics projects or having a mathematics-related hobby were studied by Johnson (1981), in a small sample of Black youth in grades seven and eight. He found no sex differences in these activities, with all students reporting low levels of mathematics activity participation.

Analyses of NAEP science assessments from 1976-1977 (Kahle & Lakes, 1983) as well as from 1981-1982 (Hueftle, Rakow & Welch, 1983), however, found sex differences for science experiences in favor of males for both 9- and 13-year-old students. Science experiences refer to the use of various science equipment and participating in science experiments. Ethnic differences were also reported in 1981-1982 NAEP science assessments with White students exceeding Black students in the number of science experiences at both age levels. In examining sex within ethnic breakdowns for both age groups, White males exceed White females and Black students of both sexes. Sex differences among 13-year-olds were slightly larger than among 9-year-olds, with Black females at both ages reporting the fewest number of science experiences.

Computer Course Participation

The situation regarding participation in computer-related courses is not comparable to that regarding mathematics and science. While instruction in the use of computers is increasing at both the elementary and middle-school level, as of January 1983 only 42% of elementary and 68% of middle or junior high schools had one or more microcomputers for use in instructing students (Schools Uses of Microcomputers, 1983). Frequently, participation in computer courses that are taught is voluntary.

Several recent studies have examined sex differences in voluntary computer course participation (Hess & Miura, 1985; Korpi, 1984; Revelle, Honey, Amsel, Schauble & Levine, 1984; Kurshan & Williams, 1984). In all such studies, a higher proportion of those participating in computer courses were male than were female, with male to female ratios ranging from 5:1 to

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*Tables 2 through 8 appear at the end of the text.

2:1. Recent data from the 1984 NAEP also indicate substantial sex differences in computer class participation, although overall levels of participation for students in grade eight were low, with only 20.3% of 13-year-old males and 16.5% of 13-year-old females reporting taking a computer class at least once per week. Statewide data from California (Fetler, 1985) also indicated that a higher proportion of sixth grade boys than girls reported having experience with computers in school. An evaluation of a computer equity training project (Sanders, 1984) found that in one school 64% of seventh grade boys as compared to 22% of seventh grade girls had taken a computer class in school; in another school, a slightly higher proportion of girls (45%) than boys (41%) had taken a computer class in school (Lockheed, 1984).

Sex differences in extracurricular computer use have also been noted. For example, McKelvey (1984) reported in a study conducted in several Ontario schools that 34 of 230 males but only 3 of 220 females used computers in extracurricular time. Similarly, 1984 NAEP data shows that among 13-year-olds 31% of males and 25% of females report using computers on a weekly basis during extracurricular time outside of school. In a large-scale study of eighth grade students in British Columbia, Collis (1984) found that 65.2% of the males compared to 44.5% of the females reported using computers outside of school to do something other than play games.

Extracurricular use of computers may be highly influenced by access to a computer at home or at a friend's house. Sex differences in this type of access have also been noted. Demarest & McKenzie (1984) found that a higher proportion of third and fourth grade males than females reported home ownership of computers. Similarly, Fetler found that a somewhat higher proportion of sixth grade males than females reported home experience with computers. In a study of children enrolled in a computer camp, Revelle Honey, Amsel, Schaubel and Levine (1984) found that 71% of the males compared to 43% of the females used a computer at home, even though there were no sex differences in family ownership of a computer. Finally, the 1984 NAEP assessment found that a higher proportion of 13-year-old males (38%) than females (26%) reported having used a computer at home.

Ethnic differences in computer course participation and access to computers have not been widely studied. Recent NAEP data indicate, however, that Hispanic children use computers less frequently than either Black or White students, who use computers approximately equally, while Asian and other students use computers more frequently. Approximately one quarter of both Black and White students report using a computer in school at least once a week, while only 17% of Hispanic students report this frequent computer use and nearly 30% of Asian and other students report such use.

Summary

Sex and ethnic differences in voluntary, extracurricular courses and activities related to science and computers were found. Boys and White students participated in these activities more than did girls and non-White students, respectively. No sex differences in mathematics activities were found, however.

Chapter 3: Sex and Ethnic Differences and Similarities in Performance

In this chapter we review the literature on sex and ethnic differences in performance on mathematics, science and computer tests. The majority of the studies that reported data for this age group focused on mathematics performance, reflecting the emphasis on this topic during the 1970's.

The chapter is organized into three major subsections, one each on mathematics, science and computers. Within each of the major subsections are sections dealing with the effects on performance of (1) sex, (2) ethnicity, and (3) sex and ethnicity considered simultaneously. The material in the accompanying tables is organized with a parallel structure, to facilitate cross-referencing.

Mathematics Performance

The first area is mathematics performance. Studies of mathematics performance typically use, as the measure of mathematics "ability" such standardized tests as the California Achievement Test or the Iowa Test of Basic Skills. Either total test score or selected domains are used. The total test score represents what experts consider to be a comprehensive picture of mathematics knowledge, covering all the domains of information that are deemed important or appropriate for a particular grade or age level. Some domains that are relevant to the grades 4-8 include--but are not limited to--computations, algebra, problem solving, spatial/visualization, mathematics concepts, story problems or applications, identifying information, estimating, probability, statistics, and proportional reasoning. Different tests are made of different proportions of questions from these domains.

Sex Effects.

Despite the findings of several recent meta-analyses (Hyde, 1981; Rosenthal & Rubin, 1982; Meehan, 1984) that sex differences in mathematics performance favoring males are pervasive, we found little evidence to support the claim of male superiority in mathematics for children in grades four to eight. It should be noted that the studies we looked at were published from 1975 to the beginning of 1984 and included only students in grades four to eight. The meta-analyses included individuals from a broader age range and also included older studies. Both factors may account for the differences we observed. Of the 31 studies of mathematics performance that we reviewed (Table 3), three reported statistically significant sex differences in favor of females, four reported sex differences in favor of males, and two reported mixed results. Sixty-six percent of the studies found no sex differences in mathematics performance for young adolescents. The findings for the remaining few studies drew no consistent picture.

On the one hand, we found three large-scale studies that reported differences favoring females. In Armstrong's (1980) study of 1,452 13-year-olds from 82 schools, girls performed better than boys in spatial visualization tasks and in computations tasks; for algebra and problem-solving tasks, no sex differences were observed. In Myers and

Milne's (1982) study of 15,579 students in grades 1-6, statistically significant sex effects were found in favor of females' mathematics achievement on the Comprehensive Test of Basic Skills for students in grades four to six. Tsai and Walberg (1983) found statistically significant differences in mathematics achievement favoring 13-year-old females on 74 items of the 1977-78 NAEP mathematics assessment covering numbers and numeration, variables, and relationships, geometry (shape, size, and position) and measurement.

On the other hand, we found four studies that reported sex differences in mathematics performance for this age group favoring males. Benbow and Stanley (1983) found that a higher proportion of a large (39,820) volunteer sample of seventh grade males (18.2%) than females (8.6%) scored over 500 on the SAT-M. The only other large-scale study reporting sex differences in mathematics performance for this age group was a statewide testing program in Pennsylvania (Strauch, 1977). The data for this study were collected in 1974 and are therefore virtually obsolete. However, for the fifth grade students, no sex effects were found on a test that covered arithmetic skills, measurement, geometry, algebraic notation, and number concepts. In the eighth grade, males outperformed females. Bush (1976) examined "quantitative concepts" among 263 eighth grade students and found that males outperformed females on a test of this domain. In a study of 77 seventh and eighth grade students, Webb (1984) found significant sex differences in performance on a test of exponents and scientific notation.

In the remaining 24 studies, which include several large-scale investigations, analyses seeking to identify sex differences were conducted and no consistent sex differences found. The large-scale studies that reported no sex differences in mathematics performance include the 1981-1982 Second International Mathematics Study and the 1978 and 1982 National Assessment of Educational Progress.

A number of authors have suggested that the failure to find overall sex differences in performance in such studies is due to the aggregation of different types of mathematical problems into a single overall score. Some classifications of mathematical problems that have been suggested are: (a) computational problems, one-step word problems, and two-step word problems; (b) computation, measurement, and problem solving; and (c) computation, measurement, geometry, and algebra. The argument is made that girls outperform boys on the simple computational problems, while boys outperform girls on the more complex problems. When a total test score includes both computational and complex "problem solving" problems, these sex differences in performance will cancel each other out, and the total test will show no sex differences.

We identified five studies that were designed to investigate this possible explanation. In three of the studies, no sex differences were found. Armstrong (1980) examined four types of mathematics problems: computational, algebra, problem solving, and spatial/visualization problems. She found no sex differences in performance on the problem-solving items or on the algebra items, and sex differences in favor of girls on computation and spatial visualization items. In a similar investigation with contrasting results, Fennema and Sherman (1978) found no sex differences on mathematics computation problems, mathematics concepts, or spatial/visualization problems for students in grades six to eight. Crosswhite, Dossey and Swafford (1984) found no sex differences in either calculations or problem solving. In two of the studies, however, sex differences favoring boys were found. Marshall (1984) found a significant sex-by-mathematics problem type interaction in her analysis of the test scores of 286,767 sixth grade students from the 1979 California Assessment Program. In this study, Marshall found that females outperformed males on computation and that this relationship held up for students of all levels of reading ability, social class, and primary language, with the exception of Asian children for whom no sex differences in computation were found. By contrast, males outperformed females on story problems for all levels of reading ability, social class, and primary languages; these sex differences, while consistent, were slight, amounting to between two and five percent difference in the probability of correctly answering the problems. In an analysis of data from the 1981-82 California Assessment, sex differences favoring sixth grade males were found for 11 of the 15 different problem types. However, while it was the case that males outperformed females on applications problems, females outperformed males on problem analysis, that is, on identifying relevant information, estimating answers, and identifying the appropriate mathematical model that should be applied to the problem. From this it appears that the observed sex differences in solving mathematical applications problems were not a function of sex differences in appropriate knowledge.

From our reading of the current literature on mathematics performance, we have concluded that there are few--if any--consistent sex differences in mathematics performance on the types of mathematics skills taught in grades four to eight. While this may be due in part to the types of problems that students in these grades are expected to perform, it may also be the case that the putative sex differences do not exist.

Ethnic Effects.

We identified 16 studies that examined ethnic differences in mathematics performance for students in grades four to eight (Table 3). The results of these studies were quite consistent, showing a distinct pattern of performance, with Asian students usually outperforming Whites, with both outperforming Hispanics, who then outperform Blacks. A study by Tsai and Walberg (1983) of 1977-78 NAEP data suggests a possible departure from the trend of Asian superiority in mathematics performance. Though statistical analyses were not conducted comparing the performance of White to Asian and Pacific Island students, the means for Whites exceeded Asian and Pacific Island students by approximately 3%. However, when examining the constituency of the sample both in terms of ethnic mixture and number of Asian and Pacific American students (n = 12) represented in comparison to White students (n = 1,840), it is questionable if a real difference exists.

We found only one study for which ethnic differences were not observed, and all of the remaining studies we located found differences in the direction previously indicated. Only Powers et al. (1983) reported finding no ethnic differences in a sample of 232 sixth grade Black and White students. Although the findings of the studies of children in grades four to eight repeat the results of previous research on high school and adult populations, it does not seem reasonable to dwell on these differences greatly, because--as previously mentioned--important factors such as SES have not typically been controlled.

Sex/Ethnic Effects.

We located six studies that examined sex differences within ethnicity (Table 3). In general, few interactions between sex and ethnicity were found, and few sex differences were observed. When interactions were reported, the directions of the sex differences within ethnicity were not consistent across studies. The most comprehensive study of sex differences by ethnicity was an analysis of data from three NAEP assessments, which used as the dependent variable a combined achievement score based on the mathematics, science and reading tests (Langer, Kalk, & Searls, 1984). This combined score blurs the distinction between performance based on reading and performance based on computational or reasoning skills. Results from the study of 9-year-olds did not conform to those from the study of 13-year-olds. At age 9, controlling for age, parental education, home environment, region and type of community, no sex differences were observed for White students, but significant sex differences in favor of boys were observed for Black students. At age 13, controlling for the same factors, sex differences in favor of girls were found for White students, while no sex differences were found for Black students. In a study of data from the 1979 California Assessment, Marshall (1984) found sex differences favoring girls in computations for all ethnic groups other than Asians, where no sex differences were observed, and sex differences favoring boys in story problems for all ethnic groups. In short, the results from these studies of mathematics provide little evidence to support a claim of female mathematics disability or of a sex by ethnicity interaction.

Science Performance

We now turn to science performance. Science as taught in elementary school and junior high school, may either involve a great number of hands-on activities or may be taught quite conceptually. The assessment of scientific knowledge may also involve physical operations or not. When science is taught with concrete manipulable objects, the issue arises as to what sort of objects to include. Objects that have been described in the research include such items as balance scales, pendulums, plants, and inclined planes: objects that some children may have encountered at home but that other children may find unfamiliar. It is important to bear in mind, while examining the findings with regard to science performance, that few studies have examined the question of what is meant by science performance: is it the demonstration of skills previously acquired at home or in extracurricular activities, or is it the demonstration of skills learned at school? We have noted previously that sex and ethnic differences in science-related out of school experiences have been found; although prior experience with scientific apparati was not controlled in any of the studies we identified, it is possible that differences in experience vis-a-vis these objects may contribute to sex and ethnic differences in performance.

Sex Effects.

Recent meta-analyses of factors related to science performance (Appendix A, Table 1) indicate several areas in which sex differences in science performance have been observed. Fleming and Malone (1983) report few sex differences in science achievement for elementary students but differences having modest "effect sizes"* favoring boys for students in middle schools. When types of science performance were analyzed separately (Kahl, Malone & Fleming, 1982), modest effect sizes were found in favor of middle school boys for application problems only; effect sizes for knowledge, comprehension and higher processes were minimal for both elementary and junior high school students. Meehan (1984) reports modest effect sizes in favor of boys in proportional reasoning, but no sex effects for either propositional logic or combinations tasks. Of the 33 data sets reviewed by Meehan that dealt with propositional logic for students in grades four to eight, 30 reported no sex differences; of the 20 data sets that dealt with combinational reasoning in the same age group, 14 reported no sex differences, four favored boys and two favored girls. Of the 27 data sets that dealt with proportional reasoning in this age group, however, 14 found no sex differences, while 13 found sex differences in favor of boys. It is interesting to note that proportional reasoning includes problems dealing with volume displacement, equilibrium in an hydrolic press or on a balance, and hauling weight on an inclined plane, all of which capitalize on what might be considered to be stereotypically male interests.

We have included in the review of science performance some studies of certain types of Piagetian tasks, since these tasks--like the proportional reasoning tasks described above--frequently involve "science-like" activities. In fact, the line between science and mathematics becomes very unclear when the specifics of the task presented to the student are described in detail. Thus, although proportional reasoning tasks may involve volume displacement or balance beams, which entail science-like equipment, they also may involve ratios, which make them more akin to certain mathematics problems. Several recent studies have broken science performance down into various domains; sex differences in these domains are far from consistent, although it appears that boys outperform girls when the domain entails using scientific apparatus in some form (Table 4).

Three large-scale science assessment reports were identified: one covering the 1970, 1973 and 1977 NAEP science assessment in the United States; one reporting the results of a 1980 Science in the Schools survey of 13-year-old students in England (Schofield, Murphy, Johnson, & Black, 1982);** and a third dealing with a 1981 Science in the Schools survey of

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*Effect sizes are typically expressed as the difference between one group (for example, male) mean and a second group (for example, female) mean as a percent of the total standard deviation. According to Cohen (1969), an effect size of .20 is "small," .50 is "medium," and greater than .80 is "large."

**These reports are part of a series of science surveys of 11-, 13-, and 15-year-olds conducted from 1980 to 1983.

11-year-olds in England, Wales, and Northern Ireland (Harlen, Black, Johnson, & Palacio, 1983).* The NAEP report (NCES, 1978) indicates that males outperformed females on all three assessments, but that the differences were very small, amounting to approximately two percentage points for 9-year-olds and four percentage points for 13-year-olds. In the Science in the Schools studies, few sex differences were found. For the 11-year-olds, no sex differences were found for reading and representing information from graphs, tables or charts; for observation; for interpreting presented information when relevant facts are contained in the questions; and in the application of knowledge of scientific facts and principles in the biological concepts area. Girls outperformed boys in planning investigations, while boys outperformed girls in the application of knowledge of scientific facts and principles in the physical science area. Among the British 13-year-olds, no significant sex differences were found for five of the six domains covered on the test: using symbolic representations, using apparatus and measuring instruments, using observation, interpreting and applying knowledge, designing investigations and performing investigations. The only sex difference observed, which favored males, was for the application of knowledge of scientific facts and principles to problems in the physical science area. Where differences were observed, moreover, they were very small.

The degree of familiarity with the various apparati used in assessing scientific performance was noted as a possible cause of differences in performance in several studies. On the one hand, tasks that entailed the use of stereotypically male apparti resulted in superior male performance. Graybill (1975), for example, comments that on four Piagetian tasks--equal angles, floating bodies, rods and chemical combinations--"boys always appeared more confident in handling the equipment and more sure in their movements (p. 343)." On the other hand, for Piagetian tasks that entailed different and less stereotypically male apparati--the pendulum, cards, plants and combinations--Overton and Meehan (1982) observed "no formal operational competence deficit for females (p. 1541)." To summarize, while few sex differences in science performance are found for 9- and 13-year-olds, differences are often reported for physical science activities in favor of males. The impact of differential experience and/or the nature of the task may account for findings of sex differences.

Ethnic Effects.

We identified only three studies that examined ethnic differences in science performance at this age level; all three examined only the performance of Black and White students, and two of the three studies examined NAEP data from the 1976-77 assessment. A three-year summary of ethnic differences in science performance on the 1970, 1973 and 1977 NAEP reported that, for both 9-year-olds and 13-year-olds, Whites outperformed Blacks by approximately 15 percentage points on all three assessments. As with the mathematics review, no study that we located controlled for social class differences among ethnic groups.

*These reports are part of a series of science surveys of 11-, 13-, and 15-year-olds conducted from 1980 to 1983.

Sex/Ethnic Effects.

We located only one study (Langer, Kalk, & Searls, 1984) that examined sex differences within ethnicity, and that study compared the performance of Black and White students only on a measure that combined science performance with mathematics and reading tests; the data were drawn from the 1974-75, 1976-77, and 1977-78 NAEP science assessments. The results of that study have been described in detail in the previous section dealing with mathematics performance.

Computer Performance and Attitudes

Because of the relatively limited number of studies that have actually been conducted on computer knowledge for students in grades four to eight, we have included both studies of performance and attitudes in this section (Table 5).

Sex Effects.

In the California State Assessment of 1982, computer proficiency was defined to include nine domains: vocabulary, distinguishing interactive from batch processes, identifying major system components, recognizing tasks appropriate to computers, describing historical developments with computers, developing procedures to perform tasks, knowing specific uses of computers, knowing computer occupations and careers, and writing simple programs. Fetler (1985) reports that sixth grade males consistently outperformed sixth grade females on all tasks. The largest differences--amounting to 4 to 8 percent differences in passing--were found for vocabulary, knowledge of system components, history and simple programming. Smaller differences--2 to 3 percent--were found for knowledge of interactive and batch processes, knowledge of specific uses of computers, and knowledge about computer-related careers. The 1977-78 NAEP assessment contained four questions related to computer proficiency: two questions about flow charts and two questions requiring knowledge of the language BASIC. Males outperformed females on three of the four items, but the proportion of either male or female 13-year-olds who passed these items was very low, between 6 and 14 percent of the examinees. A third study that actually measured computer proficiency was conducted by Revelle et al. (1984) at a computer camp. Significant sex differences in precamp computer proficiency were found, with 64 percent of the 185 males and 26 percent of the 35 females being classified as highly proficient. An evaluation of a computer equity intervention program developed by the Women's Action Alliance (Sanders, 1984; Lockheed, 1984) also provided data on sex differences in experience and knowledge about computers for seventh grade students in Oregon, New Jersey and Wisconsin. Before the intervention, sex differences favoring males were found in Oregon and slight sex differences favoring males were found in Wisconsin. The results of the studies of sex effects on computer performance suggest that, while boys do seem to be outperforming girls, the actual amount of that performance advantage is slight, reaching statistical significance primarily because of the large sample sizes.

We identified two large-scale data bases and several smaller data bases that examined sex differences in attitudes toward computers in grades four to eight. Data from the California Assessment (Fetler, 1985) indicated that both sexes were relatively positive about computers, but that males were slightly more positive. Results of a survey of eighth grade students in British Columbia found significant sex differences in attitudes toward computers (Collis, 1984), with males more positively oriented toward computers than females. In three of the six remaining data bases, males were found to have more positive attitudes about computers than females had (Demarest & McKenzie, 1984; Mokros, 1984; and Wilder, Mackie & Cooper, 1984). In the remaining three data bases, no sex differences in attitude toward computers were observed (Mokros, 1984; Swadener & Hannafin, 1984; and Wilder, Mackie & Cooper, 1985).

Ethnic Effects and Sex/Ethnic Effects.

We were unable to identify any studies that reported ethnic differences in computer performance or that looked specifically at sex differences within ethnicity.

Summary

In this section, we have examined the available evidence regarding sex and/or ethnic differences in mathematics, science and computer performance. Our finding are as follows:

(1) In mathematics, over two-thirds of the studies reported finding no sex differences in performance. Of the remaining one-third, half reported differences favoring boys and half reported differences favoring girls. We conclude, therefore, that in grades 4-8, girls and boys perform equally well at mathematics tasks that are part of the regular curriculum.

(2) In mathematics, significant ethnic differences were found, with Asian and White students outperforming Black and Hispanic students. Most of these studies failed to control for ethnic differences in home, school and community economic status, however.

(3) In mathematics, few sex/ethnic interactions were reported.

(4) In science, boys outperformed girls on tasks that required knowledge of or familiarity with stereotypically male objects or apparati, but no sex differences were observed when the task was more gender neutral.

(5) In science, White students outperformed Black students.

(6) In computers, boys outperformed girls in the few studies where performance was assessed; sex differences were small, however.

Chapter 4: Factors Related to Performance and Participation

Observed and assumed sex and ethnic differences in participation and performance in mathematics, science and computer-related courses have been attributed to a plethora of factors, both intervenable and non-intervenable. Most research studies that have examined factors related to sex and ethnic differences in mathematics, science and computer performance have not examined the intervenable factors. Instead, they have concentrated on two major sets of nonintervenable factors: (1) explanations focusing on differences in cognitive abilities (Meehan, 1984; Linn & Petersen, in press) and (2) explanations focusing on differences in affect and self-perceptions (Fennema & Sherman, 1978; Hansford & Hattie, 1982). Moreover, almost all of the studies that examine the determinants of participation or performance focus on mathematics and not on science or computer courses.

One shortcoming of the empirical literature is its generally atheoretical nature. As a result, reported correlations between certain "causal" factors and student performance outcomes do not always appear to reflect direct causality. For example, a reported correlation between "parental encouragement"--presumably at home--and student performance--presumably on a test at school--can hardly be due to a direct effect, but must certainly be reflecting an intervening variable, such as "perceived task value," through which parental encouragement operates indirectly on performance.

Conceptual Model

To provide a conceptual framework for examining this literature, we have developed a "task performance" model of mathematics, science or computer performance (Figure 4). This model draws from those proposed by Cohen (1984), Eccles (1983), Entwistle and Hayduk (1982), Morine-Dershimer (1983), Stodolsky (1984), and Webb and Kenderski (1984), but emphasizes the relationships between participation, assessment and performance.

In this model, task performance (Box O) is seen as contingent upon both task participation (enrollment or "time on task," Box M) and various characteristics of the performance assessment tool and situation (such as the actual domains of knowledge covered by the test and their relative distribution in the test, whether the test is a traditional paper and pencil test or whether it involves behavioral assessment, what the language demands of the test are, whether there is surface bias in the test such that it offends certain test takers, whether the test is individually or group administered, what the nature of the test environment is, whether there is some active teacher or tester bias in operation, whether the test is a speeded test or a power test, what the distractors are in a multiple choice test, and--for studies of different aged populations--whether the domains covered in the test are similar or different over the ages studies, Box N).

Task participation (Box M) is viewed as contingent upon the perceived value of the task (interest to the student; perceived appropriateness of the activities; perceived benefit or cost of participation; disposition toward the course, or other "affect" variables, Box J), the extent of student task-oriented interaction (such as asking questions or giving answers, Box

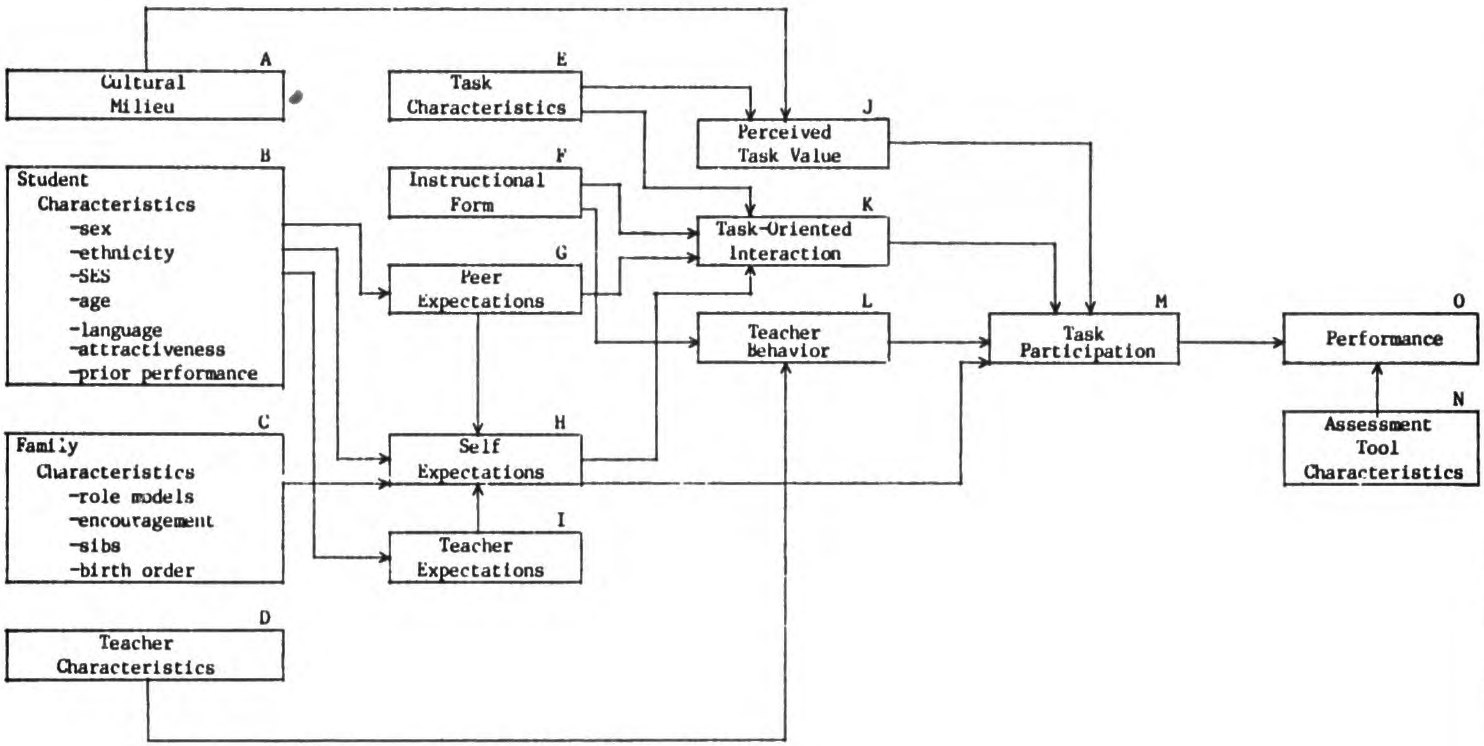

Figure 4: Task performance model of mathematics, science or computer performance

K), the behavior of the teacher (such as asking higher order questions, Box L) and the student's expectations about his or her task competence (Box H). Each of these determining factors is itself determined by other preceding factors.

Perceived task value is determined by the student's cultural milieu (Box A) and the characteristics of the task (Box E). Task characteristics include such factors as whether the task is competitive or cooperative, if it requires an objective or subjective response, if it requires public or private performance, the nature of the reward contingencies, the level of intellectual or physical development required for successful task completion, or the quality of the task.

Task-oriented interaction is determined by four factors: the characteristics of the task, the type of instructional form used in the classroom (Box F), peer performance expectations (Box G) and student self-performance expectations (Box H). Classroom instructional form includes classroom organization (whole class, small groups, individual instruction), team teaching, tracking, level of self-containment of class (from completely self-contained to departmentalized), and availability of resources. Certain instructional forms encourage task-oriented interaction, while others discourage such interaction; the teacher's choice of certain forms over others can increase, indirectly, the levels of task participation. Student and peer performance expectations are situationally specific expectations for competence vis-a-vis a particular task; they are to be distinguished from "general expectations" or "self-esteem" insofar as they vary according to task and task situation, and are not viewed as a fixed part of an individual's personality.

Teacher behavior is determined both by the teacher's expectations for the student (Box I) and other exogenous teacher characteristics (Box D).

The determinants of peer expectations and teacher expectations are such status-governing student characteristics as sex, ethnicity, social class, age, home language, attractiveness, or prior task performance (Box B). Student self-expectations are determined not only by these factors, but also by peer expectations (Box G), teacher expectations (Box I), and family characteristics, such as role models, encouragement, birth order and sibs (Box C).

The chain of determining factors that flows through student characteristics to student expectations and on to task-oriented interaction and performance is relatively non-intervenable. The two chains of determining factors that flow to student performance from the characteristics of the task and the instructional form and from the characteristics of the assessment tool, however, are completely intervenable.

In this section we review the empirical evidence regarding factors related to participation and performance in each of the subject matter areas of interest. We will not only report the correlations, but will also indicate what the probable intervening variables are.

Factors Related to Participation

As the model in Figure 4 indicates, and with the possible exception of the mathematical performance of idiot savants, performance is contingent upon participation. That is, it is virtually impossible to perform either well or poorly without actually participating in the activity to begin with. While large sex and ethnic differences in within-school participation in mathematics, science and computer-related activities have been observed at the secondary school level, at the elementary and middle school level these within-school differences are less apparent. Two factors account for this. First, students do not generally exercise choice regarding participation in these subjects (with the possible exception of computers). Second, tracking of subjects at this grade level is often "hidden," either unintentionally through insensitive data collection procedures, or intentionally by the school. When these subjects are "tracked" or offered as options, however, we would expect to see sex and ethnic differences in participation at the middle school level.

We were unable to locate any studies in which participation in fourth through eighth grade mathematics, science or computer-related courses was the dependent variable. A few studies have examined correlates of intended participation in mathematics (Brush, 1980; Armstrong, 1980), but we believe this measure is a poor proxy for participation for students in the middle grades, since they are unlikely to have a clear understanding of either the content of or their plans for enrollment in high school mathematics. We have therefore not included studies that use intended participation as the measure of participation. Despite the absence of empirical studies, we will discuss how the direct causal factors identified in Figure 4 could account for sex and ethnic differences in participation.

Four factors directly determine participation: perceived task value, task oriented interaction, teacher behavior and student self-expectation for task competence.

Perceived Task Value.

Perceived task value is affected by both the task's characteristics and the larger cultural milieu. In cultures in which mathematics is sex-typed as "male" or ethnically-typed as "White," for example, mathematics is perceived of as having little value to females or non-Whites. Perceived task value is also affected by the characteristic of the task, such that if the task demands competitive behavior, for example, it can be perceived as inappropriate for an ethnic group, such as the Hopi, that avoids competition. Presumably, changing the task characteristic from a competitive task to a cooperative task would increase the value of the task for the affected subgroup.

Task-Oriented Interaction.

Participation is also determined by task-oriented interaction, generally with the other students in the classroom. If the interaction in the classroom favored males or White students over females or Black students, for example, then sex or ethnic differences in participation would occur.

Teacher Behavior.

Teacher behaviors also affect participation. Teachers can call on students, invite their participation and otherwise make possible student involvement. To the extent that teacher behavior is affected by student sex or ethnicity, sex or ethnic differences in participation may occur.

Self-Expectations.

Finally, student self-expectations for competence affect participation. These self-expectations, based in part upon such individual characteristics as sex, ethnicity, home language, age, attractiveness, and prior experience with the task, determine the extent to which students will participate in task-oriented interaction with a group of other students or will attempt the task individually, either by enrolling in the class or by working on the activity alone.

Because of the absence of empirical work on determinants of participation in mathematics, science and computing at this age level, we turn now to determinants of performance in mathematics, science and computing. Each will be discussed separately, as it relates to the overall model.

Factors Related to Performance in Mathematics

We noted in the model that performance is directly determined by only two factors: participation and characteristics of the assessment tool. The effects of all other factors--affect, task interaction, self-perceptions, teacher behavior--operate indirectly through participation. Studies of factors related to mathematics performance are summarized in Table 6.

Direct Factors.

Participation. Unfortunately, little empirical research has studied the effects of participation on performance, and we were unable to locate any studies that examined this relationship for this age level.

Assessment-related factors. Performance on an assessment task involves an interaction between the test taker and the assessment. If there are aspects of the test or the testing situation that differentially influence the performance of certain subgroups, then the assessment is properly considered biased. Bias in testing is a large literature that cannot be covered here. It is, however, an old literature, and we only identified a few recent studies of test-related factors related to mathematics performance in grades 4-8. In part this may be due to the fact that test bias was an issue in the early 1970's, resulting in much research being published prior to 1975 and hence not meeting our criteria for inclusion in this review. It may also be due to our search technique that did not specifically look for studies identified as "test bias" studies. We recognize that this literature may be much larger than our present summary of it.

We identified only four studies that examined the effects on performance of "test bias" factors other than domains, which have been discussed previously (Marshall, 1984; Armstrong, 1980). The first factor is the discontinuity between the child's language and the language of assessment. Tests of mathematics proficiency are typically administered in English; for children whose language is not English, therefore, the test may be more difficult than for an English speaker. To test this hypothesis, Llabre and Cuevas (1983) examined the test performance of 388 bilingual fourth and fifth grade students in predominantly Hispanic schools in Florida. Students were tested on either a Spanish or an English version of the mathematics concepts and applications sections of the Comprehensive Test of Basic Skills. All students performed better when tested in English, but a positive association between mathematics performance and English language proficiency as measured by a reading comprehension test was also found, suggesting that those more familiar with the language used in the assessment did, in fact, outperform those not as familiar. Since the children were not instructed in Spanish, their failure to perform well when tested in Spanish may be attributable to a lack of familiarity with mathematics vocabulary in Spanish.

Somewhat conflicting findings on this point are offered by Tsang (1976) who tested 321 Chinese students and 121 Mexican-American students in grades 7 and 8 in California. Students were presented with mathematics word problems that were either culturally biased or unbiased, in English or in a bilingual version. While Chinese students performed better on the bilingual form of the test, Mexican-American students performed better on the English form of the test. In this study, social class was not controlled. Why and under what conditions language should be an important determinant of mathematics achievement for one ethnic group and not for another is a question that certainly bears further investigation.

A second factor is cultural bias, which was also investigated by Tsang (1976). For Chinese students who were low performers in mathematics, test performance was higher on a test that was culturally unbiased than on a test that was culturally biased against Chinese; a similar effect was not found for the effect of cultural bias on the test performance of Mexican-Americans, however.

Familiarity with a test format has also been shown to be correlated with higher test performance. In an experimental study, students in grades 8 and 9 who had received a test preparation treatment that included solving practice problems outperformed classmates who had received a test preparation lecture or no treatment (Bookman & Iwanicki, 1983).

Finally, in an analysis of performance on the California Assessment mathematics tests of 1976-1979, Marshall (1983) found that distractor type differentially affected the performance of males and females, with certain distractors more attractive to one sex than to the other.

Indirect Factors.

Most research on the determinants of performance have examined as direct effect factors those factors that we have identified as indirect effect factors: affect, task interaction, self-perceptions, teacher behavior. In addition, factors that are totally non-intervenable, such as the cultural milieu, student characteristics (biologic and cognitive), family characteristics and even teacher characteristics, have been treated as direct determinants of performance, rather than as factors affecting intervening variables. In reviewing this literature, we will take into account the current status of the empirical findings, as well as our theoretical model, and will separate our discussion of the factors related to performance into three major subheadings: intervenable factors, non-intervenable factors, and exogenous factors. Since most of the research has been conducted on non-intervenable factors, we will review these first.

Non-intervenable factors. Non-intervenable factors include biologic, cognitive, and affective variables.

1. Biologic factors. Despite a large literature on brain lateralization, hormone distribution, genetic and maturational effects on cognitive performance, we were unable to locate any recent studies that showed a direct correlation between any of these variables and mathematics performance for this age group. Biologic explanations, therefore, will not be considered further.

2. Cognitive factors. Cognitive factors theoretically related to mathematics performance in grades 4-8 include general ability, spatial-visualization, cognitive style, and language factors. Empirical evidence relating these factors to mathematics performance has been found for all but spatial-visualization.

We located three studies in which general ability was related to mathematics performance. Two studies by Boswell and Katz (1980) examined 562 children in grades 3-6 and 219 children in grade 7; all the students were from White, upper middle-class families in Boulder, Colorado. For both the elementary and the junior high school group, "non-language aptitude" was a statistically significant predictor of performance on mathematics computation, concepts and applications. A third study by Linn and Pulos (1983) examined 304 students in grade 7; controlling for several other cognitive and exogenous factors, they found that vocabulary (a measure of general crystallized ability) was positively related to performance in proportional reasoning; no sex differences were observed and ethnicity was not reported or examined.

Two studies reported a positive association between field independence and mathematics test performance (Kagan and Zahn, 1975; and Kagan, Zahn & Gealy, 1977). In both these studies, Mexican-American and Anglo students in grades K-6 from semi-rural, lower income schools comprised the sample. Analyses were not conducted separately by ethnicity even though ethnicity (as well as field independence) was correlated with performance.

We identified three studies that examined language related factors and mathematics performance. In a large-scale study, Myers and Milne (1982) examined the mathematics performance of 15,579 students in grades 1-6 in 242 schools as part of an evaluation of the sustaining effects of Title I. The performance of students from different language backgrounds was compared:

children from bilingual Italian/English homes outperformed children from monolingual English homes, who outperformed children from bilingual Spanish/English homes, who outperformed children from monolingual Spanish homes; social class effects were not examined. In another large study, Rosenthal, Baker and Ginsberg (1983) examined the performance of 12,322 children on the mathematics section of the California Test of Basic Skills. Controlling for parental education, family income, parental occupation, and ethnicity, home language (parental use of Spanish or English while helping with homework) was unrelated to initial level of mathematics performance, but was related to gains in achievement from fall to spring. Hispanic children whose parents used English only or a combination of Spanish and English to help with homework gained less than Anglos or than Hispanic children whose parents used Spanish only in their homework. In another study, Sanchez (1980) found that the mathematics achievement of children in grades K-6 in 58 bilingual settings was lower for children of limited English proficiency; family education and income were not controlled, however.

3. Affective factors. Affective factors include such culturally or situationally determined factors as liking of mathematics, perceived appropriateness of mathematics, or perceived benefit or cost of taking mathematics courses (which we have grouped under the label of "perceived task value") and such family and personally determined factors as self-expectations regarding mathematics ability. Whether or not affect is intervenable or non-intervenable is largely a matter of contention.

Liking of mathematics has been widely investigated as a factor related to mathematics performance, particularly as a factor explaining sex differences in mathematics. The results are consistently positive; students who express positive attitudes toward mathematics perform better on tests of mathematics than students who do not like mathematics (Armstrong, 1980; Boswell & Katz, 1980; Creswell, 1980; Tsai & Walberg, 1983). Whether or not positive attitudes determine performance, or performance determines positive attitudes, however, is not addressed in these studies. There is some evidence that attitudes are more salient for females than for males (Boswell & Katz, 1980), although no interaction between attitudes and sex or ethnicity was found in another large-scale study in which the relationships were tested (Tsai & Walberg, 1983).

The anticipated usefulness or perceived benefit to be obtained from the study of mathematics should also influence participation, and hence performance. Results are not consistent on this relationship, however. Armstrong (1980) investigated the effects of perceived usefulness of mathematics on performance, and found a small zero-order correlation, but no effect when analyzed within a regression model. For a sample of Black and Mexican-American students, however, Creswell and Exezidis (1982) found a significant correlation between the perceived usefulness of mathematics and performance on the Iowa Test of Basic Skills Mathematics Test. In three studies we reviewed that measured sex differences for students in grades 6-8, no differences in ratings of usefulness emerged (Brush, 1980; Sherman, 1980; Fennema & Sherman, 1978). However, after 8th grade both Sherman (1980) and Brush (1980) report a decline in the ratings of usefulness for mathematics studies for both sexes. The decline is more pronounced for females and is reported as a significant difference during high school years.

That mathematics is presumed to be a "male" or "White" activity has been proposed as a possible explanation for lower rates of participation (and lower levels of performance) by females and non-White students. Some evidence for this claim may be found in the literature, with the effect being significant for females and non-White students. In general, females who view mathematics as sex-appropriate or sex neutral outperform those who view mathematics as male. For example, Armstrong (1980) found that stereotyping of mathematics as male was negatively correlated with mathematics performance on standardized achievement tests for 13-year-old females. Similarly, Boswell and Katz (1980) found that stereotyping of mathematics as male was negatively related to performance in mathematics for females in grades 3-6 and in grade 7. Sherman (1980) also found that the perception of mathematics as a male domain was negatively correlated with mathematics performance for females but not for males in a sample of students tested in the eighth grade and followed up in the eleventh grade; the less a girl stereotyped mathematics as male in grade eight, the higher her problem-solving performance in grade eleven. A fourth study that examined the correlation between perceived appropriateness of mathematics for males versus females (Creswell, 1980) found that the perception of mathematics as a male domain contributed significantly to the mathematics test performance of both males and females on the Iowa Test of Basic Skills for Black, White and Mexican-American eighth grade students. Finally, sex role attitudes, including the perception of mathematics as appropriate for one's own sex, were found to be positively correlated to mathematics test performance for both males and females in grades 4 and 8 (Paulsen & Johnson, 1983). We were unable to identify any studies that actually examined the effects on performance of the perception of mathematics as ethnically appropriate or inappropriate.

Self-perceptions of ability in mathematics and self-expectations for future performance are closely related. Presumably, perceptions of one's academic ability lead directly to expectations about future performance. The process whereby these perceptions and subsequent expectations come to be formed is complex, involving actual performance, the evaluations of significant others (such as peers and teachers), and the instructional form of the classroom that permits or encourages the development of differential unidimensional self-perceptions. A problem with research on self-perceptions and expectations is that such research largely depends upon self-reports of these internal states that are made independent of a particular performance situation. Since performance expectations in real life are entirely dependent upon the specific performance in question, and often dependent upon some comparison group, self reports of general self-perceptions and expectations may be flawed. In general, positive correlations between perceived ability in mathematics and mathematics performance have been found; the direction of the effect, however, is rarely studied, and may be from performance to expectation, as well as from expectation to performance. We identified two studies that examined the effects of perceived mathematics ability on performance; in both cases the effects were positive (Boswell & Katz, 1980; Nelson, Knight, Kagan, &

Gumbiner, 1980). Two other studies examined the effects of confidence in one's ability to learn mathematics on mathematics performance; in both these cases the correlations were also positive (Armstrong, 1980; Fennema & Sherman, 1978). A fifth study found a correlation between arithmetic achievement and self-esteem in mathematics (a measure of perceived ability in mathematics) for a large sample of White, Black and Hispanic students in Chicago (McCormick & Karabinus, 1976).

Two other affective factors that have been mentioned as explaining performance are motivation and test anxiety. We were unable, however, to locate any studies that directly examined the effects of either of these factors on mathematics performance for this age group.

Intervenable factors. Intervenable factors include two major topics: the organization of the learning environment and the teacher-student or peer interactions that take place within the environment. Most previous work has been conducted on the interactions and their effects on performance; very little work has examined the relationship between the organization of the environment and achievement.

1. Learning environment factors. The area in which the greatest amount of change could be implemented, and yet about which the least amount of research has been conducted, is that of organization of the learning environment. While the organization of the classroom may appear to be relatively fixed—one teacher, 30 students—a number of classroom organizational features are in fact potentially variable; such elements include instructional groupings, the characteristics of the learning task, the instructional method, student reward contingencies, whether the work is organized around public or private behavior, and how resources are allocated. One method of reorganizing classroom instruction is to create small cooperative groups, such as those called for in Team Assisted Instruction (Slavin & Karweit, 1985). Slavin (1985) reports findings from four studies of the effects of TAI on mathematics performance of students in ethnically diverse schools. Although none of the studies specifically reported sex or ethnic effects, three studies showed that students in TAI classrooms scored higher on the mathematics computations, concepts, and applications sections of the Comprehensive Test of Basic Skills than did students from control classrooms or from classrooms that were taught using individual instruction. Sanchez (1980) found that students in classrooms of teachers who were judged to be more "cooperative" scored higher on mathematics achievement than did students in the classrooms of less cooperative teachers.

In an experimental study of the effects of different instructional methods on student learning, Hannafin (1983) found that White and Hispanic children who received mathematics instruction that presented a hierarchically sequenced set of mathematics computational skills outperformed—for adding and subtracting fractions—students taught in a traditional manner; no differences were found for performance on items dealing either with whole numbers or with decimals.

It may seem surprising that we were unable to locate any more studies dealing directly with instructional method or classroom organization effects on performance, since such research constitutes a large body of educational studies. The reader is reminded that we restricted our search to those studies dealing specifically with grades 4-8 and that reported examining the data for sex, ethnic, or sex by ethnic effects. For studies meeting these conditions, therefore, we found few published.

2. Classroom interaction. While reviews of the research on classroom interaction abound (see Brophy, in press; and Good & Findley, 1982), these reviews do not examine findings according to grade level, subject matter or student characteristics other than sex. In general, moreover, most classroom interaction research fails to link interaction to performance. This is true for both studies of teacher-student interaction and peer interaction. Interaction factors asserted to influence performance include teacher praise, teacher criticism, teacher higher order questioning, teacher waiting time, student explaining, student questioning, and student tutoring. We found only one teacher-student interaction study in which mathematics performance was related to the interaction. Webb and Kenderski (1984) found that in whole class settings, receiving help from the teacher was positively related to student achievement. In one other study, student report of teacher encouragement was positively correlated with mathematics performance (Armstrong, 1980).

We identified three studies in which peer interaction was related to performance. In an Australian study of peer tutoring (Sharpley, Irvine & Sharpley, 1983), the performance of fifth and sixth grade students who had assumed the role of tutor vis-a-vis younger students was higher than that of their classmates who had not assumed such a role. Tutoring may entail explaining material, which in turn may facilitate learning. Some evidence in support of this point is provided by Webb (Webb & Cullian, 1983; Webb & Kenderski, 1984) who found that giving explanations was positively correlated with mathematics performance for students in three junior high school mathematics classrooms, and that asking a question and receiving an answer was positively related to achievement in four mathematics classes in grades 7-9.

Exogenous Factors.

The model in Figure 4 identified a number of factors that are--for the most part--properly considered exogenous. For parsimony, we have grouped them as social factors and other factors.

Social factors. Social factors, which more properly should be related to participation than to performance but that have a tradition of empirical literature linking them to performance, include parental encouragement, teacher and counselor encouragement, and general cultural milieu, such as role models. These factors are presumed to work differentially for males and females. In general, measures of such factors are limited to student perceptions, so that the measure of parental encouragement, for example, will be the student's report of parental encouragement. Significant effects for paternal expectations and maternal role modeling in mathematics on student mathematics performance were reported by Armstrong (1980); maternal role modeling was a unique predictor for females. Maternal influence but not paternal influence was a significant predictor of performance for White, Black and Mexican-American eighth grade students in Texas (Creswell, 1980). For a sample including only Black and Mexican-American students in Texas, Creswell and Exezidis (1982) found that paternal influence and not maternal influence was a significant predictor of mathematics performance. Counselors have also been identified as important sources of encouragement to students (Armstrong, 1980). Numerous claims for the effect of large cultural values on the performance of different ethnic groups have been made, but empirical tests of these claims for the age group under investigation have not been made.

Other factors. Many factors that are totally exogenous to the school environment have been identified as important determinants of student mathematics performance; two such factors that have been the subject of this general investigation are sex and ethnicity. Other such factors include student socioeconomic status, the geographical location of the school, cultural and religious factors, school size, and community socioeconomic status. While these factors are rarely intervenable (a possible exception is school size) they play an important role in determining student achievement.

Socioeconomic status of the student's family or of the community is a major factor related to achievement. The effects of SES on mathematics performance for this age group have been reported in several studies (Armstrong, 1980; Conway, 1977; Rosenthal, Baker & Ginsberg, 1983; Jones, Burton & Davenport, 1982; Strauch, 1977; and Tsai & Walberg, 1983). Students from more advantaged homes, schools or communities outperform students from less advantaged homes, schools or communities.

Geographical region has also been found to be related to mathematics performance, primarily as a variable that unpredictably accounts for variance. That is, coefficients for geographical region are found to be statistically significant, but no particular explanation is provided for such differences.

Factors Related to Performance in Science

Science, as taught in elementary school and junior high school, may either involve a great number of hands-on activities or may be taught quite conceptually. The assessment of scientific knowledge may also involve physical operations or not. When science is taught with concrete manipulable objects, an issue arises regarding the sort of objects to include: should they be restricted to familiar household objects, or should they include more exotic apparati? Objects that have been described in the research to be summarized herein include such items as balance scales, pendulums, plants, and inclined planes: objects that some children may have encountered at home but that other children may find unfamiliar. It is important to bear in mind, while examining the factors that are associated with science performance (Table 7), that few studies have examined the question of what is meant by science performance: is it the demonstration of skills previously acquired at home or in extracurricular activities, or is it the demonstration of skills learned at school? We have noted previously that sex and ethnic differences in science-related out of school experiences have been found; although prior experience with scientific apparati was not controlled in any of the studies we identified, it is possible that the observed differences in experience vis-a-vis these objects may--in great part--be the cause of the observed sex and ethnic differences in performance.

Direct Factors.

Participation. We were unable to locate any studies that examined the relationship between participation in science and performance in science for this age level.

Assessment-related factors. The assessment of scientific knowledge and the application of that knowledge has not widely been studied as influencing performance differences. Some evidence that the language used in science may be easier for males than females is provided by a study of 7th and 8th grade students in Tasmania (Lynch & Paterson, 1980). In this study, students were asked to correctly identify 16 concept words in science. For half of the items, no sex differences were found, but for the other half, the males outperformed the females (with one exception at the 7th grade). The concepts for which males outperformed females in both the 7th and the 8th grades were "liquid," "solid," "volume," and "compound." The differences were small, and perhaps could have been due to differences in the male and female samples, as some of the male students were enrolled in an all-boys school, which may have had a different science curriculum from the coeducational schools. No differences at either grade were found for "length," "area," "element," or "proton."

In a second study of assessment domain effects on performance, Treagust (1980) individually interviewed 36 eighth grade students and had them complete science tasks involving telephone poles, railway lines, rods, water level, triangles and a model landscape. Significant sex differences were found for all tasks other than the telephone poles task (which, the author noted, was taught in art class) and the model landscape task, which virtually no one passed. We were interested to note the relative absence of research interest in the relationship between the context of science assessment and science performance; it seems that much more attention has been paid to exploring deficits in cognitive ability than to determining whether assessments relying upon tasks and apparati associated with upper-middle class White males could possibly explain the observed differences.

Indirect Factors.

Again in science, many factors that we consider to operate indirectly on performance have been examined empirically as if they operated directly. These will be addressed as non-intervenable factors or as intervenable factors.

Non-intervenable factors. With science, as with mathematics, much discussion has addressed biologic, cognitive and affective factors that are believed to determine performance.

1. Biologic factors. Although biologic factors have often been cited as possible explanations for sex and ethnic differences, few studies have established empirical relationships between them. In our review, we identified only two studies in which a biologic factor was found to be associated with science performance, and these factors were student age and physical maturation. In a study that examined the performance of students in the NAEP mathematics, science and reading tests of 1974-75, 1976-77, and 1977-78, a significant correlation between age and test performance was found for both Black and White students (Langer, Kalk, & Searls, 1984). In another study of 85 White females, 11 years of age, Newcombe and Bandura (1983) found a positive correlation between physical maturation and performance in spatial ability as assessed by the spatial relations subtest of the primary mental abilities test, and by the block design subtest of the WISC-R.

2. Cognitive factors. Cognitive factors include general ability, spatial-visualization, cognitive style, and language. For example, one study of White and Mexican-American fifth grade students (Brown, Fournier & Moyer, 1977) examined the relationship between Piagetian concrete reasoning and performance on a science concepts tests and on grade received in science. A correlation between science grade and Piagetian "velocity" and between performance on the science test and Piagetian "volume" and "spatiality" was found. In a related study, Linn and Pulos (1983) found that performance on the Piagetian task, predicting displaced volume, was correlated with crystallized ability, fluid ability and cognitive style for seventh grade students.

Although language has been mentioned as a factor related to performance, we were able to locate only one study that directly addressed the effects of language on performance, and this study did not control for family SES; students having Spanish as a home language performed less well on a test of science achievement (Brown, Fournier, & Moyer, 1977).

3. Affective factors. Affective factors found related to science performance include self-concept, self-efficacy and test anxiety. Liking for science, unlike liking for mathematics, has not been examined in this age group. The studies themselves have been correlational. In a study of 65 Black seventh grade students, Bernreuter (1981) found a significant correlation between science grade and self-concept. The point has been made previously and is made by Bernreuter, that grades can as easily determine self-concept as the other way around; in the Bernreuter study, in fact, the putative dependent variable is self-concept and the independent variable is the student's grade in science.

Sex role orientation has also been included as a possible factor related to science performance. In a study of 13-year-old students from a Catholic school, a positive relationship between a sense of mastery (responsibility for intellectual achievement, which is comparable to academic self-concept or academic efficacy) and performance on four Piagetian tasks was found (Overton & Meehan, 1982). An interaction between gender identity (masculine, feminine and androgynous) was also found, however, such that masculine/helpless students and androgynous/mastery students outperformed androgynous/helpless students. In a study restricted to 11-year-old White females, Newcombe and Bandura (1983) found positive correlations between spatial ability and perception of having socially desirable masculine and feminine traits, wanting to be a boy, and having a positive image of oneself.

Intervenable factors. Considerable attention has been paid to exploring different ways of presenting science information in the classroom. Much of this research has been summarized in meta-analyses (Wise & Okey, 1983; Bredderman, 1983; Shymansky, Kyle & Alport, 1983). Although these meta-analyses have not been limited to students in grades 4-8; however, their findings correspond to the findings of studies we will review in this section that hands-on science curricula have differentially positive effects for disadvantaged students and females. In addition, effects have been found for factors associated with differences in the learning environment and in classroom interaction.

1. Learning environment factors. We identified one study that directly examined the effects of reorganizing the learning environment on science performance, and two studies that examined changing the nature of the curriculum. In the first study (Cohen, personal communication, 1984) Mexican-American students in bilingual fourth and fifth grades in California participated in a year-long science program that entailed structured hands-on curriculum, cooperative learning centers and student responsibility for task completion. Over the course of the year, fourth grade students raised their performance, on the average, from the 37th national percentile on the California Test of Basic Skills in science to the 49th percentile; fifth grade students went from the 29th percentile to the 32nd percentile. In the second, a study of biology classification skills, students in traditional classes were compared with students who had actually sorted specimens (Ryman, 1977). While males in traditional classes scored higher than females or than males in the "hands-on" classes, an interaction between sex, ability and treatment was observed, with more able females in the "hands-on" class performing equally as well as males in either class, and significantly outperforming more able females who were given the traditional instruction. In a third study, sex differences in performance on Piagetian tasks involving volume and density were examined in three British classes of 10-year-olds and in two American fourth grade classes. (Howe & Shayer, 1981). Students were tested before giving them a "guided classroom experience with volume and heaviness" and then tested afterwards. In both settings, the males outperformed the females, but the females gained more from the classroom experience than did the males.

We identified two studies that attempted to improve science learning through providing cognitive structures for the students. In one, students in eighth grade introductory physical sciences (IPS) classes were assigned to receive behavioral objectives for four units, for two units, or for no units (Akers, 1980). For two of the four competency measures, females who had been in the "behavioral objectives" condition achieved at a higher level than females who had not received behavioral objectives. Cognitive structuring was also found to be related to performance in fifth grade biology (Bin Abdullah & Lowell, 1981).

Although the studies we have identified are few and limited, these results suggest that possibly some differences in performance may be due to differential out-of-school experiences. Possibly, when these differences are compensated for by telling students what is expected and by providing firsthand experiences with the concepts being taught, they may be reduced.

2. Classroom interaction. Virtually no research has been conducted on the relationship between classroom interaction, teacher behavior, and student behavior and student performance in science. We did identify two notable exceptions to this statement. The first was a study of 7th grade students who were observed during science class instruction throughout an entire year and for whom performance data on the Cooperative Science Test were obtained (Morse & Handley, 1982). Student behaviors were coded for a set of task-related social interactions: no response to questions, unsolicited responses, direct instructional questions, teacher-initiated instructions, simple acknowledgement, correct responses, teacher wait time and social questions. These interactions accounted for 23% of the variance in student science achievement. Although the observed sample of students was approximately 60% Black, no ethnic differences were reported.

A second study that examined ethnic differences in behavioral effects on science performance was conducted in science classes in an urban junior high school (Howe, Hall, Stanback & Seidman, 1983). Although no ethnic differences in student learning behaviors, attending behaviors or nonattending behaviors were observed, these behaviors were differentially associated with final grade in science. For Black males--but not for White males--learning and attending were positively associated with the end of year grade, and nonattending was negatively associated with end of year grade; the sample did not include females. The reader is reminded that the dependent variable in this case is the grade given to the student by the teacher, not an actual performance measure; grades are more subjective than test scores and hence more vulnerable to bias. It appears that the teachers were using the behavior of the Black students, but not of the White students, as indicators of ability.

Exogenous Factors.

Social factors. We were unable to identify any studies that examined the effects of relevant others on student performance in science.

Other factors. In the majority of studies that examined factors related to science performance, exogenous factors such as family or community socioeconomic status or geographical region have not been controlled. In those studies that have controlled for SES, significant effects have been observed (Linn & Pulos, 1983; Langer, Kalk, & Searls, 1984).

Factors Related to Performance in Computer Courses

We identified eight studies that sought to examine factors related to performance in computer courses (Table 8). Of these, only two included any indicator of performance, the remainder examined factors related to attitudes towards computers. The studies range in size from a handful of students, to data from the California Assessment Program, and each study examines different factors and different dependent variables. Since this is the case, our discussion of factors related to computer performance will be structured somewhat differently from our discussions of factors related to science and mathematics performance. That is, this section will include discussions of factors related to computer participation and use, factors related to attitudes towards computers, and factors related to computer performance.

Participation and Use.

Attitudes towards computers and access to computers have been identified as major contributors to computer use and participation in computer-related activites. Sex differences in these effects, however, have been observed. Collis (1984), in a study of approximately 1000 eighth grade students in Victoria, British Columbia, found that attitudes towards computers were more strongly associated with computer class participation for boys than for girls. Computer class participation has also been found to be related to the emphasis placed on participation by the schools. In schools in which girls were encouraged to participate in computer-related activities, girls substantially increased their participation in computer-related courses (Lockheed, 1984).

Attitudes Towards Computers.

Access to computers has also been noted as related to attitudes towards computers. In a study of all students in grades 3 and 4 in one upper-middle class district, it was found that a higher proportion of home owners expressed comfort with computers than did non-owners (Demarest & McKenzie, unpublished ms., 1984). Similarly, Miura (1984) found that junior high school students who owned computers engaged in more extracurricular computer use, were more likely to plan to take courses in programming in high school, were more interested in learning more about computers and were more likely to think about considering a computer-related career than were students who did not own computers. Among computer owners, males were more positive in their attitudes than were females. Liking of computers has also been related to the content of the software. Computer games that involved puzzles were more appealing to sixth grade females than to males (Perez & White, 1983), whereas games that involved action, stimulation, or violence appealed to males more than females (Perez & White, 1983; Wilder, Mackie & Cooper, 1985).

Computer-Related Performance.

As yet, few studies have examined computer-related performance in grades 4-8. The California Assessment Program of 1983, however, did include a survey of basic computer literacy skills covering vocabulary, interactive and batch systems, systems components, history, systematic procedures, simple programs, specific uses of computers and computer related careers in its sixth grade assessment (Fetler, 1985). In this study, family socioeconomic status was significantly related to performance, with children from higher SES backgrounds outperforming children from lower SES backgrounds. In another study, knowledge of and experience with computers was significantly associated with access to computers, computer class participation and frequency of computer use for seventh grade females but not for males; for males, only prior levels of knowledge and frequency of use were correlated with knowledge (Lockheed, 1984).

Summary

In this chapter, factors related to student participation and performance in mathematics, science, and computer-related courses have been reviewed. While the majority of empirical studies have addressed essentially non-intervenable variables--such as "self" variables--a few studies have provided evidence for the effects of intervenable variables on performance; no research has examined factors related to differences in participation.

The results of this chapter are:

(1) Virtually no empirical studies on the determinants of middle-school student participation in mathematics, science, or computer-related activities have been conducted.

(2) The vast majority of studies reviewed in this section addressed sex differences in mathematics performance and "affective" correlates of performance.

(3) Mathematics test performance was directly affected by such potentially intervenable assessment factors as language discontinuities, test domain, cultural bias, test familiarity and distractor type.

(4) Mathematics performance was improved by the use of small cooperative groups and by structured instruction.

(5) Mathematics performance was associated with giving explanations, asking for and receiving answers.

(6) Science test performance was directly affected by such assessment factors as technical language and test domain.

(7) Science performance was improved by the use of small cooperative groups, "hands-on" experiences, and cognitive structuring.

(8) Science performance was associated with questioning and responding to questions, receiving instructions, and attending to the teacher.

(9) Little research on factors related to computer performance or addressing intervenable variables has been conducted.

Chapter 5: Intervention Programs

A search was undertaken for programs currently operating to increase the participation and/or performance of young girls and/or minorities in mathematics, science or computer science within grades four through eight. In conjunction with a review of the literature, we contacted a number of organizations and spoke with professionals working in these subject areas to identify noteworthy programs. We were interested in identifying programs that had been evaluated and were considered models by the professional community. Among the organizations we contacted were the American Association for the Advancement of Science, the Math/Science Network, the Mathematics Association of America, National Council of Teachers of Mathematics, National Institute of Education, and the National Science Foundation. Both our literature review and these professional contacts revealed few programs operating for students in grades 4-8; when programs existed, they tended to serve junior high school students.

The following programs represent the results of our search. While we do not contend that this list is exhaustive, we believe that it is representative of model efforts to intervene with these students. Few of these programs, however, have been formally evaluated. In most cases, the programs have been visited by assessment teams. In all but two cases, the programs are currently operating; a directory of programs appears in Appendix C.

The programs represented here are diverse in organization, strategies and emphasis. Though a few are limited to developing awareness and interest in technical fields, most are directed toward the development of students' competence and confidence in their performance. While the selection and combination of strategies vary across programs, most projects are using multiple approaches to effect change. In some programs, parents, teachers, counselors, university staff and/or business professionals are involved in a variety of arrangements to assist in the development and implementation of interventions. Their involvement brings with it an opportunity to affect not only students in the program but also to influence the school and the professional community. Programs will be described under the following categories: (1) minority programs, (2) programs for girls, and (3) inservice programs for teachers, counselors and/or parents.

Programs for Minority Students

We identified 12 programs operating for minority students; six of the programs were aimed at all disadvantaged minorities, while the remainder focused primarily on one or two specific groups. Four of the programs identified Black students as their principal target, two focused on Hispanic students and two focused on Native American students.

The majority of these programs operate during the day as an integral part of the school program. By reaching students on an ongoing basis they are afforded an opportunity to have a substantial impact on their pupils.

The program components are varied and include such elements as practice with the scientific method and conducting research projects; career information, role modeling, and interaction with minority scientific and mathematical professionals; extracurricular specialized training; required participation in mathematics and science courses when such participation would be typically elective; curriculum revision to permit more peer interaction with hands-on materials; and computer-assisted instruction or training in programming. Programs frequently include more than one of these components. In the following sections, we briefly describe each program. A directory containing the address, phone number, and contact person for each program appears in Appendix C.

American Indian Science and Engineering Society (AISES)

AISES, located at the University of Colorado operates a Science Fair Model for Native American students in kindergarten through high school. The model is based on the International Science and Engineering Fair Program. Presently in its third year of operation, the program is serving approximately 4,000 students, two-thirds of them at the elementary level. The program trains interested teachers in the model, and addresses strategies for teaching science, obtaining materials, and involving parents and the community. During the year teachers work with their students on research projects that will be presented at the fair. The purpose of this activity is to expose students to the scientific method in a creative and supportive environment. AISES is planning an evaluation to assess the impact of this program on students' interest in future science careers, on students' academic performance and on community reaction to the science fair activity.

Blacks and Mathematics (BAM), A Visiting School Lecturer Program sponsored by the Mathematical Association of America (MAA)

BAM is part of the Visiting Lecturer Program to Secondary Schools sponsored by the Mathematical Association of America. The program currently has ten regional centers located in large urban areas across the country, including, for example, Hartford, Connecticut; Houston, Texas; Detroit, Michigan; Grambling, Louisiana; and Washington, D.C. Within each center a regional coordinator recruits local Black professionals who are working in such mathematics-related fields as chemistry, engineering, mathematics and computer programming to serve as presenters to junior high and high school students. Visits are arranged at no charge to the requesting school district. The content and format of the visits vary according to individual requests and include a range of activities from informal, small group demonstrations to large, formal assemblies.

The goal of the program is not only to provide students with information about a range of rewarding careers for which mathematics is a prerequisite, but also to expose students to role models with whom they can identify. As part of the program, speakers encourage students to enroll in college preparatory mathematics courses: algebra, geometry, trigonometry, probability and statistics, calculus, and computer programming.

Although the program requires that both students and a school representative complete a short evaluation during the visit, lack of funding has not permitted the conduct of a formal evaluation to assess the effects of the program on students' course selections, attitudes or performance.

Finding Out/Descubrimiento

This program, originating at Stanford University, is designed to develop the thinking skills of bilingual students in grades two through five. Based upon concepts from sociology and cognitive psychology, the program provides instruction within a cooperative group structure in which children work out solutions to problems on their own. Emphasis is on the acquisition of mathematics and science concepts and of problem solving skills by utilizing intrinsically interesting activities which require the cooperation of other students.

The program has been formally evaluated when implemented in San Jose and Milpitas, California, elementary schools. Students in grades two through five made significant gains in national percentiles on standardized mathematics, on reading achievement tests, and made significant gains in English language proficiency and science as well.

Mathematics, Engineering, Science Achievement Program (MESA)

Since 1970 MESA has been operating high school and college programs geared to attracting and retaining minority students--primarily Black, Chicano, Mexican-American, Puerto Rican and Native American--into mathematics, engineering and physical sciences studies. Headquartered at the University of California's Lawrence Hall of Science, MESA currently serves approximately 4,000 students in 140 high schools and 2,350 college students on 15 campuses. The program is based within local schools under the support and guidance of one of 30 MESA centers. Each center is affiliated with a university which has strong engineering and physical science departments.

Traditionally, MESA has targeted for enrollment ninth grade students who have completed Algebra I are currently enrolled in geometry. Potential MESA students must express an interest in math or science and plan to continue college preparatory courses. To participate in MESA, students must take four years of high school mathematics and English, three or four years of science, including chemistry and physics, and maintain a high scholastic average.

MESA students are provided a variety of support throughout their high school and college years. During high school years this support includes mentorship from high school, university and/or industry staff; peer and staff led study groups; MESA academic chapter activities; visits to industry; summer enrichment programs in mathematics or science; summer employment; and scholarship incentive awards for those enrolled in advanced high school courses.

MESA keeps comprehensive records on the performance and course selection of its students throughout high school and college years. Their data show that more than 90 percent of MESA students go on to study at colleges and universities; of these more than two-thirds pursue majors in technical fields.

Beginning in 1984-85, MESA conducted an extension of the program into junior high schools. In 1985-86 nearly 1,000 students from 26 schools participated. Students who score above the 60th percentile on the California Test of Basic Skills in the seventh grade and have an interest in mathematics or science are invited to participate. The program offers many of the features of the high school program with the advantage of involving promising students before they elect to opt out of college preparatory courses.

Minneapolis Public Schools Math Bridge Program

The Minneapolis public schools have undertaken a number of activities to increase the participation and performance of minorities and women in mathematics programs in junior and senior high school. One of these efforts, the Math Bridge Program, is designed to increase the enrollment of Black, Hispanic, and Native American students in college preparatory programs. Students who are identified by teachers as having the academic skills necessary to succeed in algebra are invited to participate. The program operates on Saturday mornings and includes highly motivating activities and discussions of the importance of mathematics to future occupational opportunities. An evaluation of the program from 1975 to 1981 showed that greater numbers of Black female students had enrolled in high level mathematics courses during that period than before the program was operating. In addition, the Minnesota Society of Civil Engineers has been involved in a mathematics tutoring program involving minority and female students. This program provides mentorship to students to encourage their pursuit of technical careers as well as to increase skills.

National Action Council for Minorities in Engineering (NACME)

NACME is a non-profit organization that serves to initiate, facilitate and develop programs and services that support Blacks, Mexican Americans, Puerto Ricans and American Indians on an educational path leading to a baccalaureate degree in engineering. NACME often acts as a catalyst for program development by helping to establish cooperative relationships between the schools, community, university, industry, and government.

As an enabling organization, NACME achieves its goals in a variety of ways. Its Incentive Grants Program is the nation's largest privately supported source of scholarship funds available to minorities in engineering. Its Field Services Program provides professional coordinators who offer experience-based technical assistance to precollege professional societies and minority organizations; and it invests funds directly with those groups who require seed money, support or enhancement for their activities. NACME also supports active research and publications programs which collect and disseminate statistics and information that impact on students, educators, government officials and corporate supporters. Though most of its efforts are concentrated at the high school and college level, NACME reaches junior high students and teachers with curriculum materials.

PRIME, INC.

PRIME works with the Philadelphia and Camden public schools, industry, colleges and the community to increase the participation of minorities in engineering, pharmacy and other mathematics and science-based professions. the program is school-based and provides services to students and teachers both during the school day and through extracurricular activities.

The program begins in seventh grade and continues through college. Within each participating junior high school, the top seventh grade and eighth grade classes are selected to enter the PRIME program. At ninth grade, with the transition into high school, new students can be admitted upon recommendation of teachers or counselors.

PRIME students must maintain a high grade point average and must take four years of prescribed mathematics and science courses. Since students are enrolled in seventh grade, counseling for course selection begins early to ensure that students are aware of future career opportunities, are guided to take the appropriate prerequisite courses, and maintain high grades.

PRIME views its role as supporting and supplementing the existing curricula by providing teachers with materials and consultation from professionals in industry and/or the university. At least once a month, outside consultants contact PRIME students and their teachers to conduct in-school demonstrations or discussions or to arrange out-of-school activities such as trips to local industry. In addition, PRIME operates an extensive summer program following seventh grade where students receive enrichment in subject areas on local college campuses. Although PRIME keeps longitudinal data on the progress of each student, no formal evaluation has yet been conducted.

Beginning this year PRIME is operating a new program for students in fourth through sixth grades. This program has a different orientation in that it is directed towards improving teachers knowledge and skills in science instruction rather than interacting directly with students. The program was developed in conjunction with the Franklin Institute and will provide teachers with hands-on experience with activities that illustrate science concepts and that are appropriate for use with their own classes.

Program for Rochester to Interest Students in Science and Math (PRISM)

In 1978, the Rochester Public Schools along with private industry developed an elementary and middle school program to increase the interest and skills of Black and Hispanic students in science. One of the products has been the development of a science curriculum for students in grades 7 and 8 which has recently received an award from the National Science Teachers Association. The curriculum stresses hands-on activities and trains students in experimental approaches to prepare them for high school laboratory work. Currently PRISM is focusing its efforts on high school students in grades 9 through 12.

Project SEED (Special Elementary Education for the Disadvantaged)

Project SEED brings professional mathematicians and scientists from industry and the university into public school classrooms on a daily basis to teach mathematics to disadvantaged elementary students, the majority of whom are from ethnic minority groups. The program, based in Berkeley, California, is a supplement to, not a replacement for, the regular mathematics curriculum.

SEED takes a new approach to remediation by avoiding material on which students have previously failed and by presenting math concepts within a discovery format to elicit student involvement and understanding. SEED instructors who have an indepth knowledge and appreciation for their subjects teach abstract mathematics concepts selected from high school and college algebra. It is believed that mastery of these concepts will bring with it enhanced confidence and interest in mathematics studies. At the same time, classroom teachers who are present during SEED classes gain in-service training in effective teaching methods and subject matter content.

The program is presently operating in sites throughout the country and has been evaluated by external, independent reviewers. Statewide evaluations in California and Michigan found that SEED students both improved their computational skills and demonstrated an ability to perform abstract mathematics. A more recent evaluation conducted by Educational Planners and Evaluators Associated found that SEED students nationwide achieved more than two months growth in arithmetic for each month they participated in the program.

Saturday Academy

The Saturday Academy is a joint venture of Bennett College, North Carolina A&T and Pembroke State Universities. A key feature of the program is the use of the computer as a motivational tool to teach mathematics, science, and computer literacy and communication skills to minority students, primarily Black and Native American children, in grades four through seven. Utilizing both commercial and teacher-made software, students are engaged in various activities including learning Logo and BASIC. Instruction is presented in a group-centered, highly interactive format that demands the active involvement of all students.

The academy brings participants to a college setting each Saturday morning for twelve weeks per session, two sessions per year. The sessions are taught by college faculty in the specific disciplines addressed. Each student has access to a microcomputer for a minimum of one hour per Saturday. Laboratory experiments, conducted in regular college laboratories, include pendulum motion, laser beams, dissection of a pig embryo and other topics to improve reasoning skills. In addition to building competencies, focus is also directed toward bringing parents together to discuss workable support structure in the home and highlighting community role models in science, engineering and related fields.

The Saturday Academy is one facet of the Accessing Mathematics-Based Careers (AM-BC) project piloted initially by the Ford Foundation. The second facet, the Intensive Summer Science Program (ISSP), addresses the same discipline areas but is a college resident program for ninth through twelfth grade minority students and women.

Saturday Science Academy

The Saturday Science Academy is an extracurricular program conducted at the Center for Science and Engineering at Atlanta University. Those attending are minority, predominantly Black students in grades three through eight. The program is concerned with increasing students' competence in, and developing more positive attitudes towards mathematics, science and computer science. The program operates for half a day on Saturday for 10-week sessions. Students are engaged in highly motivating activities including laboratory work, creative arts and dramatic activities, field trips and discussions with professionals from the community. The program operates two semesters per year and accommodates up to 400 students per semester. The staff includes doctoral level mathematicians and scientists as well as students from the Atlanta University. The program encourages parent participation as volunteers at the academy and during field trips.

Southeast Consortium for Minorities in Engineering (SECME)

The Southeastern Consortium for Minorities in Engineering is located on the campus of the Georgia Institute of Technology. SECME was established in 1975 by the Deans of Engineering from seven Southeastern universities. Today, SECME's network is the largest in the country, linking 23 universities and 50 corporations with 160 schools and more than 12,000 students in seven Southeastern states.

The program works within the existing education structure at the secondary school level. At each participating school, a SECME Team is formed to plan and carry out the program. The team usually includes the principal, a counselor, a math teacher, a science teacher, and an English teacher.

Team members are trained by SECME at a Summer Institute held for two weeks at a different engineering school campus each year. Education faculty join engineering school faculty and SECME staff to conduct the Institute which is designed to help attendees understand SECME's goals, to teach new methodology for curriculum enrichment, to use the microcomputer as an instructional tool, to explain the opportunities in the engineering profession and to review the requisites for successful engineering study. Participants work with their school system colleagues, engineering faculty and industry consultants to develop an implementation plan for their classrooms and to coordinate a SECME program in their home schools.

The local SECME program is a grassroots effort and typically has direct links with the faculty at an engineering school as well as support from community organizations. It raises cash and in-kind contributions from local sources and is often able to provide summer technical employment for students.

Student participants are identified as early as the sixth grade. Nominations come from teachers or counselors and include both those students who are achieving and those with the potential to achieve. Overall, more than 85% of graduating SECME seniors attend a college or university and more than half of those opt for engineering or other math-based pursuits.

Programs for Girls

We identified four programs specifically targeted at girls in grades four to eight; several of the minority programs included females as target populations, however, so girls may have been the recipients of more interventions than are indicated herein. Components of programs for girls were in some way similar to those for minorities, with role models and hands-on activities. In one important aspect they differed in stressing the importance of the all-female environment--an important contextual variable whose positive effects have been suggested but not recently investigated empirically for this age group.

Computer Equity Training Project

This two-year project operated by the Women's Action Alliance of New York City was funded in October 1983 by the Women's Educational Equity Act Program, U.S. Department of Education, to increase access to, and use of, computers by middle school female students. In the first year of the project, three middle schools participated as pilot sites; the objective of the pilot activities was to increase girls' voluntary use of computers. The Computer Equity Training project staff provided training and technical assistance to assist the schools to design, implement and evaluate their strategies. In the second year of the project, staff developed a manual based on effective strategies and field tested and these strategies in five new middle school sites. Girls at the three experimental schools increased their voluntary computer use by 144% over the 5 month field test period. There was little or no change in the control schools and no significant racial differences were found. Though the project has ended, strategies to encourage the use of computers are described in The Neuter Computer: Computers for Girls and Boys (Sanders and Stone, in press).

Expanding Your Horizons in Math and Science

Beginning in 1976 the Math/Science Network designed and supported a conference model for girls in grades 7 through 12 to increase interest in career opportunities in mathematics and science, and to develop contacts with professional women working in traditionally male fields. The Math/Science Network is an organization of professionals, educators, and community people interested in fostering the participation of women and young girls in science and mathematics-related fields.

The program operates through the Math/Science Resource Center at Mills College in Oakland, California. In 1985, over 23,000 students, 3,500 parents and teachers, and 3,800 women professionals in mathematics, science and engineering participated in 77 conferences. Of these meetings, 41 were held on college campuses outside the state of California. For groups who wish to conduct their own sessions, the center provides assistance through such materials as handouts for students and adults, press releases, fund raising information, and lists of Network members who could assist in planning or presenting at local conferences. Typically components include panel presentations by women in technical fields, "hands on" experience in mathematics, science or computer science activities and/or informal small group discussions.

On surveys completed immediately following these meetings, students have indicated an intention to take more science, mathematics and computer classes in high school and indicated a great knowledge of career opportunities in these fields. After six to nine months, students were found to have increased their coursework in these subject areas.

Math for Girls Project

This program conducts after school and weekend classes in mathematics, computer science and science for girls ages 6 to 14. This project is one of several programs operated at the Lawrence Hall of Science in Berkeley, California. A unique feature of the program is that activities are conducted in an all-female environment. Eight, one-and-a-half-hour, sessions are taught by university students who serve as role models to these younger students.

The program's goal is to instill positive attitudes toward mathematics and to increase problem-solving skills and logical thinking. Motivational activities and materials are used to demonstrate that mathematics can be fun and challenging.

No formal evaluation of this program has been conducted, though informal observation of girls within this setting has found them to participate more than in mixed sex environments.

Women and Mathematics: Visiting Lecturer program, sponsored by the Mathematics Association of America

Women and Mathematics (WAM) is a visiting lecturer program for girls in grades 8 through 12. It is similar to the Blacks and Mathematics (BAM) program also operated by the Mathematics Association of America. This program brings women from science and mathematics careers into the schools to speak with students, counselors and parents about opportunities for women in mathematics and mathematics-related careers. There is particular interest in holding discussions with adults as MAA recognizes the importance of adult influence on course selection and career choice and believes it is necessary to work with school personnel and parents as well as students. For students, WAM presence of women professionals discussing their experiences and encouraging girls to pursue mathematics-related careers serves as a realistic model for young students to emulate.

Programs for Educational Personnel and Parents

A large number of programs previously mentioned include educational personnel and/or parents within the scope of their activities. Three programs that have not been mentioned will be discussed.

EQUALS

EQUALS is an in-service program for teachers, administrators and counselors of students in grades kindergarten through 12 to promote nondiscriminatory practices in instruction and counseling. During the workshops, educators collect and analyze research findings on sex differences in mathematics participation and career aspirations, learn about mathematics-related careers, and participate in activities designed to motivate students' interest in mathematics and develop problem-solving skills. Additionally, participants are required to disseminate information derived from these sessions by planning and conducting workshops for other educators.

The EQUALS staff have also developed an inservice program dealing with computer technology. Incorporating many of the successful elements of the original EQUALS program, this project provides teachers with materials and strategies to encourage females and minority students to participate and succeed in computer courses. Teachers are made aware of differing attitudes toward computers by collecting data from their own students. They are then trained in hardware survival skills, classroom logistics, software evaluation and LOGO to develop their own competence and sensitize them to students' learning experiences.

The program has undergone a number of evaluations. A follow-up survey conducted in 1981 of all participants since 1977 indicated that a majority were still using EQUALS materials. Evaluation of the effects on students has revealed a modest improvement in attitudes toward mathematics and heightened interest in mathematics-related careers. The EQUALS staff at the University of California at Berkeley has been active in disseminating information about the program through direct training publishing project materials and making conference presentations. Additionally, through a Carnegie grant the staff is currently replicating the EQUALS program at six sites across the country. These sites conduct training and provide technical assistance to districts in their own regions.

Family Math Program

The program was originally designed for low income and/or minority families with children in grades kindergarten through eight. However, according to the EQUALS staff, who developed the program, it is applicable to, and used by, families of all income levels. The program emphasizes problem-solving skills within the context of daily life activities. It encourages parents to participate in activities that will complement school curricula. Parents are taught tasks to do with their children that provide "hands-on" mathematics experience using manipulative materials. Role models from the community discuss with participants their experiences in studying mathematics; they also describe varied career opportunities afforded by their continued mathematics study.

One of the most effective dissemination vehicles for minority families has been through programs conducted by teachers and/or parents initially trained at Berkeley. Though no formal evaluation has been conducted, 988 people have taken the two-day training course to learn how to teach Family Math and more than 300 classes for approximately 6,000 parents and children have been conducted as a result of this training.

Ideas for Equitable Computer Learning

Through a grant from the Women's Educational Equity Act Program, U. S. Department of Education, American Institutes for Research (AIR) in Palo Alto, California, operated a program designed to promote equal opportunities in computer use for students in elementary and middle school grades. The unique feature of this project was that it identified specific conditions which limit or facilitate students' access to and use of computers. Information on "critical incidents" or situations related to access and/or use were obtained through interviews with students, education personnel and parents. By collecting and examining individual events, patterns became apparent. Solutions to identified problems were developed by educators for educators, thus increasing the likelihood that changes would be effected. Though the project ended, the product, Ideas for Equitable Computer Learning (Schubert, Wolman, DuBois, and Eaton, 1984) is available from AIR.

Chapter 6: Summary and Recommendations

Summary of Findings

Our findings can be summarized as follows:

(1) Little recent research has been conducted that directly addresses either gender differences within ethnicity or gender-ethnicity interactions, or that examines the factors that are related to the achievement of minority girls, per se, in grades 4-8.

(2) The results of the studies that have been conducted indicate:

- o Ethnic, but not sex, differences in participation and performance in mathematics
- o Ethnic and sex differences in participation and performance in science
- o Ethnic and sex differences in participation in computers, and sex differences in performance.

(3) Virtually no empirical studies on the determinants of middle-school student participation in mathematics, science, or computer-related activities have been conducted.

(4) The primary focus of most empirical studies of factors related to participation and performance has been on affective factors rather than on policy-oriented factors.

(5) Policy-oriented factors found to directly affect performance included:

- o Student enrollment and participation in mathematics, science or technology classes
- o Adapting the language of instruction and assessment to take into account the student's language of origin, and adapting the assessment tools to take into account test domains, cultural bias, test familiarity and distractor type.

(6) Policy-oriented factors that indirectly affected performance included:

- o Out-of-school experience with mathematics, science or technology
- o Hands-on activities in science and use of "gender neutral" tasks
- o Reorganization of the classroom to permit and encourage peer learning

- o Providing opportunities for the students to develop positive expectations for their competence vis-a-vis mathematics, science and technology.

(7) The studies available for review were frequently flawed in two important ways:

- o Factors that were known to be correlated with gender or ethnicity were not held constant before conclusions regarding differences were drawn (for example, gender comparisons did not adjust for age differences between male and female students in the same grade; ethnic comparisons did not adjust for language or social class differences between ethnic groups).
- o Sex and ethnic differences in achievement were erroneously attributed to factors that, although associated with either gender or ethnicity, were actually uncorrelated with achievement.

(8) Few intervention programs directly addressed to minorities, females or minority females were found for students in grades 4-8.

It is very clear that performance differences are evident for a large segment of minority students beginning in elementary school years and that these differences escalate over time. Contextual factors including home, school, and community influences contribute to poor performance mitigating against the pursuit of advanced studies during high school years. Students are not encouraged nor are they prepared to enroll in courses which will increase their competence and afford them future positions in technical careers.

While the situation for females is distinct from minority students in a number of respects, there are also parallels. Unlike minority students, few performance differences exist for females in elementary and junior high school grades. However, as is the case for minority students, differing performance expectations are prevalent for girls, especially in junior high school years. Students, school personnel and parents reinforce the message that both groups are not expected to achieve in mathematics or science. This message is accompanied by others devaluing the importance of these subjects for females and minorities alike. Existing research for this age group which directly examines the relationship of affective factors to performance and participation is limited, especially for minority students. However, there is some evidence which suggests that specific and general performance expectations are related to future enrollment patterns and achievement for females.

There is no question that problems exist for each group and are compounded by membership in both. For both minorities and females experiences in elementary and junior high school years contribute to their failure to continue mathematics and science studies in high school thus limiting career opportunities and perpetuating disadvantaged status in society and the labor market.

Recommendations

In drafting our recommendations, we are cognizant of the tremendous scope and complexity of the problems facing minority and female students. We are also aware of limitations in available funding to address these concerns. Therefore, our recommendations are pragmatic, encompassing both support for existing intervention programs and for research on the conditions which promote effective strategies.

1. First, it appears critical to support effective intervention programs so they might continue their efforts and serve as models for replication in other communities. There are intervention programs which have demonstrated their effectiveness in improving students' performance and retention in mathematics and science studies. These programs need assistance to maintain and expand their activities.

2. Second, for those programs that have not yet been evaluated, there is a need to conduct formal studies. It is important to measure the impact of various strategies in order to strengthen existing approaches and to document their effectiveness. As an outcome of such activity, programs will not only become more effective they will also become more financially viable. Evidence of a program's ability to impact on students will enhance its chances of securing future funding.

3. Third, little attention has been directed to research on contextual variables which lend themselves to direct intervention. There certainly are indications both from the few available intervention studies and program reports that substantial changes in performance and participation can result from reorganizing the learning environment utilizing strategies such as cooperative groupings, hands-on activities, and mentoring. As we have also noted, there is considerable diversity in the operation and strategies employed by intervention programs. What is needed is to learn more about the conditions under which given strategies are most effective and to disseminate this information to administrative personnel and practitioners.

Tables

Table 2

SEX/ETHNIC DIFFERENCES IN PARTICIPATION FOR MATHEMATICS, SCIENCE, AND COMPUTER EDUCATION

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Mathematics					
Armstrong (1980)	1,452 students	13 years	82 schools	-Intended math participation	-No sex differences in planned amounts of high school math
Johnson (unpublished ms., 1981)	158 Black	Grades 7 & 8	6 classes	-Math activities and interest (9 items): How often do you... -read about math -watch TV math -attend math lectures -do non-required math projects -have math hobbies -solve math problems -talk to friends regarding math	-No grade or sex differences found ([illegible] reported means, however) -Overall activity rates were low, modal response for 2/3 of items was "seldom" or "never"; -Students report "always" or "often" for: read books on math, solve math problems, talk to friends about math

Table 2 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Science					
Hueftle, Rakow & Welch (1983)	684 White males 666 White females 210 Black males 228 Black females 172 Other ethnic	9 years	NAEP Science Assessment, 1981-1982	-Science experiences (including use of equipment and involvement in science activities)	For 9-year-old students concerning the number of reported science experiences: -W>B (~ 4.5%) -M>F (~ 2.5%) -Within ethnic groups, there is a slightly larger sex difference between White students (4% vs. 1%) than between Black students WM = 64% BM = 58% WF = 60% BF = 57%
	2824 White males 2957 White females 553 Black males 658 Black females 881 Other ethnic	13 years			For 13-year-old students: -W>B (~ 2%) -M>F (~ 3%) -Within ethnic groups, there is a slightly larger sex difference between White students (~ 5% vs 3%) than between Black students WM 58% BM 55% WF 53% BF 52%
Kahle & Lakes (1983)	17,345 students 25,653 students	9 years 13 years	NAEP assessment, 1976-1977	-Science experiences	-For both ages M>F in science experiences for every area surveyed, including science observations, instrument skills, field trips, experimental tasks and extracurricular activities -In examining data for 13-year-olds, though M>F in electrical or mechanical tasks, F>M in number of times they tried to work with an unhealthy plant or animal

Table 2 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Computer Education					
Collis (1984)	539 males 479 females	Grade 8	Victoria, BC Canada	-Use of computers to play games outside of school -Use of computers to do something else outside of school	-84.8% of males and 73.4% of females reported game use ($z = 4.02$, $p < .001$) -65.2% of males and 44.5% of females reported game use ($z = 5.77$, $p < .001$)
Demarest & McKenzie (unpublished ms., 1984)	112 males 111 females	Grades 3 & 4	All students in one district—enrolled in Logo program	-Ownership of computers	-48.5% of males and 31.1% of females reported home ownership
Fetler (1985)	293,717 students	Grade 6	California statewide testing, 1983	-Experience with computers	-M>F for home experience with computers (M=25%, F=20%) -M>F for reporting in school experience (M=71%, F=65%) -M=F in experience with drill and practice (13%) -M>F by 2-3% in writing programs, general information and simulations in math and science

Table 2 (continued)

Author & Year	Sample Characteristics: #/Ethnicity/Sex	Sample Characteristics: Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Computer Education					
Hess & Miura (1985)	5,533 students (Of the total sample 3,217 students	Grades 1-12 Grades 5-8)	23 computer camps	-Enrollment in computer camps	-For total sample, enrollment constituted 2% low income and 98% middle to high income; 9% minority (5% Asian, 2.5% Black, 1.0% Hispanic, 0.5% Other) and 91% White -The more expensive the camp, the fewer the females -The more advanced the course, the fewer the females
Korpi (personal communication, 1984)	249 males 141 females	Junior high school	Luehrmann and Peckman's computer literacy course, enrollment not required, 6 schools, 12 classes	-Enrollment in computer literacy course	-M>F in course enrollment (64% to 36%)
Kurshan & Williams (1984)	42 males 58 females (23% Black 77% White)	Grade 7	School 1, computers used in Grade 7 math classes	-Exposure to computers	-M>F for taking computer courses (23% to 11%) and writing programs (24% to 14%)
	49 males 62 females (26% Black 75% White)	Grade 7	School 2, no computers in classrooms		
Lockheed (1984)	42 males 45 females	Grades 7 & 8	Oregon	-Constructed student questionnaire: computer class participation	At pretest: -In Oregon, M>F in enrollment in computer classes, t (85) = 4.33, p<.01; (M=64%, F=22%) -In Wisconsin, F>M in computer class enrollment, but difference not significant, (F=45%, M=41%)
	106 males 95 females	Grades 7 & 8	Wisconsin Women's Action Alliance Computer Equity Project operating in both sites		

Table 2 (continued)

Author& Year	Sample Characteristics #/Ethnicity/Sex	 Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Computer Education					
McKelvey (1984)	230 males 220 females	Grades 2 & 8	Toronto, Ontario, Canada	-Extracurricular computer use	-34 of 230 males used computers in extracurricular time -3 of 220 females used computers in extracurricular time
NAEP (unpub- lished data, 1984)	1533 males 1526 females (2230 White 436 Black 306 Hispanic 87 Other)	Grade 8	NAEP assessment, 1983-1984	Student questionnaire -Home computer use	-M>F in home computer use $\bar{x}_m$ = 37.7%, $\bar{x}_f$ = 25.8% -W B>O*>H in home computer use $\bar{x}_B$ = 32.5%, $\bar{x}_W$ = 32.1% $\bar{x}_O$ = 30.3%, $\bar{x}_H$ = 26.5%
	9165 males 9550 females (13534 White 2487 Black 2070 Hispanic 626 Other)			-Computer class participation	-M>F for computer class participation once per week $\bar{x}_m$ = 20.3%, $\bar{x}_f$ = 16.5% -W B>O>H for computer class participation once per week $\bar{x}_W$ = 18.9%, $\bar{x}_B$ = 18.1% $\bar{x}_O$ = 18.7%, $\bar{x}_H$ = 13.8%
	1131 males 1148 females (1628 White 297 Black 274 Hispanic 80 Other)			-Extracurricular computer use	-M>F in extracurricular computer use at least once per week $\bar{x}_m$ = 30.7%, $\bar{x}_f$ = 24.8% -B>W>H>O in extracurricular computer use at least once per $\bar{x}_B$ = 29.6%, $\bar{x}_W$ = 28.7% $\bar{x}_H$ = 20.3%, $\bar{x}_O$ = 18.9%
	1725 males 1625 females (2464 White 498 Black 340 Hispanic 98 Other)			-Frequency of school use	-M>F for school use of computers at least once per week $\bar{x}_m$ 27%, $\bar{x}_f$ 20% -O>W>B>H for school use of $\bar{x}_O$ 29%, $\bar{x}_W$ 25% $\bar{x}_B$ 23%, $\bar{x}_H$ 17% *Other = Other ethnic

Table 2 (continued)

	Sample Characteristics		Setting/Experimental	Dependent	
Author& Year	#/Ethnicity/Sex	Age/Grade	Condition	Variable/Measure	Findings/Results
Computer Education					
Revelle, Honey Amsel, Schauble, & Levine (1984)	185 males 35 females	Mean age= 13 years (range=7-19 years)	Computer camp	-Frequency of computer use -Home computer use -School computer use -Family ownership -Applications	-Frequency of use: M>F $\bar{x}_m = 3.77$, $\bar{x}_f = 2.0$[illegible] ($F=37.2$, $p<.001$) -Home use: M>F 71%M, 43%F $X^2 = 9.1$, $p<.01$ -School use: M>F 81%M, 60%F $X^2 = 6.4$, $p<.05$ -No sex difference in family ownership -No sex difference in precamp use of any language other than BASIC -No sex difference in applications other than games (91%M and 63%F played games), no difference in use for art, drill and practice, creating games, word processing, or music

Table 3

MATH PERFORMANCE

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Armstrong (1980)	1,452 students	13 years	Women in Mathematics National Survey, 82 schools	-Computation -Algebra -Problem solving -Spatial visualization (% of correct responses)	-F>M in spatial visualization $\bar{x}_m$=51.5, $\bar{x}_f$=56.6, $p<.05$ -F>M in computation $\bar{x}_m$=48.3, $\bar{x}_f$=53.6, $p<.05$ -No sex differences in problem solving or algebra
Benbow & Stanley (1983)	19,883 males 19,937 females (ethnicity not specified)	Grade 7	National Search	-Scholastic Aptitude Test: Math	-For scores of SAT-M, M>F at all levels: N — % of Total 420 or more: M 9119 — 45.9% F 6220 — 31.2% 500+: M 3618 — 18.2 F 1707 — 8.6 600+: M 648 — 3.3 F 158 — 0.8 700+: M 260 F 20
Bookman & Iwanicki (1983)	180 White	Grade 8	Suburban junior high in Hartford, CN; 2 methods of test preparation and a control condition	-Competency Test of Basic Skills: Math	-No sex effect and no sex by treatment interaction
Boswell & Katz (1980)	109 White males 110 White females	Grade 7	Boulder Valley school district	-McGraw-Hill Test of Basic Aptitudes: Math	-No significant sex effect

Table 3 (continued)

Author & Year	Sample Characteristics		Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
	#/Ethnicity/Sex	Age/Grade			
Sex Effects					
Bush (1976)	263 students	Grade 8	12 classrooms	-Constructed test of quantitative	-M>F quantitative concepts derived from history textbooks
California Assessment (1982)	293,281 students	Grade 6	California statewide testing, 1981-82	-Survey of Basic Skills	-M>F on 11/15 problem types. -M>F on application problems, but F>M on problem analysis (i.e., identifying relevant information, estimating answers, and identifying appropriate math model. Therefore, girls know how to solve problems, but they are not applying these skills. -Biggest differences in favor of males was measurement. [Note: Ethnic information not reported]
Creswell & Exezidis (1982)	42 males 70 females (61 Black and 51 Mexican-American)	Unspecified "adolescents"	One school in Houston, TX; low SES	-Iowa Test of Basic Skills: Math	-Sex was not a significant contributor to math performance
Creswell & Houston (1980)	25 Black males 25 Black females 25 Anglo males 25 Anglo females 25 Chicano males 25 Chicano females	Grade 8	Houston, TX; random selection of students; all SES levels included	-Iowa Test of Basic Skills: Math	-Sex was not a significant contributor to math performance

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Crosswhite, Dossey, & Swafford (1984)	7,500 students	Grade 8	600 U.S. Math classrooms; Second International Mathematics Study (IAEA), 1981-1982	-Algebra -Arithmetic -Geometry -Measurement -Probability -Statistics	-No sex differences at 8th grade -Differences of only 2% at most separated males from females on subtests; no difference in overall achievement. -No significant differences found in calculation or problem solving
Fennema & Sherman (1978)	1,320 students (predominantly White)	Grades 6-8	Middle schools in Madison, WI; (bottom 15% of students omitted from study); predominantly middle class population	-Math Concepts Test -Math Computation Test -Romberg-Wearne Problem Solving Test -Spatial Relations Test -Stanford Mathematics Achievement Test	-No significant main effects for math computation, math concepts, applications, problem solving, or spatial visualization -Significant sex by geographic area interactions found -F>M in computations for school area 4 (differences < 1/3SD); M>F in applications and problem solving for school area 3, a high SES area (differences ranged from 1/4 to 1/2 S.D.)
Fendrich-Salowey, Buchanan, Drew (1982)	12 females on grade level 12 females 30% < grade level 12 males on grade level 12 males 30% < grade level (primarily White)	Grades 5 and 6	One elementary school in Salt Lake City, Utah (students selected by use of stratified random sampling)	-Stanford Diagnostic Arithmetic Test: .Math counting .Math operations	-No sex differences for students at or below grade level

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Hannafin (1983)	19 Hispanic males 17 Hispanic females 29 Anglo males 20 Anglo females	Grade 6	Traditional instruction vs. "Instructional system": hierarchically sequenced set of math computational skills	-40-item constructed response test: .Whole numbers .Adding decimals .Subtracting decimals .Adding fractions .Subtracting fractions	-No sex main effect for any subject
Jacobowitz (1983)	113 Black males 148 Black females	Grade 8	Inner city junior high school	-Math grade	-No significant sex difference
Jones, Burton, & Davenport (1982)	8,000 White 1,200 Black	13 years	Special NAEP assessment of mathematics, 1975-76	40 math exercises	-No significant sex differences for either ethnic group at age 13
Kagan & Zahn (1975)	29 Anglo students 9 Mexican-American students	Grade 2	Semi-rural, lower income elementary schools	-Comprehensive Test of Basic Skills: Math -Grade equivalent score	-No sex effect for math
	37 Anglo students 11 Mexican-American students	Grade 4			
	27 Anglo students 21 Mexican-American students	Grade 6			

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Latorre, Yu, Fortin, & Marrache (1983)	20 masculine males 19 undifferentiated males 25 feminine males 19 masculine females 18 undifferentiated females 14 feminine females	First year junior high school (grade not specified)	Predominantly English speaking school in Canada	-Math grade	-No differences in math grades by biological sex or gender role, although means for masculine males and feminine females were higher ($\bar{x}$=78.5) than for masculine females and feminine males ($\bar{x}$=71.5)
Linn & Pulos (1983)	145 males 159 females	Grade 7	3 school districts in California	-Balance puzzle: proportional reasoning	-Controlling for district, courses taken, vocabulary, general fluid visualization, familiar field and formal reasoning, sex was not related (F=2.89, n.s.) to proportional reasoning
Marshall (1984)	144,462 males 142,305 females (All fluent English speakers)	Grade 6	California Assessment Program, 1979	-Survey of Basic Skills: .Story problems .Math computations (Response patterns and probability of correct response)	-Females > males on computations, for all levels of reading ability -Males > females on story problems for all levels of reading ability -Sex differences, while consistent, were slight (∿ 2-5% probability of correct response) -No interaction between SES, language and sex

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	 Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Marshall (1983)	166,204 males 163,868 females 157,013 males 153,710 females 148,801 males 145,647 females 144,462 males 142,305 females	Grade 6 Grade 6 Grade 6 Grade 6	1976 California Assessment Program 1977 California Assessment Program 1978 California Assessment Program 1979 California Assessment Program	-Distractors in 160 multiple-choice math items (Correct responses excluded)	-Consistent sex differences in responses to all but 19 of the 160 items -Sex by distractor interaction -F>M in number and type of errors: -Language/semantics: F>M in confusion of meaning M>F errors in translation -Spatial visualization: F>M units of scale on graph F=M confusion of geometric shape -Mastery: F>M choice of operations -Faulty associations: F>M number patterns M>F perseverance F>M word associations M>F interference (one formula for another) F>M interference (horizontal vs. vertical)
Moskowitz, Malvin, Schaeffer, Schaps (1983)	33 males 38 females 37 males 39 females 38 males 39 females 23 males 24 females	Grade 5 Grade 6 Grade 5 Grade 6	2 "cooperative" classrooms 2 control classrooms middle class, suburban California district	-Stanford Achievement Test: Math	-No significant sex differences -No significant sex by treatment interactions

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Myers & Milne (1982)	15,579 (91.3% English) 1.4% Spanish 6.7% Spanish/ English 0.7% Italian/ English)	Grade 1-6	Sustaining Effects study of Title I 242 schools	-Comprehensive Test of Basic Skills: Math	-Significant sex effect (F=122.1, p<.001) F>M ($\bar{x}_f$=49.3, $\bar{x}_m$=46.7)
NAEP Report (1983)	14,752 students 13,947 students 26,661 students 15,758 students	9 years 13 years	NAEP math assessment 1977-1978, 1981-1982	-Knowledge -Skills -Understanding -Applications	-No sex differences for 9- or 13-year-olds for total math performance in 1978 or 1982 In 1982, at both ages M>F in applications by 1% point and F>M in skills by 1%; at age 9, F>M in knowledge by 2% points.
Nelson, Knight, Kagan, & Gumbiner (1980)	45 Anglo students 125 Mexican-American students	Grades 4, 5, and 6	Lower income elementary school	-California Test of Basic Skills: Math	-No significant sex differences in any variable
Nelson (1979)	Black students (no numbers given)	Grade 5	All black elementary school, New Orleans, Louisiana	-SRA Achievement Series: Math	-No significant sex differences
Paulsen & Johnson (1983)	57 males 54 females 49 males 49 females (predominantly White)	Grade 4 Grade 8	2 elementary and 1 junior high in high SES area; voluntary recruitment of homerooms; among criteria to participate was English as primary language	-Stanford Math Achievement Test	-No significant sex differences in math achievement at either grade or across grades

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Powers, Thompson, Azevedo, & Schaad (1983)	Cohort I 48 Black males 68 Bla k females 68 White males 48 White females Cohort II 47 Black males 50 Black females 56 White males 41 White females	First tested in 6th grade; followed up in 8th grade	Large urban district in Southwest; Longitudinal Study	-California Achievement Test: Math	-Controlling for Stanford Achievement Tests for Advanced Math and Intermediate Math: -Significant sex effect in Cohort I; however, there was a tendency to underpredict the performance of females and to overpredict the performance of males -For Cohort II, no sex effects [Note: No coefficients were provided]

Table 3 (continued)

Author & Year	Sample Characteristics: #/Ethnicity/Sex	Sample Characteristics: Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Pulos, Stage, & Karplus (1982)	57 males 45 females 46% Black, 30% Asian, 5% Hispanic, 18% White	Grade 8	4 schools: 3 predominantly minority urban schools, 4th school predominantly White, middle class (All tests individually administered)	-Lemonade puzzle: Proportional reasoning -Number puzzles: Reasoning with unknowns -Paper folding puzzles: Spatial reasoning	-No sex differences in proportional reasoning, reasoning with unknowns, or spatial reasoning -Strong site effects on all measures -No sex by site interactions
	44 males 39 females 30% Black, 40% Asian, 17% Hispanic, 9% White	Grade 8			
	42 males 33 females 51% Black, 4% Asian, 35% Hispanic, 8% White	Grade 8			
	30 males 30 females 58% White, 21% Black, 14% Asian, 7% Hispanic	Grade 8			
Sherman (1980)	135 females 75 males	Tested at Grade 8 and again at Grade 11	High school Longitudinal Study	For grade 8: -Mathematical Concepts Test -Romberg-Wearne Problem Solving Test For Grade 11: -Basic Mathematics Concepts -Mental Arithmetic Problems	-In grade 8: -no sex difference in math problem solving or math concepts; -In grade 11: -M>F for problem solving, $\bar{x}_m$=13.97, $\bar{x}_f$=12.10, t=8.94, p<.01 -For math concepts, $\bar{x}_m$=41.75, $\bar{x}_f$=37.32, t=10.50, p<.01

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Strauch (1977)	50,000 students 50,000 students	Grade 5 Grade 8	Statewide testing in Pennsylvania	-Educational Quality Assessment: .Arithmetic skills .Measurement .Geometry .Algebraic notation .Number concepts	In 5th grade math: -No sex effect -No interactions -In 8th grade math: -Sex effect $p<.05$, -No interactions [Note: means not provided and other factors such as region, size of school, etc., not considered]
Tsai & Walberg (1983)	1,206 males 1,117 females (1,840 White 335 Black 130 Hispanic 12 Asian)	13 years	NAEP math assessment, 1977-78	-74 math items with high internal consistency ($\alpha=.92$): .Numbers and numeration .Variables and relationships .Geometry .Measurement .Other topics	-F>M in achievement ($\bar{x}_f = 41.72$, $\bar{x}_m = 40.57$, $F=5.42$, $p>.05$); -No sex within ethnic breakdown but both sex and ethnicity are significant when considered simultaneously in multiple regression
Webb (1984)	44 males 33 female (26% minority)	Grades 7 and 8		-20-item achievement test on exponents and scientific notation	-Significant sex differences in achievement: M>F ($\bar{x}_m=13.6$, $\bar{x}_f=11.1$, $t=3.37$, $p<.01$)

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Ethnic Effects					
Anick, Carpenter, & Smith (1981)	70,000 students	9, 13, and 17 years	NAEP math assessments 1973, 1978	-Total math score for exercises including: .Numbers and numeration .Variables and relationships .Geometry .Measurement .Other topics (probability, statistics, graphs, tables)	For 1977-78 assessment: -Black and Hispanic performance significantly below the national average at each age level -At age 9, Blacks < nation by 11 points -At age 13, Blacks < nation by 15 points -The performance of Hispanic students was similar, but less pronounced. The pattern of performance of Blacks and Hispanics paralleled the nation. While computation was reasonably good, students had difficulty with math concepts in geometry, measurement, probability, and statistics. They also had difficulty with tables and graphs and need help to improve problem solving skills. -At age 9, Hispanics < nation by 9 points -At age 13, Hispanics < nation by 12 points -Analysis of the change in performance from 1973 to 1978 shows some slight decrease in the difference from the national score at each age group for Blacks (4% at year 9; 2% at age 13). The change in score is modest for Hispanics (2% at age 9; 0% at age 13)

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Ethnic Effects					
Anick, Carpenter, & Smith (1981) (continued)					Affective Response -In contrast to their enrollment patterns in high school, Black students at all ages are equal to or exceed the nation in indicating that they like math
Creswell & Exezidis (1982)	42 males 70 females (61 Black and 51 Mexican-American)	Unspecified "adolescents"	Houston, TX; low SES	-Unspecified standardized math achievement test administered district-wide	-Ethnicity significant ($\underline{r}^2$=12) Mexican-Americans > Blacks in math achievement
Creswell & Houston (1980)	25 Black males 25 Black female 25 Anglo males 25 Anglo females 25 Chicano males 25 Chicano females	Grade 8	Houston, TX; random selection of students; all SES levels included	-Iowa Test of Basic Skills: Math	-Ethnicity contributed 5% ($p<.01$) to math performance [Note: Neither means for ethnic groups nor comparative differences are reported.]
Hannafin (1983)	19 Hispanic males 17 Hispanic females 29 White males 20 White females	Grade 6	Traditional instruction vs. "Instructional system": hierarchically sequenced set of math computational skills	-40-item constructed response test: .Whole numbers .Adding decimals .Subtracting decimals .Adding fractions .Subtracting fractions	-Significant ethnicity main effects for all subtests ($p<.001$) in favor of Whites: Whole numbers $\bar{x}_W$=18.43, $\bar{x}_H$=16.78 Adding decimals $\bar{x}_W$=4.19, $\bar{x}_H$=2.99 Subtracting decimals $\bar{x}_W$=3.52, $\bar{x}_H$=2.36 Adding fractions $\bar{x}_W$=3.91, $\bar{x}_H$=2.51 Subtracting fractions $\bar{x}_W$=3.33, $\bar{x}_H$=2.51

Table 3 (continued)

Author & Year	Sample Characteristics: #/Ethnicity/Sex	Sample Characteristics: Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Ethnic Effects					
Hare (1980)	67 Black females 224 White females 50 Black males 241 White males	Grade 5	Champaign, Illinois, all 5th graders in district who consented to participate and were present	-Unspecified standardized achievement test administered district-wide	-Ethnic differences for math achievement favoring whites White: $\bar{x}_m$=48.70, $\bar{x}_f$=46.43 Black: $\bar{x}_m$=24.48, $\bar{x}_f$=31.96
Holmes (1982)	Total sample 80,000 students. Of these, 2,500 at each age (400 Black 125 Hispanic 50 Asian 50 Native American 1,925 White)	9 & 13 years	NAEP math assessment, 1977-78	-Difference between Black and national performance in passing; unit of analysis is the number of items with national % pass of 50% or better: 193 math items for 9-year-olds, 337 math items for 13-year-olds	-At 9 and 13 years of age Blacks performed well below national performance in math -9-year-old Black students had difficulty with knowledge items (50% of the items were in this domain). Numbers and numeration, other topics and measurement were also troublesome. About 25% of the items are in other topics area. This area includes items which assess skills, understanding, and applications indicating problems in these skills as well. -For 13-year-old Black students performance in numbers and numeration and measurement was improved over 9-year-old level, but greater discrepancies in performance occurred for geometry and other topics.

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Ethnic Effects					
Holmes (1982) (continued)					-For 13-year-olds, 25% of items were in skills, and the remainder were equally divided between understanding and applications domains. [Note: unequal distribution items within taxonomy of skills at both ages]
Jones, Burton, & Davenport (1982)	8,000 White 1,200 Black	13 years	Special NAEP assessment of mathematics, 1975-76	40 math exercises	-Significant ethnic effects at 13, Whites > Blacks by 18% points in sample 1 and 17% points in sample 2 -Variance in achievement scores larger for White males relative to White females. No significant difference in variance for male vs. female Black students
Kagan, Zahn, & Gealy (1977)	144 Anglo 86 Mexican-American (approximately equal sex distribution)	Grades K-2, 4, and 6 (numbers by grade not available)	Semirural, low-income school in California	-Comprehensive Test of Basic Skills: Math and Reading Subtests	-Anglo > Mexican-American for math at 4th, for reading at 6th
Kagan & Zahn (1975)	37 Anglo 11 Mexican-American 27 Anglo 21 Mexican-American students	Grade 4 Grade 6	Semirural, low-income elementary school in California	-Comprehensive Test of Basic Skills: Math	-Significant ethnic effects (A>MA, $F=5.08$, $p<.05$) =.11, which increase across grades For 4th grade: $\bar{x}_A=3.42$, $\bar{x}_{MA}=3.24$ For 6th grade: $\bar{x}_A=5.26$, $\bar{x}_{MA}=4.65$

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Ethnic Effects					
NAEP Report (1983)	14,752 students 13,947 students 26,661 students 15,758 students	9 years 13 years	NAEP math assessment 1977-1978, 1981-1982	-Knowledge -Skills -Understanding -Applications	-Whites > Hispanics > Blacks at both periods. Slightly greater differences in math achievement among 13-year-olds though this age group has made greater gains from 1978 to 1982. [Note: Within disadvantaged urban communities (and minority schools) where a large number of Black and Hispanic students reside, performance is substantially reduced.]
Nelson, Knight, Kagan, & Gumbiner (1980)	45 Anglo students 125 Mexican-American students	Grades 4, 5, and 6	Lower income elementary school	-California Test of Basic Skills: Math	-Mexican-American students performed at grade level in math, and Anglos performed at .91 above grade level
Ng & Tsang (1980)	52 White 39 Chinese-American 37 Hong Kong Chinese 56 White 65 Chinese-American 82 Hong Kong Chinese	Grade 7 Grade 8	High/mid SES	-Constructed test of ability: .Computation .Concepts .Applications .Arithmetic reasoning -Constructed test of reading ability: .Missing words (English and Chinese versions)	-For all tests means for Hong Kong Chinese > Chinese-American > White Comp. / Concepts / Arith. Anglo 12.5 / 8.5 / 7.2 Ch. Am. 13.5 / 9.3 / 7.5 Hong Kong 14.1 / 9.7 / 9.0 On the basis of their performance on the 3 math tests, the distribution of students in high vs. low ability groups revealed a greater number of

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Ethnic Effects					
Ng & Tsang (1980) (continued)				-Constructed test of mathematical cognitive structure: .Word association test .Sorting test	Chinese and Hong Kong Chinese in the high ability group: 44 low and 64 high Anglo 32 low and 72 high Chinese-American 12 low and 107 high Hong Kong Chinese
Powers, Thompson, Azevedo, & Schaad (1983)	Cohort I 48 Black males 68 Black females 68 White males 48 White females	First tested in 6th grade, followed up in 8th grade	Large urban district in southwest, Longitudinal Study	-California Achievement Test: Math Math score	-Controlling for Stanford Achievement Test of Advanced and Intermediate Math, no significant ethnic effects in Cohort I and II
	Cohort II 47 Black males 50 Black females 56 White males 41 White females	First tested in 6th grade followed up in 8th and 9th grades			
Strauch (1977)	152,944 students (95% White)	Grades 5, 8	Statewide testing in Pennsylvania	-Educational Quality Assessment: .Arithmetic skills .Measurement .Geometry .Algebraic notation .Number concepts	For 5th grade math: -Significant ethnic effect ($p<.001$) -No interactions For 8th grade math: -Ethnicity effect ($p<.001$) -SES effects ($p<.001$) -No interactions [Note: Means not provided, and other factors such as region, size of school, etc., not considered]

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Ethnic Effects					
Tsai & Walberg (1983)	1,206 males 1,117 females (1,840 White 335 Black 130 Hispanic 12 Asian)	13 years	NAEP math assessment, 1977-1978	-74 math items with high internal consistency (=.92): .Numbers and numeration .Variables and relationships .Geometry .Measurement .Other topics	-Ethnic differences W>A>H>B: $\bar{x}_W$=43.64, $\bar{x}_A$=40.33, $\bar{x}_H$=32.95, $\bar{x}_B$=30.59 F=99.08, (p<.01) -No sex within ethnic breakdown given, but both sex and ethnicity significant when considered simultaneously in multiple regression

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex/Ethnic Effects					
Hannafin (1983)	19 Hispanic males 17 Hispanic females 29 Anglo males 20 Anglo females	Grade 6	Traditional instruction vs. "Instructional system": hierarchically sequenced set of math computational skills	-40-item constructed response test: .Whole numbers .Adding decimals .Subtracting decimals .Adding fractions .Subtracting fractions .Computational	-No sex by ethnic interactions for any subtest -No sex by treatment or ethnic by treatment interactions -No sex by ethnic by treatment interactions
Hare (1979)	67 Black females 224 White females 50 Black males 241 White males	Grade 5	90% of enrolled 5th graders Champaign, IL	-Unspecified standardized achievement test administered district wide	-For Black students, F>M math achievement $p<.05$; $\bar{x}_{Bf}=31.96$, $\bar{x}_{Bm}=24.48$; -No difference in math achievement for Whites.
Jones, Burton, & Davenport (1982)	8,000 White 12,000 Black	13 years	Special NAEP assessment of mathematics for 13 and 17 year olds, 1975-1976; 2 samples studied at each age.	-40 math exercises score = % correct	-No significant sex differences for either ethnic group at age 13, but White males more variable than White females -Significant ethnic effects at age 13, Whites > Blacks by 18% points in sample 1 and 17% points in sample 2.

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex/Ethnic Effects					
Langer, Kalk, & Searls (1984)	97,000 White 17,000 Black	9, 13, 17 years	NAEP math assessment 1974-75, 1976-77, 1977-78	-Combined math, science, and reading score (ratio of correct responses to attempted exercises)	For age 9, White students: -Controlling for class age, relative age, parental education, home environment, region, and type of community, sex not related to achievement; all other factors significant For age 9, Black students: -Controlling for other factors, sex negatively related to achievement; (β =-.045, F=6.6, p<.01) all other factors significant. For age 13, White students: -Controlling for other factors, sex positively related (β =.023, F=9.4, p<.01) to achievement; all others significant except age For age 13, Black students: -Controlling for other factors, sex not related to achievement; all others significant [Note: Study finds more Blacks and more males who have been retained one grade. Proportion who belong in modal grade (by age) but have been retained one grade: White: 9 / 13; Black: 9 / 13 Male .18 .21 .23 .31 Female .11 .12 .15 .21]

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex/Ethnic Effects					
Marshall (1984)	144,462 males 142,305 females (All fluent English speakers. Hispanic, Anglo, and Asian students)	Grade 6	California Assessment 1979 Program	-Survey of Basic Skills: .Solving computations .Story problems (response patterns and probability of correct response)	-Females > males on computations for all levels of reading ability -Males > females on story problems for all levels of reading ability -Same results found for all levels of SES (teacher rating of unskilled, semi-skilled, semi-professional, professional) -Same results found for primary language of Spanish and English -For Asian students, M=F on computations; M>F on story problems -Asian speakers were highest performers -For all groups sex differences, while consistent, were slight (∿ 2-5% probability of correct response) -No interaction between SES, language, and sex

Table 3 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex/Ethnic Effects					
Strauch (1977)	50,000 students 50,000 students (95% White)	Grade 5 Grade 8	Statewide testing in Pennsylvania 1974	-Educational Quality Assessment: .Arithmetic .Measurement .Geometry .Algebraic notation .Number concepts	For 5th Grade math: -No sex effect but significant ethnic effects ($p<.001$) -No interactions For 8th grade math: -Sex effect ($p<.05$) -Ethnicity effect ($p<.001$) -SES effect ($p<.001$) -No interactions. [Note: means not provided, & other factors such as region, size of school, etc., were not considered]

Table 4

SCIENCE PERFORMANCE

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Bin Abdullah & Lowell (1981)	24 males 24 females	Grade 5	Newfoundland	-Ability to generalize "Insect" and "Animal"	-No significant sex effect found for ability to generalize either concept
Graybill (1975)	3 males 3 females 3 males 3 females 3 males 3 females	9 years 11 years 13 years	4 Piagetian tasks	-Rating on level of Piagetian development for 4 tasks: .Equal angles .Floating bodies .Rods .Chemical combinations	-For all tasks, males were rated as more developed [Note: "Boys always appeared more confident in handling the equipment and more sure in their movements."]
Harlen, Black, Johnson, & Palacio (1983)	1,600 to 2,500 students for each subcategory	11 years	England, Wales, and Northern Ireland Science in Schools Study (1981); Activity based science assessment	-Reading and representing information from graphs, tables, and charts -Using apparatus and measurement instruments -Observation -Interpretation and application -Design of investigation -Performance of investigation	-F>M in planning investigations (this task required an extended written response) $\bar{x}_f$=42.1, $\bar{x}_m$=38.1 -M>F in application of knowledge of scientific facts and principles in the physical science area, $\bar{x}_f$=34.3, $\bar{x}_m$=36.5 -M=F in application in the biological concepts area, -M=F for symbolic representation, observation, and interpreting presented information when relevant facts are contained in questions

Table 4 (continued)

Author & Year	Sample Characteristics: #/Ethnicity/Sex	Sample Characteristics: Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Howe & Shayer (1981)	29 White males 35 White females	10 years	Three intact classes in Bedfordshire, England	-Volume and heaviness (conservation of substance, conservation of weight, density, and volume, displacement of volume, size); tasks rated on 1-6 scale corresponding to Piagetian levels of development	-Pretest: M>F ($\bar{x}_m$ = 3.8, $\bar{x}_f$ = 3.1) $\underline{t}$=2.54, p<.01 -Posttest: M>F ($\bar{x}_m$=4.2, $\bar{x}_f$=3.9)
	25 females 22 males	Grade 4	2 intact classrooms in Austin, Texas	-11-item task of volume and density, converted to 1-6 scale	-Pretest: M>F ($\bar{x}_m$=3.8, $\bar{x}_f$=2.9) $\underline{t}$=2.68, $\underline{p}$<.01 -Posttest: M>F ($\bar{x}_m$=4.6, $\bar{x}_f$=3.9) [Note: No test of mean posttest difference.]
Hueftle, Rakow, & Welch (1983)	684 White males 666 White females 210 Black males 228 Black females 172 Other ethnic	9 years	NAEP science asessment, 1981-1982	-For 9-year-olds: .Inquiry .Science, technology, and society	For 9-year-old students: -Within the inquiry domain there are no overall differences in % correct, M=52.8%, F=52.5%. Some sex differences appear by item type. No differences in ability to draw conclusions

Table 4 (continued)

Author & Year	Sample Characteristics: #/Ethnicity/Sex	Sample Characteristics: Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Hueftle, Rakow, & Welch (1983) (continued)	684 White males 666 White females 210 Black males 228 Black females 172 Other ethnic	9 years	NAEP science assessment, 1981-1982	-For 9-year-olds: .Inquiry .Science, technology, and society	and generalizations; M>F ($\sim$3%) in uses of scientific method. F>M (5.6%) in classification -Within science, technology and self-domain, no significant differences, M$\simeq$F overall; For item types within this domain F>M on health and nutrition items and M>F on remaining items including applied technology items
	2,824 White males 2,957 White females 553 Black males 658 Black females 881 Other ethnic	13 years		-For 13-year-olds: .Science content .Inquiry .Science, technology, and society	-For 13-year-olds: -M$\simeq$F on inquiry items, M=54.5%, F=55% -Within science content domain M>F on biology ($\sim$3%), physical science ($\sim$7%) and earth science (3%) -Within science, technology, and society M>F on societal problems ($\sim$4.7%) and applied science and technology ($\sim$5.7%); M$\simeq$F on science and self
Jacobowitz (1983)	113 Black males 148 Black females	Grade 8	Inner city junior high	-Science grade	-No significant sex difference
Lazarowitz (1981)	43 Israeli males 128 Israeli females	Grade 7		-Biological Classification Ability Instrument: classifying and naming plants, animals, etc.	-No significant sex difference [Note: Sample sizes differ for males and females.]

Table 4 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Linn & Pulos (1983)	145 males 159 females	Grade 7	3 school districts in California	-Predicting Displaced Volume Test	-Sex differences in predicting displaced volume found in favor of males -Males used correct volume strategies more often, and were therefore successful
Lynch & Paterson (1980)	481 students 504 students	Grade 7 Grade 8	Tasmania	-16 concept words in science (K-R=.71) as multiple-choice and as free response items (mass, length, area, volume; solid, liquid, gas; element, compound, mixture; atom molecule, ion, electron, proton, neutron)	-For 7th grade: Significant sex differences for 6 of 18 items: atom, molecule, ion, solid, liquid, volume, compound, mixture. [Note:for molecule F>M; for all others, M>F. [No [illegible] provided] -From [illegible] gures, the sex difference appears to be generally about 5% -Though statistical analyses were not conducted for 8th grade students, males appear to retain a slight edge over females on 7 of 18 items: liquid, solid, mass, volume, compound, neutron, and electron. F>M on molecule and protron. Though most differences are small, increasing differences are seen for mass, volume, liquid, and solid in favor of males.

Table 4 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
NCES (1978)	For each assessment period 19,000 23,000 (80% White 13% Black 7% Other; 50% Female)	 9 years 13 years	NAEP science assessment 1970, 1973, 1977	-Science achievement: Total performance Includes domains of: .Knowledge .Skills .Understanding .Applications	-Males > females on all 3 assessments but small differences especially for 9-year-olds: M > F ∿ 2% points (9-year-olds. M > F ∿ 4% points (13-year-olds)
Overton & Meehan (1982)	33 White females 27 White males (predomiantly white)	Mean age 13 years, 4 months	Catholic School, middle SES	-Pendulum task a variation of Inhelder and Piaget -Card sorting task based on information from pendulum task -Plant task: attributing causal factors to plant health -Combinations task: to test for systematic strategy	-No significant sex differences for any formal reasoning task -Main effect for helpless/mastery ($\underline{F}(6.53) = 2.42$, $\underline{p}<.04$) and sex role by helpless/mastery ($\underline{F}(6.53) = 2.35$, $\underline{p}<.01$) on all tasks taken together. -For all but plant task, masculine/helpless subjects and androgynous/mastery subjects performed better than androgynous/helpless subjects -On plant task, masculine/helpless and feminine/mastery subjects performed better than feminine/helpless subjects -"The present study found no formal operational competence deficit for females. Nor did individuals with a feminine sex role perform more poorly than individuals with a masculine sex role."

Table 4 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex Effects					
Ryman (1977)	48 White males 48 White females	Mean age 12 years, 5 months	Britain	-Classification test in biology	-No significant sex differences in classification test
Schofield, Murphy, Johnson, & Black (1982)	11,000 British students	13 years	1980 Science in Schools Survey conducted in England; assessment involves process as well as content and includes evaluation of performance in "hands on" activities	-Using symbolic representations -Using apparatus and measuring instruments -Using observation -Interpretation and application -Design of investigations -Performance of investigations	-No significant sex differences for five of the six domains M>F on application of physics concepts

Table 4 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Ethnic Effects					
Holmes (1982)	Total sample, 80,000 students, of these 2,500 complete each exercise: 400 Black 125 Hispanic 50 Asian 50 Native American 1,925 White	9 & 13 years	NAEP science assessment, 1976-1977	-Difference between Black and national performance in passing; Unit of analysis is the number of items with national percentage pass of 50% or better: 96 items included in analysis for 9-year-olds, 120 items included for 13-year-olds	-At 9 and 13 years of age Blacks performed well below national performance in science -9 year old black students had particular trouble with comprehension (50% of all items are in this domain). Application, knowledge, biology, and physical science are also troublesome. The latter two subject areas are heavily weighted with comprehension items -13-year-old Black students had trouble with comprehension and application items (50% of items are comprehension, followed closely by application items). Biology and physical science continue to be problematic with indication of problems in the process methods. [Note: Unequal distribution of items within skills taxonomy]
Howe, Hall, Stanback, & Seidman (1983)	26 White males 26 Black males	Grades 8 and 9	14 activity-centered science classrooms	-Final grade in science	-No ethnic differences in observed "learning","attending", or "nonattending"

Table 4 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Ethnic Effects					
Huettle, Rakow, & Welch (1983)	684 White males 666 White females 210 Black males 228 Black females 172 Other ethnic	9 years	NAEP science assessment, 1982	-For 9-year-olds: . Inquiry . Science, technology, and society	For 9-year-old students: -Within inquiry domain W>B (∿ 14.5%). Largest differences were on ability to draw conclusions and generalizations, and for items measuring knowledge of scientific method -Within science, technology, and society items, W>B (∿ 11%) Black students had particular difficulty on ecologically related items.
	2,824 White males 2,957 White females 553 Black males 658 Black females 881 Other ethnic	13 years		-For 13-year-olds: • Science content • Inquiry . Science, technology, and society	For 13-year-old students: -Within the inquiry domain W>B (∿ 12%) -With the content domain W>B in biology (∿ 11%), physical science (∿14%), and earth science (∿ 14%)

Table 4 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Ethnic Effects					
NCES (1978)	For each assessment period 19,000 23,000 (80% White 13% Black 7% Other; 50% Female)	 9 years 13 year	NAEP science assessment, 1969-1970, 1972-1973, 1976-1977	-Science achievement: Total performance includes domains of: .Knowledge .Skills .Understanding .Applications	-White > Blacks on all 3 assessments; slight reduction in relative difference, but absolute difference remains substantial: $\bar{x}$ difference from national % correct: 1970 / 1973 / 1977 W > B 17% 15% 14% (9-year-olds) W > B 18% 16% 16% (13-year-olds) -For all 9- and 13-year-olds, decline in science achievement since 1970 appears to be lessening. Though there continues to be a decline in physical science, achievement in biology is stable.

Table 4 (continued0

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex/Ethnic Effects					
Hueftle, Rakow, & Welch (1983)	684 White males 666 White females 210 Black males 228 Black females 172 Other ethnic	9 years	NAEP science assessment 1981-1982	-For 9-year-olds: .Inquiry .Science, technology, and society	For 9-year-old students: -For inquiry items, sex by ethnic differences are small (∿.6%) in favor of White males and Black females WM=55.9% BM=40.8% WF=55.3% BF=41.4% -For science, technology, and society items, small sex by ethnic differences in favor of White males (∿1.5%) and Black females (∿1%) WM=62.7% BM=50.7% WF=61.3% BF=51.7%
	2,824 White males 2,957 White females 553 Black males 658 Black females 881 Other ethnic	13 years		-For 13-year-olds: ·Science content ·Inquiry ·Science, technology, and society	For 13-year-old students: -For process items within the inquiry domain, White males > White females (∿1%); no differences between Black students WM=60.3% BM=49.9% WF=59.3% BF=49.9% -For decision making Black females > Black males (∿2%), White females > White males (∿.7%) -Within science, technology, society domain, sex difference between White students is slightly larger than differences between Black students (4.1% vs. 3.3%). [Note: Statistical analyses of of sex by ethnic interactions are not reported, only means are provided.]

Table 4 (continued)

Author & Year	Sample Characteristics: #/Ethnicity/Sex	Sample Characteristics: Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Sex/Ethnic Effects					
Langer, Kalk, & Searls (1984)	97,000 White 17,000 Black	9, 13, 17 year-olds	NAEP assessment, 1974-75, 1976-77, 1977-78	-Combined math, science, and reading (ratio of correct responses to attempted exercises)	For age 9, White students: -Controlling for class age, relative age, sex, parental education, home environment, region, and type of community, sex not related to achievement; all other factors significant For age 9, Black students: -Controlling for other variables, sex negatively related (β=-.045, F=6.6, p<.01); all other factors significant. For age 13, White students: -Controlling for other variables, sex positively related (β=.023, F=9.4, p<.01). All other variables significant except age. For age 13, Black students: -Controlling for other variables, sex not related to achievement; all other variables significant.

Table 5

COMPUTER PERFORMANCE AND ATTITUDES

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Computer Performance					
Fetler(1985)	293,717 students	Grade 6	California statewide testing, 1983	-Survey of Basic Skills: Computer literacy .Vocabulary .Interactive and batch .Systems components .History .Systematic procedures .Simple programs .Specific uses .Careers -In school computer learning	Scores for both sexes were low: -M>F consistently on all tasks (∿4%) -Biggest differences M>F vocabulary (8%), system components (5%), history (7%), and simple programs (4%) -Small differences (M>F) seen in interactive and batch (2%), specific uses (2%), and careers (3%) -M>F report school involvement in computer learning (M=71%, F=65%)
Lockheed (1984)	42 males 45 females 106 males 95 females	Grades 7 and 8 Grades 7 and 8	Oregon Wisconsin Women's Action Alliance study	-Constructed student questionnaire: Experience with computers (19 activities; higher scores indicate greater experience with computers)	Significant sex differences at pretest: -In Oregon, M>F, $\bar{x}_f$=4.38, $\bar{x}_m$=8.43; $\underline{t}(85)=5.21$, $\underline{p}<.01$ -In Wisconsin M>F, $\bar{x}_f$=9.57 $\bar{x}_m$=10.56; $\underline{t}(199)=2.27$, $\underline{p}<.05$
Revelle, Honey, Amsel, Schauble, & Levine (1984)	185 males 35 females	Mean age 13 (age range 7-19)	Computer camp	-Precamp proficiency	-Significant sex differences for proficiency, M>F, 64% males high vs. 26% females high, X^2 =15.9, $\underline{p}<.001$

Table 5 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Computer Performance					
Wright, (personal communication 1983)	1,250 males 1,250 females	13 years	NAEP assessment, 1977-1978	-4 computer questions	-14.3% M and 11.0% F passed unreleased BASIC item -14.9% M and 12.6 % F passed released BASIC item -10.8% M and 6.5 % F passed unreleased flow chart item -10.3% M and 11.2% F passed released flow chart item
Attitudes Toward Computers					
Collis (1984)	539 males 479 females	Grade 8	Victoria, B.C.	-Attitudes toward computers	-M showed more positive attitude on 18 of the 24 items

Table 5 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Attitudes Toward Computers					
Demarest & McKenzie (unpublished ms. 1984)	112 males 111 females	Grades 3 and 4	All students in one district enrol'ed in Logo program	-Rating of comfort with computers	-57.1% males and 32.4% females reported high comfort $p<.05$.
Fetler (1985)	293,717 students	Grade 6	California statewide testing, 1983	-Attitudes toward computers	-Both sexes relatively positive; but males slightly more positive.
Mokros (personal communication, 1984)	84 students (1984)	Grades 6 and 7 (cross-sectional)	6th grade computer curriculum (Logo)	-Attitudes about computers	-Significant sex by grade interaction ($F=8.58$, $p=<.005$) but no sex or grade first order effects $\bar{x}_m$ = 8.9 in 6th grade $\bar{x}_f$ = 9.9 in 6th grade $\bar{x}_m$ = 10.08 in 7th grade $\bar{x}_f$ = 5.46 in 7th grade
	88 students (1983-84)	Grades 6 and 7 (longitudinal)		-Attitudes about computers	-Significant sex effect ($F=14.69$, $p=<.001$) M>F attitudes $\bar{x}_m$ = 7.8 in 6th grade $\bar{x}_f$ = 5.3 in 6th grade $\bar{x}_m$ = 10.1 in 7th grade $\bar{x}_f$ = 5.5 in 7th grade

Table 5 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Findings/Results
Attitudes Toward Computers					
Swadener & Hannafin (1984)	17 males 15 females	Grade 6	Middle-class, suburban district (15% minority population)	-17-item constructed computer attitude scale: .General attitude toward computers .Self-confidence with computers .Utility of computers	-No sex differences on computer self-confidence -No main effect for sex on perceived utility of computers; interaction of sex by math achievement was significant (F=3.69, p<.07); however mean response was "no opinion" -No main effect for sex on general attitude toward computers, however, interaction of sex by math achievement was significant (F=4.57, p<.04). High math females and low math males rated computers lower than low math females and high math males
Wilder, Mackie, & Cooper (1984)	44 males 40 females	Grades 4 and 5	Suburban school in central New Jersey Paper and pencil (Maze game) Nonviolent computer game (Pacman) Violent computer game (Missile Command)	-Liking of games (5-point scale, with high ratings indicating liking)	-Female players liked Maze (4.25) > Pacman (4.0) > Missile (3.3) -Males liked all equally (4.2, 4.4, 4.4, respectively)
Wilder, Mackie, & Cooper (1985)	1,600 students	Grades K-12	Suburban school in central New Jersey	-Constructed student questionnaire: Sex typing of computers (1 indicated mostly male, 9 indicated mostly female)	-In grades 4-8, males perceived the computer as slightly more appropriate to males, $\bar{x}_m$=4.4, $\bar{x}_f$=4.7 [Note: A rating of 5 indicated a neutral response]

Table 6

FACTORS RELATED TO MATH PERFORMANCE

Author & Year	Sample Characteristics: #/Ethnicity/Sex	Sample Characteristics: Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Armstrong (1980)	1452 students	13 years	82 schools, Women in Mathematics national survey	-Stanford Achievement Test: math computation -Cooperative Algebra I: algebra -Metropolitan Achievement Test: problem solving	-Sex role stereotypes -Career & academic plans -Attitude toward math -Usefulness of math -Parental influence (role, encouragement, stereotyping, help) -Significant others influence -School experience -Background (SES, parent education and occupation)	-Significant predictors of math achievement from regression analyses were: exogeneous factors (SES, school enrollment), $\underline{R}^2 = .03$; teacher treatment, counselor encouragement, father's educational expectations, mother as role model, $\underline{R}^2 = .23$. -Exogeneous factors plus stereotyping, attitude toward math, school anxiety, educational aspirations were best predictors of achievement, $\underline{R}^2 = .26$. -Unique predictors for each sex were: for females, school anxiety and mother as role model; for males, locus of control. [Note: No ethnic analyses were reported.]
Arzi & Amir (1977)	171 Israeli males (99 underprivileged) (74 privileged) 169 Israeli females (all underpriv.)	Grade 4	Israeli schools -Homogeneous schools, underprivileged students -Heterogeneous schools with both underprivileged & privileged students	-Math achievement -Numerical facility	school composition (heterogeneous & homogeneous)	-Underprivileged students in heterogeneous schools had better achievement than underprivileged students in homogeneous schools. -Underprivileged students in homogeneous schools had better self-concept & personal adjustment. -Sex was not included as a factor.

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	 Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Bookman & Iwanicki (1983)	180 White	Grade 8	Hartford, Conn.; suburban, junior high; 2 methods of test preparation plus control condition	-Comprehensive Test of Basic Skills: total math for present and prior year	-Methods of test preparation -Sex	-Significant treatment effect (F=7.25, p<.01) for 8th grade; -No sex effect & no sex by treatment interaction were found. -"Practice problems" treatment group scored higher than "lecture" or "control" groups.
Boswell & Katz (1980)	562 students	Grades 3-6	Boulder, Colorado Valley School District; White, middle class	-McGraw Test of Basic Skills: •Computation •Concepts •Applications	-Sex -Sex role flexibility (adapted from BEM): •Masculine •Feminine •Androgynous •Undecided -Nonlanguage aptitude -Attitude	-For females, stereotyping of math as male was negatively correlated with achievement; no effect for males. -Nonlanguage aptitude was the strongest predictor of achievement for both sexes. Personality factors had small but significant effects. Attitude toward math was a stronger predictor for boys.
Boswell & Katz (1980)	109 males 110 females	Grade 7	2 junior highs in Boulder, Colorado	-McGraw Test of Basic Skills: •Computation •Concepts •Applications	-Grade -Sex -Attitude -Intellectual achievement -Bravery -Usefulness -Stereotyping -Peer Influence -Family aspirations	-Significant effects for nonlanguage aptitude, self-perceived ability, and and self-perceived bravery in predicting math achievement were found. -Unique predictors were: for females, stereotyping of math as male domain; for males, attitude toward math.

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Conway (1977)	271 students (White Black Mexican-American American Indian)	Junior high	Longitudinal study, K to Grade 7; Whites, mid to low SES; minorities, all low SES	-Iowa Test of Basic Skills: math (given during grades 4-6)	-SES -Ethnicity -Grade	-White mid SES > all low SES groups on math achievement at grade 4. -White mid SES > all other groups in problem solving at higher grades. -For 4 low SES groups, White students > other cultural groups in math concepts at 4th grade; no differences at higher grades.
Creswell (1980)	25 Black males 25 Black females 25 Anglo males 25 Anglo females 25 Chicano males 25 Chicano females	Grade 8	Houston, Texas, large ethnic population	-Iowa Test of Basic Skills: math	-Grade -Sex -Ethnicity -Mother influence -Father influence -Male domain -Usefulness -Attitude	-Sex was not a contributor to math performance; ethnicity contributed 5% ($p<.01$). -All 5 attitude variables accounted for 18% of the variance, however, math as a male domain and mother influence contributed significantly ($p<.01$). [Note: No tables provided in document].
Creswell & Exezidis (1982)	42 males 70 females (61 Black 51 Mexican-Americans)	"Unspecified adolescents"	Single school in Houston, Texas; low SES community	-Iowa Test of Basic Skills: math	-Fennema-Sherman Math Attitude scales: •Mother influence •Father influence •Math as male •Usefulness of math -Aiken & Dreger Revised Math Attitude Scale -12-item-constructed scale measuring teacher influence -Sex	-Significant predictors of math achievement were: ethnicity ($r^2=.12$), perceived usefulness of math ($r^2=.15$), and father influence ($r^2=.05$), $p<.01$. -Sex was not a significant predictor ($r^2=.02$).

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Fennema & Sherman (1978)	1320 students (nearly all White)	Grades 6-8	9 middle schools in Madison, WI; (bottom 15% of students omitted from study)	-Math Concepts Test -Math Computation Test	-Sex -Grade -Geographic area -Fennema-Sherman Attitude Scales	-No sex differences were found in math computation or math concepts. -Significant grade and area main effects as well as sex by area interactions were found for math computations and concepts. -Significant grade by area interaction was found for math computation. -Positive correlations between confidence in learning math and math achievement were found for both males and females, with higher correlations found for males -Rating math as "sex neutral" had a higher correlation with achievement for females than for males
Hannafin (1983)	19 Hispanic males 17 Hispanic females 29 Anglo males 20 Anglo females	Grade 6	Traditional instruction vs. "instructional system": hierarchically sequenced set of math computational skills	40-item constructed response test: • Whole numbers • Adding decimals • Subtracting decimals • Adding fractions • Subtracting fractions	-Instructional method: Unsystematic, traditional instruction versus Systematic: "instructional system" -Ethnicity -Sex	The following effects were found: -No sex by ethnicity interaction for any subtest; -No sex main effect for any subtest; -Ethnicity main effects for all subtests; -No sex by treatment or ethnic by treatment interactions; -No sex by ethnic by treatment interaction; and, -Main effect for treatment only for subtracting and adding fractions.
Hare (1980)	101 Black 412 White	Grade 5	Champaign, Ill., all 5th graders in district who consented to participate and were present.	-Unspecified standardized achievement test administered district wide, total math score used.	-SES -Ethnicity	-SES differences were found for math achievement ($F = 37.91$, $p < .001$). Lower SES students had lower achievement relative to upper SES students. -No ethnic by SES interactions were found.

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Holmes (1982)	Total sample 80,000 students; of these, 2,500 at each age answered each exercise 400 Blacks 125 Hispanics 50 Asians 50 Native Americans 1,925 Whites	9 & 13 years	NAEP math assessment, 1977-1978. Unit of analysis is the number of items with national % pass of 50% or better: 193 math items for 9-year-olds, 337 math items for 13-year-olds	-Difference between Black and national performance in passing	Test domain: -Taxonomy (Knowledge, Skills, Understanding, Applications); -Category (Numbers & numeration, Variables & relationships, Geometry, Measurement, Other topics).	-9-year-old Black students had difficulty with knowledge items (50% of the items were in this domain). Numbers and numeration, other topics, and measurement were also troublesome. About 25% of the items are in other topics area. This area includes items which assess skills, understanding, and applications indicating problems in these domains as well. -For 13-year-old Black students difficulty in numbers and numeration, and measurement not as great as at 9-year-old level, but greater discrepancies in performance occurred for geometry and other topics. -For 13-year-olds, 25% of items were in knowledge domain, 34% were in skills, and the remainder were equally divided between understanding and applications domains. [Note: unequal distribution of items within taxonomy of skills at both ages.]

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Jones, Burton, & Davenport (1982)	8000 White 1200 Black	13 years	Special NAEP math assessment, 1975-1976	-40 math exercises	-Individual background factors: • Grade • Printed materials in home -School background factors: • Region • Parent occupational level • Mean grade • Mean parent education • Printed materials in home	-Approximately 40% of the mean achievement differences between Blacks and Whites is accounted for by regression on individual background and school factors. Most of the reduction in math achievement difference is attributable to between school rather than within school differences.
Kagan & Zahn (1975)	29 Anglo students 9 Mexican-American students 37 Anglo students 11 Mexican-American students 27 Anglo students 21 Mexican-American students	Grade 2 Grade 4 Grade 6	Semirural, lower income elementary school	-Comprehensive Test of Basic Skills: math -Grade equivalent score	-Sex -Culture -Grade -Field independence	-Significant cultural differences were found: (A>MA, F=5.08, p<.05) β =.11; -Grade and field dependence are related to math achievement; -No sex effect for math was found.

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	 Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Kagan, Zahn, & Gealy (1977)	144 Anglo students 86 Mexican-American students	Grades K, 1, 2, 4 & 6	-Semirural, lower income elementary school	-Comprehensive Test of Basic Skills: math	-Ethnicity -Field independence -Competitiveness	The following correlations were found: -For grade 4, ethnicity and field independence were correlated with math achievement: r=.35 and r=.36, respectively. -For Grade 6, field independence correlated with math achievement: r=.33. -General ability was not controlled. -No relationship of competitiveness with achievement was found.
Langer, Kalk, & Searls (1984)	97,000 White 17,000 Black	9, 13, & 17 year olds	NAEP math assessment, 1974-1975, 1976-1977, 1977-1978	-Combined math, science & reading (ratio of correct responses to attempted exercises)	-Class age -Relative age -Sex -Parent education -Home environment -Region -Type of community -Modal grade	-For 9-year-old White students, all factors with the exception of sex were significantly related to achievement. -For 9 year old Black students all factors including sex were significantly related to achievement; For Black students sex was negatively related ($\beta = -.045$, $F = 6.6$, $p < .01$) -For 13 year old White students, all factors with the exception of age were significantly related to achievement. Sex was positively related to achievement ($\beta = .023$, $F = 9.4$, $p < .01$) -For 13 year old Black students, all factors with the exception of sex were significantly related to achievement. -More Blacks and more males have been retained one grade: White students — Age 9 / Age 13 Male — 18% / 21% Female — 11% / 12% Black students — Age 9 / Age 13 Male — 23% / 31% Female — 15% / 21%

Table 6 (continued)

Author & Year	Sample Characteristics		Setting/Experimental	Dependent	Independent	
	#/Ethnicity/Sex	Age/Grade	Condition	Variable/Measure	Variable/Measure	Findings/Results
Linn & Pulos (1983)	145 males 159 females	Grade 7	3 school districts	-Balance Puzzle: proportional reasoning	-Formal reasoning: -Combinations -Permutations -Predicting displaced volume -Controlling variables -Aptitude: -Vocabulary (a) -Letter series (b) -Find a shape (c) -Paper folding (d) -Water level (e) (a) measures general crystallized ability; (b, c & d) fluid visualization; (e) familiar field -Sex	-Controlling for district, courses taken, vocabulary ($\beta = .13$, $F = 9.03$, $p < .01$), general fluid visualization ($\beta = .14$, $F = 17.87$, $p < .01$), familiar field, and formal reasoning, sex was not related to proportional reasoning ($F = 2.89$, n.s). [Note: No ethnic information provided.]

Table 6 (continued)

Author & Year	Sample Characteristics		Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
	#/Ethnicity/Sex	Age/Grade				
Llabre & Cuevas (1983)	188 males 220 females (bilingual Hispanic students proficient in both languages	Grades 4 & 5	5 public schools in Florida-studies selected on functional bilingualism in English and Spanish (schools were 70% Hispanic)	-Comprehensive Test of Basic Skills: Concepts Applications	-English language proficiency as measured by reading comprehension on Stanford Achievement Test -Test language (English vs. Spanish)	-Higher level of reading comprehension associated with higher levels of math performance. -Students performed better when tested in English. [Note: Effect of gender was not assessed.
Marshall (1983)	166,204 males 163,868 females 157,013 males 153,710 females 148,801 males 145,647 females 144,462 males 142,305 females	Grade 6	1976 California Assessment 1977 California Assessment 1978 California Assessment 1979 California Assessment	-Distractors on 160 multiple choice math items (correct responses excluded)	-Sex -Response year -Distractor type	-Sex by distractor interaction found. -F>M in number and types of errors: -Language/semantics F>M in confusion of meaning M>F errors in translation -Spatial visualization: F>M units of scale on graph F=M confusion of geometric shape -Mastery: F>M choice of operations -Faulty associations: F>M number patterns M>F perseverance F>M word associations M>F interference (one formula for another) F>M interference (horizontal vs. vertical)

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Marshall (1984)	144,462 males 142,305 females	Grade 6	California Assessment Program, 1979	-Survey of Basic Skills: •Solving math computations •Story problems (probability of correct response)	-Sex -SES -Primary language spoken at home -Chronological age -Reading ability	-Sex differences were found depending upon problem type. Females outperformed males on computations for all levels of reading ability. Males outperformed females on story problems for all levels of reading ability. Absolute values of the differences were small but consistent. -There was little or no interaction between language and sex on performance measures. -For all levels of SES (teacher rating of unskilled, semi-skilled, semi-professional and professional), males outperformed females on story problems and females outperformed males on computations. Differences in both cases were small but consistent across SES levels. -There were large differences in performance between SES levels. The higher the SES level, the better the performance for both item types. -For students whose primary language was English or Spanish, the same pattern of higher male performance on story problems and higher female performance on computation was found. -For Asian students, no sex differences on computation was found. Males outperformed females by a slight margin on story problems. -Of the 3 primary language groups, Asians performed the highest on both types of items. English language students had the second highest performance followed by Spanish language students.

Table 6 (continued)

Author & Year	Sample Characteristics: #/Ethnicity/Sex	Sample Characteristics: Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
McCormick & Karabinus (1976)	1235 students White, Black, & Hispanic (sex not reported)	Grades 4, 5, & 6	Middle and working class Chicago suburb	-Self Esteem Inventory -Test Anxiety Scale for Children -General Anxiety Scale for Children	-Metropolitan Achievement Test: Math -Ethnicity -Grade	-Math achievement and self-esteem were significantly related for: Black students in Grades 5 & 6 Hispanic students in Grade 4 White students in all grades. -Math achievement and test anxiety were significantly related for: Black students in Grade 5 Hispanic students in Grades 5 & 6 White students in Grades 4, 5, & 6. -Math achievement and general anxiety were significantly related for: Hispanic students in Grade 5 White students in Grades 4 & 6
Moskowitz, Malvin, Schaeffer, Schaps (1983)	33 males 38 females	Grade 5	Experimental (jigsaw)	-Stanford Achievement Test: Math	-Classroom organization -Sex	-Findings refer to only 3 of 8 experimental classes, as only 3 classes had correctly performed the jigsaw intervention. -At pretest, there were significant differences in achievement in favor of males. -At posttest, there was no effect for treatment when pretest status was controlled.
	37 males 39 females	Grade 6	Experimental (jigsaw)			
	38 males 39 females	Grade 5	Control			
	23 males 14 females	Grade 6	Control			

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Myers & Milne (1983)	15,579 students (91.3% English 1.4% Spanish 6.7% Spanish/ English 0.7% Italian/ English)	Grades 1-3 Grades 4-6	Sustaining Effects Study of Title I - 242 schools	-Comprehensive Test of Basic Skills: math	-Home language -Sex	The following effects were found: -For grades 1-3, significant sex effect ($F=7.41$, $p<.01$), and significant home language effect ($F=51.1$, $p<.001$), and no interaction; -For grades 4-6, significant sex effect ($F=122.1$, $p<.001$), significant language ($F=47.9$, p .001), and no interaction. Math by Lang.: English $\bar{x} = 50.3$; Spanish $\bar{x} = 41.6$; Sp/Eng $\bar{x} = 45.7$; Ital/Eng $\bar{x} = 54.4$ Math by Gender: female $\bar{x} = 49.3$; male $\bar{x} = 46.7$ [Note: Females outperform males in math.]

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
NAEP, 1983 Report	14,752 students 13,947 students 26,661 students 15,758 students	9 years 13 years	NAEP math assessment 1972 & 1978	-Total math performance	-Sex -Ethnicity -Type of community -% of minority enrollment	-Math performance of 9 and 13-year-old students in predominantly minority schools approximately 11% below predominantly White schools. Though performance improved, especially for Black 13-year-olds (8.1%), the difference between ethnic groups remained substantial. Greater discrepancy was seen in disadvantaged vs. advantaged urban communities. Though performance improved for both communities, considerable difference (~ 6%) existed for 13-year-olds. -In 1982, approximately 26% Black and 22% Hispanic 9 & 13-year-olds lived in disadvantaged urban communities. -In 1982, 72% Black & 68% Hispanic 9-year-olds, and 56% Black & 69% Hispanic 13-year-olds attended minority schools. [Note: As students get older, a greater number go to integrated schools.]

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Nelson, Knight, Kagan, & Gumbiner (1980)	45 Anglo 125 Mexican-American	Grades 4, 5, & 6	Lower income elementary school	-California Test of Basic Skills: Math	-Intellectual Achievement Responsibility Questionnaire -Coopersmith Self-Esteem Inventory -Man-in-the-Frame Box -Grade -Ethnicity	-No sex differences found in any variable. -For Anglos, only locus of control accounts for significant portion of variance in math achievement (r^2=.11). -For Mexican-Americans, only locus of control accounts for significant portion of variance (r^2 = .23). -Mexican-Americans are at grade level in math, and Anglos are .91 above grade level.
Paulsen & Johnson (1983)	57 males 54 females 49 males 49 females	Grade 4 Grade 8	High SES area	-Stanford Math Achievement Test -Questionnaire on sex roles derived from Stein & Smithells (1969) and Dwyer (1974)	-Sex -Grade -Sex role attitude	-No sex differences in math achievement at any grade or across grades. -Both sexes were positive in attitude toward math as appropriate for their sex. -Sex role attitude related to higher math scores at 4th and 8th Grade: Grade 4 (r=.49); Grade 8 (r=.32).

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Rulos, Stage, & Karplus (1982)	57 males 45 females (46% Black, 30% Asian, 5% Hispanic, 18% White) 44 males 39 females (30%B, 40%A, 17%H, 9%W) 42 males 33 females (51%B, 4%A, 35%H, 8%W) 30 males 30 females (58%W, 21%B, 14%A, 7%H) [Note: Percentages reflect ethnic composition of schools.]	Grade 8 Grade 8 Grade 8 Grade 8	4 schools: 3 predominantly minority, urban; 4th school predominantly White, middle class Tasks individually administered	-Reasoning with unknowns (number puzzles) -Proportional reasoning (Lemonade puzzles) -Spatial reasoning (paper folding)	-Math Aptitude Survey -5 cognitive measures •Crystallized intelligence (vocabulary) •Fluid intelligence (series completion) •Processing capacity (figural intersection) •Field dependence (group embedded figures) •Field dependence (water level) -Sex	-Site effects found for attitude and achievement. Though variance accounted for by site was small for spatial reasonig and reasoning with unknowns (~ 5%), it was substantially higher for proportions (~ 21%). -Sites differed in the perceived usefulness of math, perceived math ability, and amount of work performed in math relative to other subjects. -Students in site with lowest achievement also had poorest attitude toward math. -Different patterns of cognitive correlates found for different sites. [Note: No sex differences found on any task (reasoning or attitude) within any site.]
Rosenthal, Baker & Ginsburg (1983)	12,322 students (Language background of sample: 11,383 English 803 Spanish)	Grades 1-6	Of Spanish students participating in the study, 619 used English only on homework, 35 used both English & Spanish on homework, 149 used only Spanish on homework.	-California Test of Basic Skills: math, fall achievement and learning gain score (Spring-Fall)	-Parental education -Family income (log) -Parental occupation (Duncan) -Ethnicity (Black, Hispanic) -Language parents use to help with homework (English, Spanish, or both English & Spanish)	-Controlling for other variables, parental language used for homework had no effect on fall math achievement. -Significant income, occupation, and ethnicity effects were found. -Controlling for other variables, parental language used for homework had significant effect for learning of math. Children of parents using English or Spanish and English did less well. Children of parents using Spanish only learned as much as Anglos.

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Sanchez (1980)	Not given	Not given	58 bilingual settings (K-6)	Math achievement	-Teacher training -Cooperativeness of teacher -English language proficiency	Cooperation measured by paper & pencil -Non-English or limited English students scored lower on math posttest than fluent English speakers. -Students in Grades 4-7 with cooperative teacher scored higher. -More proficient English speakers with cooperative teachers scored higher. Cooperation measured by "prisoners dilemma": -Students in Grades 4-7 with cooperative teachers scored higher. -Less proficient English speakers with cooperative teachers scored lower.
Sharpley, Irvine, & Sharpley (1983)	76 students (tutors) 63 students (control)	Grades 5 & 6 high & low achievers	Australia tutor hi/ tutee low tutor hi/ tutee hi tutor low/ tutee hi tutor low/ tutee low (6th grade students tutored 3rd grade students)	-30-item constructed achievement test: •Operations •Estimation •Geometry •Fraction •Time	Tutor vs. nontutor	-No sex or ethnic results reported. -Tutors gained in math operations ($F = 29.85$, $p < .01$) and "other" math skills ($F = p < .01$) as opposed to nontutors.

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	 Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Sherman (1980)	135 females 75 males	Tested at grade 8 and again at grade 11	High school longitudinal study	For grade 8: -Mathematical Concepts Test -Romberg-Wearne Problem Solving Test For grade 11: -Basic Mathematics Concepts Test -Mental Arithmetic Problems	-Fennema-Sherman Math Attitude Scales II -Sex -Grade	-For females only, significant correlations between math as male and 2 math performance measures ($r = .45$ & $r = .38$) were found. -In 8th grade, only sex difference was that males saw math as more male than did females. -For females, the more neutral in grade 8, the higher the math performance in grade 11 ($\beta = .14$). -In 11th grade, males were more confident in math, saw math as more useful and as male domain.

Table 6 (continued)

Author & Year	Sample Characteristics: #/Ethnicity/Sex	Sample Characteristics: Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Slavin (1985)	504 students (80% White 15% Black 5% Asian)	Grades 3, 4, & 5	18 classes in 6 middle class suburban schools	-Comprehensive Test of Basic Skills: math computation	Instructional groupings: -TAI (Team assisted individualization) -Individualized instruction -Control (traditional, whole class instruction)	-Math computation: TAI > control (F = 5.39, p<.03) individual > control (F = 2.90, p<.10)
	375 students (55% White 43% Black 2% Asian)	Grades 4, 5, & 6	Suburban middle schools, 10 TAI & 6 control classes	-Same	-TAI vs. control	-Math computation: TAI > control (F = 4.70, p<.03)
	1407 students	Grades 3, 4, & 5	4 middle class suburban schools, 31 TAI classes, & 30 control classes	-Math computation -Math concepts & -Applications	-TAI vs. control	-Math computation: TAI > control (F = 13.6, p>.001)
	160 students (66% Black, 34% White)	Grades 4, 5, & 6	7 classes in Baltimore	-Same	-Same	-No effect on achievement found (attributed to poor implementation of intervention). [Note: None of these studies examined sex or ethnic effects.]

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Strauch (1977)	152,944 students (95% White)	Grades 5, 8, & 11	Statewide testing in Pennsylvania	-Educational Quality Assessment: •Math concepts •Measurement •Geometry •Algebraic notation •Number concepts	-Sex -Ethnicity -SES	5th grade math: -No sex effect, significant ethnicity ($p<.001$) and SES effects ($p<.001$), and no interactions found. 8th grade math: -Sex effect ($p<.05$), ethnicity ($p<.001$) & SES effects ($p<.001$), and no interactions found. [Note: Means are not provided and other factors such as region, size of school, etc. were not considered.]
Tsai & Walberg (1983)	1206 male 1117 female 1840 White 335 Black 130 Hispanic 12 Asian	13 years	NAEP math assessment, 1977-1798	-Math achievement (74 items) -Math attitude (14 items)	-Experience in math ($\alpha = 16$) -Sex -Ethnicity -Reading materials ($\alpha = .44$) -Maternal education -Paternal education	-F>M in achievement ($\bar{X}_f = 41.72$, $\bar{X}_m = 40.57$; $F = 5.42$; $p<.05$) -Sex, ethnicity, reading material, paternal and maternal education, attitude toward math, and experience significantly contributed to the variance in math achievement ($R^2 = .32$). First-order interactions among factors tested and found not significant.
Tsang (1976)	321 Chinese 121 Chicano	Grades 7 & 8	California	-40-item constructed test from items contained in unspecified standard achievement tests • Math computations (20 items) • Word problems (20 items)	Test form: -Original (biased) -Bilingual (biased) -English culturally unbiased -Bilingual culturally unbiased	-The Chinese students who lived in the U.S. < 6 years performed better on bilingual rests (Chinese/English) than on tests written entirely in English. -Chinese low achievers did better on modified form (unbiased) than on biased (original) form. -Chicano students scored higher on English forms than on bilingual forms.

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Turrentine (1982)	85 students 168 students	Grade 6 Grade 9		-California Achievement test: math	-Teacher rating of body mass •Below •Normal •Larger	-Subjects with greater than normal body mass had poorer academic achievement.
Webb (1984)	33 females 44 males (26% minority Black, Asian American)	Grades 7 & 8	Math classes group discussion of math problems (exponents & scientific notation)	-20-item constructed achievement test on exponents & scientific notation)	-Task oriented interaction-(13 variables) -Sex -Ability level of group	-Females more responsive to requests for help than were males. -Females were equally responsive to all group members. -Males responded to males more than to females. -Both males & females sought help from males more than from females.
Webb & Cullian (1983)	105 students	Grades 7-9	2 average and 2 above-average general math classes in Los Angeles, CA	-Constructed test covering class curriculum; -Curriculum for average classes: Consumer math area & perimeter	-Asks question, receives response -Asks question, receives no response -Asks questions -Gives help -Receives help -Works alone -Works with other -Off task	-The most potent predictor of achievement was asking a question and receiving no answer. This was negatively correlated with achievement ($r = -.41$ and $r = -.42$, $p < .001$) in 2 samples. -Asking a question and receiving an answer was positively related to achievement (.24, $p < .09$ and .34, $p < .02$) in 2 samples.

Table 6 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Webb & Kenderski (1984)	107 students (51% female and 54% minority)	Grades 7 & 8	-3 junior high math classrooms -Small vs. whole class grouping	-Curriculum for above average classes: consumer math probability -24-item constructed test related to curriculum content	-Math ability -Introversion -Locus of control -16 different interaction variables -Classroom grouping	-No difference in achievement between small-groups and whole-class instruction found. -Interaction variables (for small group) related to achievement: gives explanation (r = .47) receives no explanation (r =-.58) receives response to procedural question (r =-.33) -Interaction variable (for whole class) related to achievement was receiving help from teacher (r = .45) -For both small and whole-class groups analyses, ability within group was controlled.

Table 7

FACTORS RELATED TO SCIENCE PERFORMANCE

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Akers (1980)	424 students	Grade 8	18 Introductory Physical Sciences (IPS) classes; Virginia, suburban district; treatment was the provision of behavioral objectives	-4 competency measures of IPS course	-Behavioral objectives for all 4 units -Behavioral objectives for 2 units -Behavioral objectives for no units -Sex	-Treatment x sex interaction found. Females who received behavioral objectives achieved significantly higher than females who did not, on 2 of the 4 competency measures.
Bernreuter (1981)	65 Black students	Grade 7	3 science classes; 29 students (control group), 46 students (experimental group); experimental group given 18 weeks of values clarification lessons	-Tennessee Self Concept Scale-total score	-Reading level -Math score -GPA -Family size -Science grade -Age -Sex -SES -Values clarification	-A significant correlation was found between science grade and self-concept ($p<.05$).

Table 7 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Bin Abdullah & Lowell (1981)	24 males 24 females	Grade 5	Newfoundland; students randomly assigned to experimental or control conditions; treatment was instruction in a particular concept	-Ability to generalize "Insect" and "Animal"	-Instruction in the form of a mental set -Sex -Levels of stimulus complexity (related to the number of attributes available)	-Differences were found for students instructed in the concept of "Animal" at all levels of stimulus complexity. -Though no overall differences were found between experimental and control groups for the concept of "Insect" due to ceiling effects, when degree of stimulus complexity was considered, students in the experimental group were able to select slightly more instances of the most complex items illustrating this concept ($\bar{x}_{exp} = 4.63$, $\bar{x}_c = 3.79$, $p < .05$). -No sex differences were found in ability to generalize.
Brown, Fournier & Moyer (1977)	75 White 75 Mexican-American	Grade 5	Colorado, rural district	-Science Concepts Test (Fournier, 1975) -Science grade	-Piagetian Concrete Reasoning Test: • Conservation of weight • Length • Area • Continuous quantity (volume) • 1:1 correspondence • Class inclusion • Transivity • Euclidean space • Spatiality • Velocity -Ethnicity -Home language	-Mexican-American students scored significantly lower than White students on both tests, $p < .01$. -Author's conclusion: Student lag in development was ~2+ years. -Having a Spanish surname and Spanish as a home language were negatively related to science achievement and performance on Piagetian test. -Science grade was predicted by "velocity," ($r^2 = .26$). -Science test was predicted by "volume" ($r^2 = .39$) and "spatiality" ($r^2 = .41$).

Table 7 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Cohen (personal communication, 1984)	129 students	Grade 4	Four 4th grade and one 5th grade bilingual classes in Santa Clara County, California	-CTBS Science national percentile	-Bilingual program involving hands-on and cooperative learning experience	-Students in 4th Grade classes raised their performance, on average, from 36% to 49% over a one-year period.
	24 students (predominantly Hispanic)	Grade 5				-Students in the one 5th Grade class raised their performance from 29% to 32% over a one-year period.
Holmes (1982)	Total sample 80,000 students; of these, 2,500 at each age answered each exercise 400 Blacks 125 Hispanics 50 Asians 50 Native Americans 1,925 Whites	9 & 13 years	NAEP science assessment, 1976-1977. Unit of analysis was the number of items with national % pass of 50% or better: 96 items for 9-year-olds, 120 items for 13-year-olds	-Difference between Black and national performance in passing	Test domain: -Taxonomy (knowledge, skills, understanding, applications) -Category (biology, physical science)	-9 year old Black students have difficulty with comprehension exercises, applications and knowledge (not analysis or synthesis), biology and physical science. -13 year old Black students had trouble with comprehension and applications, biology and physical science.
Howe, Hall, Stanback, & Seidman (1983)	26 White males 26 Black males	Grades 8 & 9	Science classrooms (activity centered) urban junior high	-Final grade in science	-19 categories of observation -California Achievement Test: Math -California Achievement Test: Reading -Ethnicity	-No race difference in observed "learning," "attending" or "nonattending" were found. -Controlling for CAT-M and CAT-R, "learning" (r=.47, p<.01) and "attending" (r=.40, p<.01) were positively associated with end of year grade, and nonattending was negatively associated with end of year grade for Black but not for White males.

Table 7 (continued)

Author & Year	Characteristics #/Ethnicity/Sex	Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Howe & Shayer (1981)	29 males 35 females	10 years	Three intact classes in Bedfordshire, England	-Volume and heaviness: (conservation of substance, conservation of weight, density and volume, displaced volume, size); tasks rated on 1-6 scale corresponding to Piagetian levels of development	-Guided classroom experiences with volume and heaviness -Sex	-Pretest: MDF ($\bar{x}_m$=3.8, $\bar{x}_f$=3.1) t =2.54, p<.01 -Posttest: MDF ($\bar{x}_m$=4.2, $\bar{x}_f$=3.9) but no difference in change between males and females -No test of mean posttest difference was conducted.
	25 females 22 males	Grade 4 10 years	2 intact classrooms, in Austin, Texas		-Guided classroom experience -Sex	-Pretest: MDF ($\bar{x}_m$=3.8, $\bar{x}_f$=2.9) t=2.68, p<.01 -Posttest: MDF ($\bar{x}_m$=4.6, $\bar{x}_f$=3.9), but no difference in change between males and females -No test of mean posttest difference was conducted. [Note: The females did gain more than the males for both British and American students, but males still exceeded female performance.] -Also, there was no difference in the pattern of development of ideas of volume and density; rather, a time lag in development for girls was found.

Table 7 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Langer, Kalk, & Searls (1984)	97,000 White 17,000 Black	9, 13 & 17 year olds	NAEP assessment, 1974-1975, 1976-1977, 1977-1978	-Combined math, science and reading (ratio of correct responses to attempted exercises)	-Class age -Relative age -Sex -Parent education -Home environment -Region -Type of community	-For 9 year old White students, all factors with the exception of sex were significantly related to achievement. -For 9 year old Black students all factors including sex were significantly related to achievement. For these students sex was negatively related ($\beta = -.045$, $F = 6.6$, $p < .01$). -For 13 years old White students, all factors with the exception of age were significantly related to achievement. For these students the effect for sex was $\beta = .023$, $F = 9.4$, $p < .01$. -For 13 year old Black students, all factors with the exception of sex were significantly related to achievement.

Table 7 (continued)

Author & Year	Sample Characteristics: #/Ethnicity/Sex	Sample Characteristics: Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Linn & Pulos (1983)	145 males 159 females	Grade 7	3 school districts in California	-Predicting Displaced Volume Test	-Crystalized ability (vocabulary) -Fluidability (letter series) -Cognitive style (find a shape) -Spatial visualization (paper folding) -Horizonality/verticality (water level) -Formal reasoning (balance, controlling variables, permutations, combinations) -Sex	-Sex differences in predicting displaced volume were found, $\bar{x}_m = 63\%$, $\bar{x}_f = 49\%$. -Males used correct volume strategies more often; as females get older they increase their use of volume strategies. -Determinants of predicting displaced volume were vocabulary, letter series, familiar field, SES and sex (not formal reasoning or courses).
Lynch & Paterson (1980)	481 students 504 students	Grade 7 Grade 8	Six Tasmanian high schools (12-16 years) including one all-boys school	-16 concept words in science (K-R = .71) as multiple-choice and as free response items (mass, length, area, volume; solid, liquid, gas; element, compound, mixture; atom, molecule, ion; electron, proton, neutron)	-Sex -Grade	-At 7th Grade, significant differences between males and females for 8 of 16 items: atom, molecule, ion, solid, liquid, volume, compound, and mixture. [Note: For molecule, F>M; all others, M>F. No means provided.] -From figures, the sex differences at 7th grade appear to range from 3% to 15% points. -Though statistical analyses were not conducted for 8th grade students, M>F on 7 of 18 items: liquid, solid, mass, volume, neutron, compound, and electron. F>M on molecule and protron. Though most differences are relatively small, increasing differences are seen for mass, volume, liquid and solid in favor of males.

Table 7 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Morse & Handley (1982)	81 females 94 males (41% White 59% Black) 89 females 101 males (40% White 60% Black)	Grade 7 Grade 8	7th-grade students observed on six occasions for total of 3 hours of observation over a period of 15 months; at the end of the study students were in 8th grade	-Cooperative Science Test (CST)	-Task-related social interaction -Observation with student as target -Sex	-Sex differences in task-related social interaction were found in science classrooms. -M>F for total interactions and number of instructional questions posed by teacher in both 7th and 8th grade. -F>M for student response time in 8th grade. -Interaction variables entered as a set (no response to questions, unsolicited responses, direct instructional questions, teacher-initiated instructions, simple acknowledgment, correct responses, teacher wait time, and social questions) accounted for 23% of the variance in students' science achievement $F(8,146) = 5.48$, $p < .01$. [Note: Ethnic differences were not reported.]
Newcombe & Bandura (1983)	85 White females	11 years	Laboratory-volunteer sample	-Spatial Relations Subtest of Primary Mental Abilities Test -Block Design Subtest of WISC-R	-Femininity -Personality Attributes -Intellectually relevant masculine sex-typed items -Liking to be person of opposite sex -Activity in spatial activities -Physical maturation (% body fat)	-Spatial abilities correlated with socially desirable masculine traits, $\beta = .43$, $p < .001$ Ideal self, $\beta = .37$, $p < .01$ Opposite sex desire, $\beta = .28$, $p < .01$ Socially desirable feminine traits, $\beta = -.25$, $p < .05$ CPI femininity, $\beta = .38$, $p < .001$ Physical maturation $\beta = .25$, $p < .01$.

Table 7 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Overton & Meehan (1982)	33 females 27 males	Mean age 13 years, 4 months 13 years, 4 months	Catholic school attendees; White middle class	-Pendulum task - a variation of Inhelder & Piaget task -Card sorting task based on information from pendulum task -Plant task—attributing causal factors to plant health -Combinations task to test for systematic strategy	-Intellectual Achievement Responsibility Scale: helpless vs. mastery-oriented -Sex role	-Main effect for helpless/mastery ($F(6,53) = 2.42$, $p < .04$) and sex role x helpless/mastery ($F(6,53) = 2.35$, $p < .01$) were found on all tasks taken together. For all but plant task, masculine/helpless subjects and androgynous/mastery subjects performed better than androgynous/helpless subjects. On plant task, masculine/helpless and feminine/mastery subjects performed better than feminine/helpless. -"The present study found no formal operational competence deficit for females. Nor did individuals with a feminine sex role perform more poorly than those with a masculine sex role."
Payne, Smith & Payne (1983)	24 Black males 39 Black females 40 White males 68 White females 26 Black males 41 Black females 68 White males 52 White females	Grade 4 Grade 8	Participants in innovative science curriculum in urban school system, Georgia	-Aggregate Science Test Score, derived from 4 objectives-based exams developed by authors -Exams covered material taught during school year	-Survey of Feelings About Tests developed from Harnisch, Hall, & Fyans (1980) instrument -Ethnicity -Grade	-Significant correlations were found between test anxiety and test performance for: .39 Black male-grade 4 -.31 White male-grade 4 -.30 White male-grade 8 -.39 White female-grade 8 -Only for Black males in grade 4 were more anxious students better performers.

Table 7 (continued)

Author & Year	Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Ryman (1977)	48 White males 48 White females	Mean age 12 years, 5 months	England	-Classification Test in biology	-Type of instruction: .Traditional .Nuffield hands-on sorting of specimens -Sex -Intelligence	-Males in traditional (T) classes scored higher (32.58) than Nuffield (N) males (27.42) or females in (T) 25.42 or Nutfield (N) 24.58 classes. -Interaction of sex, intelligence, and treatment found: .Smart females scored higher in N (34.17) than T (21.67). .Below-average females scored higher in T (29.17) than in N (15.00). .Smart males scored higher in T (37.42) than N (33.92). .Below-average males scored higher in T than N. -No significant first-order sex effect found. -No significant sex x treatment or sex x intelligence effects found. -Significant sex x treatment x intelligence ($F=7.04$, $p<.01$) found. -This suggests that lack of experience with science objects may be causing lower achievement for females.

Table 7 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Treagust (1980)	18 males 18 females	Grade 8	Individually interviewed (no information on sex ot interviewer)	-Telephone poles task -Railway lines task -Rods task -Water level -Similar triangles -Model landscape	-Sex	-Significant sex differences in telephone poles, rods, water level, and triangles found, M>F, p<.05. -Number of students who passed: M F 36 : 21 on telephone poles 21 : 5 on rods 36 : 16 on water level 21 : 9 on triangles -Only 2 subjects passed model landscape. On railway ties, something taught in art class, no sex difference observed. -No discussion of when these tasks should be learned.

Table 8

FACTORS RELATED TO COMPUTER PARTICIPATION AND ATTITUDES

Author & Year	Sample Characteristics #/Ethnicity/Sex	Sample Characteristics Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Collis (1984)	539 males 479 females	Grade 8	Victoria, BC Canada	-Computer class participation	-24 item constructed attitude survey	-Attitudes correlated with experience for males ($p<.01$) but not for females ($p<.09$). -Attitudes account for 5% of the variance in school experience for males and 3% for females. -"A negative correlation occurred between computer studies and self-confidence in math for grade 8 females."
Demarest & McKenzie (unpublished manuscript, 1984)	112 males 111 females	Grades 3 & 4	All students in one district enrolled in Logo program	-Ratings of comfort with computers	-Home Ownership	-55.6% home owners and 38.3% non-owners reported high comfort with computers ($p<.05$).
Fetler (1985)	293,717 students	Grade 6	California Statewide Testing, 1983	Survey of Basic Skills: Computer Literacy -Vocabulary -Interactive and batch -Systems components -History -Systematic procedures -Simple programs -Specific uses -Careers	-Sex -SES (as measured by parental occupation)	-Children from professional or more skilled families > children from less skilled families. Differences in computer literacy according to parental occupation are 1.5 times larger than sex differences. -No interaction between SES and sex though the difference between sexes was greatest at semiprofessional and professional levels with M>F.

Table 8 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Lockheed (1984)	42 males 45 females 106 males 95 females	Grades 7 & 8 Grades 7 & 8	Oregon Wisconsin Alliance Equity Project to increase female access to computers	-Computer class participation -Experience gain	-Sex -Intervention program -Access -Computer class -Frequency of computer use	For computer class participation: -In Oregon, at the beginning of the year, M>F (64% vs 22%); at the end of the -In Wisconsin, at the beginning of the year, M ≅ F (41% vs 45%); at the end of the year, both increased participation to about 70%. -For females, access, class participation and frequency of use were significantly related to experience gain. -For males, only prior experience and frequency of use were related to gain.
Perez & White (1983)	19 females 21 males	Grade 6	Parochial school	-Rating of computer games (1-10, high rating positive)	-Motivational quality of game: • Action • Simulation • Puzzle, problem solving	Action: M>F, $\bar{x}_m = 8.78$, $\bar{x}_f = 7.80$ Simulation: M>F, $\bar{x}_m = 9.3$, $\bar{x}_f = 8.4$ Puzzle: F>M, $\bar{x}_f = 9.14$, $\bar{x}_m = 7.5$

Table 8 (continued)

Author & Year	Sample Characteristics #/Ethnicity/Sex	Age/Grade	Setting/Experimental Condition	Dependent Variable/Measure	Independent Variable/Measure	Findings/Results
Swadener & Hannafin (1984)	17 males 15 females	Grade 6	Middle class suburban district (15% minority population)	17-item constructed computer attitude scale: -General attitude toward computers -Self confidence with computers -Utility of computers	-Sex -Math achievement level (high vs. low)	-Significant effect for math achievement ($F=4.1$, $p<.05$) on computer self confidence, no math by sex interaction. -No main effect of math achievement for perceived utility of computers, though sex by math ability interaction was significant ($F=3.69$, $p<.07$). However, mean response was "no opinion." -No main effect for math achievement on general attitude, but interaction of achievement by sex was significant ($F=4.57$, $p<.04$). High math females and low math males rated computers lower than low math females and high math males.
Wilder, Mackie, & Cooper (1985)	44 males 40 females	Grades 4 & 5	Suburban community in central New Jersey -Pacman -Missile Command	-Liking of games (5-point scale, with high rating indicating liking)	-Type of game: •Paper and pencil (Maze game) •Nonviolent computer game (Pacman) •Violent computer game (Missile Command)	-Female players liked Maze (4.25) > Pacman (4.0) > Missile Command (3.3). -Males liked all equally (4.2, 4.4, 4.4 respectively).

References

References

Aiken, L. R., Jr. (1972). Language factors in learning mathematics. Review of Educational Research, 42(3), 359-385.

Akers, G. D. (1980). The effect of behavioral objectives on student achievement in introductory physical science (IPS). (Doctoral Dissertation, University of Maryland, 1979.) Dissertation Abstracts International, 40(9), 4983-A.

Anick, C.M., Carpenter, T. P., & Smith, C. (1981). Minorities and mathematics: Results from the National Assessment of Educational Progress. Mathematics Teacher, 73, 560-566.

Armstrong, J. M. (1980). Achievement and participation in mathematics: An overview. Report of a two-year study (Grant No.NIE-G-77-0061). Washington, D.C.: National Institute of Education.

Arzi, Y. & Amir, Y. (1977). Intellectual and academic achievements of underprivileged children in homogeneous and heterogeneous classrooms. Child Development, 48(2), 726-729.

Benbow, C. P. & Stanley, J. (1983). Sex differences in mathematical reasoning ability: More facts. Science, 222(4627), 1029-1031.

Bernreuter, J. D., III. (1981). A study of self concept and achievement of inner city Black seventh grade students as influenced by values clarifications lessons in science. (Doctoral dissertation, University of Northern Colorado, 1980.) Dissertation Abstracts International, 41(9), 3937-A.

Bin Abdullah, K., & Lowell, W. E. (1981). The ability of children to generalize selected science concepts. Journal of Research in Science Teaching, 18(6), 547-555.

Bookman, A. B., & Iwanicki, E. F. (1983). The effects of test preparation on standardized mathematics achievement test performance. Journal of Research and Development in Education, 16(4), 46-51.

Boswell, S. I., & Katz, P. A. (1980). Nice girls don't study mathematics (Grant No. NIE-G-79-0023). Washington, D.C.: National Institute of Education. (Eric Document Reproduction Service No. ED 188 888)

Bredderman, T. (1983). Effects of activity-based elementary science on student outcomes: A quantitative synthesis. Review of Educational Research, 53(4), 499-518.

Brophy, J. (in press). Interactions of male and female students and male and female teachers. In L. C. Wilkinson & C. B. Marrett (Eds.), Gender related differences in the classroom. Academic Press.

Brown, R. L., Fournier, J. F., & Moyer, R. H. (1977). A cross-cultural study of Piagetian concrete reasoning and science concepts among rural fifth-grade Mexican- and Anglo-American students. Journal of Research in Science Teaching, 14(4), 329-334.

Brush, L. (1980). Encouraging girls in mathematics: The problem and the solution. Cambridge, MA: Abt Books.

Bush, H. L. (1976). An investigation of eighth grade pupils' understanding of quantitative concepts from United States history textbooks. (Doctoral dissertation, University of the Pacific, 1976). Dissertation Abstracts International, 37(4), 2104-A.

California Assessment Program, State Department of Education. (1982). Student achievement in California schools: 1981-1982 annual report. Sacramento, CA: Author.

Cohen, E. G. (1984). Talking and working together: Status, interaction, and learning. In P. L. Peterson, L. C. Wilkinson, & M. Hallinan (Eds.), The social context of instruction: Group organization and group processes (pp. 171-187). San Diego: Academic Press.

Cohen, E. G. (personal communication, 1984)

Cohen, J. (1969). Statistical power analysis for the behavioral sciences. New York: Academic Press.

Collis, B. A. (1984). The development of an instrument to measure attitudes of secondary school males and females toward computers. Unpublished doctoral dissertation, University of Victoria.

Conway, P. D. C. (1977). A longitudinal analysis of intellectual ability and educational achievement of children from different social class and cultural groups. (Doctoral dissertation, University of Nebraska, 1976). Dissertation Abstracts International, 37(7), 4223-A.

Creswell, J. L. (1980). A study of sex-related differences in mathematics: Achievement of Black, Chicano, and Anglo adolescents. (Eric Document Reproduction Service No. ED 189 029)

Creswell, J. L., & Exezidis, R. H. (1982). Research brief - Sex and ethnic differences in mathematics achievement of Black and Mexican-American adolescents. Texas Technical Journal of Education, 9(3), 219-222.

Creswell, J. L., & Houston, G. M. (1980). Sex related differences in mathematics achievement of Black, Chicano, and Anglo adolescents. Paper presented at the Annual Meeting of the American Educational Research Association, Boston. (Eric Document Reproduction Service No. ED 198 073)

Crosswhite, F. J., Dossey, J. A., & Swafford, J. O. (April, 1984). Second study of mathematics: Interim summary report -- United States. Champaign, IL: International Association for the Evaluation of Educational Achievement, U.S. National Coordinating Center, University of Illinois.

Demarest, M., & McKenzie, J. (1984). Probing the computer gender gap. Unpublished manuscript.

Druva, C. A., & Anderson, R. D. (1983). Science teacher characeristics by teacher behavior and by student outcome: A meta-analysis of research. Journal of Research in Science Teaching, 20(5), 467-479.

Eccles, J. (Parsons) (1983). Achievement and achievement motives. In J. T. Spence (Ed.), Expectancies, values, and academic behaviors (pp. 75-146). San Francisco: W. H. Freeman & Company.

Entwistle, D. R. & Hayduk, L. A. (1982). Early Schooling: Cognitive and Affective Outcomes. Baltimore, MD: The Johns Hopkins University Press.

Fendrich-Salowey, G., Buchanan, M., & Drew, C. J. (1982). Mathematics, quantitative, and attitudinal measures for elementary school boys and girls. Psychological Reports, 51(1), 155-162.

Fennema, E., & Sherman, J. (1978). Sex-related differences in mathematics achievement and related factors: A further study. Journal for Research in Mathematics Education, 9(3), 189-203.

Fetler, M. (1985). Computer literacy in California schools. Sex Roles: A Journal of Research, 13(3/4), 181-192.

Fleming, M. L., & Malone, M. R. (1983). The relationship of student characteristics and student performance in science as viewed by meta-analysis research. Journal of Research in Science Teaching, 20(5), 481-495.

Good, T. L. & Findley, M. J. (1982). Sex role expectations and achievement. Unpublished manuscript.

Graybill, L. (1975). Sex differences in problem-solving ability. Journal of Research in Science Teaching, 12(4), 341-346.

Hannafin, M. J. (1983). Fruits and fallacies of instructional systems: Effects of an instructional systems approach on the concept attainment of Anglo and Hispanic students. American Educational Research Journal, 20(2), 237-249.

Hansford, B. C., & Hattie, J. A. (1982). Relationship between sex and achievement/performance measures. Review of Educational Research, 52(1), 123-142.

Hare, B. R. (1979). Black girls: A comparative analysis of self-perception and achievement by race, sex, and socioeconomic background (Report No. 271). Baltimore, MD: Johns Hopkins University, Center for Social Oranization of Schools.

Hare, B. R. (1980). Self-perceptions and academic achievement: Variations in a desegregated setting. American Journal of Psychiatry, 137(6), 683-689.

Harlen, W., Black, P., Johnson, S., & Palacio, D. (1983). Science in Schools. Age 11: Report No. 2. London, England: DES.

Hess, R. D., & Miura, I. (1985). Gender differences in enrollment in computer camps and classes. Sex Roles: A Journal of Research, 13(3/4), 193-203.

Holmes, B. J. (1982). Black students' performance in the national assessments of science and mathematics. Journal of Negro Education, 51(4), 392-405.

Howe, A. C., & Shayer, M. (1981). Sex-related differences on a task of volume and density. Journal of Research in Science Teaching, 18(2), 169-175.

Howe, A. C., Hall, V., Stanback, B., & Seidman, S. (1983). Pupil behaviors and interactions in desegregated urban junior high activity-centered science classrooms. Journal of Educational Psychology, 75(1), 97-103.

Hueftle, S. J., Rakow, S. J., & Welch, W. W. (1983). Images of science: A summary of results from the 1981-1982 National Assessment in Science. Minneapolis, MN: Minnesota Research and Evaluation Center, University of Minnesota.

Hyde, J. (1981). How large are cognitive gender differences? A meta-analysis using w^2 + d. American Psychologist, 36(8), 892-901.

Jacobowitz, T. (1983). Relationship of sex, achievement and science self concept to the scientific career preferences of black students. Journal of Research in Science Teaching, 20(7), 621-628.

Johnson, R. C. (1981). Psychosocial influences on the math attitudes and interests of Black junior high school students. Unpublished manuscript.

Jones, L. V., Burton, N. W., & Davenport, E. C., Jr. (1982). Mathematics achievement levels of black and white youth (Report No. 165). Chapel Hill: University of North Carolina, L. L. Thurstone Psychometric Laboratory.

Kagan, S., & Zahn, G. L. (1975). Field dependence and the school achievement gap between Anglo-American and Mexican-American children. Journal of Educational Psychology, 67(5), 643-650.

Kagan, S., Zahn, L. G., & Gealy, J. (1977). Competition and school achievement among Anglo-American and Mexican-American children. Journal of Educational Psychology, 69(4), 432-441.

Kahl, S. R., Malone, M. R., & Fleming, M. L. (1982). Sex-related differences in pre-college science: Findings of the science meta-analysis project Paper presented at the Annual Meeting of the American Educational Research Association, New York. (Eric Document Reproduction Service No. ED 216 909)

Kahle, J. B., & Lakes, M. K. (1983). The myth of equality in science classrooms. Journal of Research in Science Teaching, 29(2), 131-140.

Korpi, M. C. (personal communication, 1984)

Kurshan, B., & Williams, J. (1984). The effect of the computer on problem solving skills - a comparison of junior high school boys and girls Manuscript submitted for publication.

Langer, P., Kalk, J. M., & Searls, D. T. (1984). Age of admission and trends in achievement: A comparison of Blacks and Caucasians. American Educational Research Journal, 21(1), 61-78.

LaTorre, R. A., Yu, L., Fortin, L., & Marrache, M. (1983). Gender-role adoption and sex as academic and psychological risk factors. Sex Roles: A Journal of Research, 9(11), 1127-1136.

Lazarowitz, R. (1981). Correlations of junior high school students' age, gender, and intelligence with ability in construct classification in biology. Journal of Research in Science Teaching, 18(1), 15-22.

Lerner, J. W. (1976). Children with learning disabilities. Boston, MA: Houghton Mifflin Company.

Linn, M. C., & Petersen, A. C. (in press). A meta-analysis of gender differences in spatial ability: Implications for mathematics and science achievement. In J. S. Hyde & M. Linn (Eds.), The Psychology of Gender: Advances Through Meta-Analysis. Baltimore, MD: Johns Hopkins University Press.

Linn, M. C., & Pulos, S. (1983). Male-female differences in predicting displaced volume: Strategy usage, aptitude relationships and experience influences. Journal of Educational Psychology, 75(1), 86-96.

Linn, M. C., & Pulos, S. (1983). Aptitude and experience influences on proportional reasoning during adolescence: Focus on male-female differences. Journal for Research in Mathematics Education, 14(1), 30-46.

Llabre, M. M., & Cueves, G. (1983). The effects of test language and mathematical skills assessed on the scores of bilingual Hispanic students. Journal for Research in Mathematics Education, 14(4), 318-324.

Lockheed, M. E. (1984). Evaluation of the Women's Action Alliance Computer Equity Training Project (Grant No. G0083-02954). Princeton, NJ: Educational Testing Service and Department of Education (Women's Educational Equity Act Program), Washington.

Lynch, P. P., & Paterson, R. E. (1980). An examination of gender differences in respect to pupils' recognition of science concept definitions. Journal of Research in Science Teaching, 17(4), 307-314.

Malcom, S. (1983). An assessment of programs that facilitate increased access and achievement of females and minorities in K-12 mathematics and science education. A study conducted for the NSB commission on pre-college education in mathematics, science, and technology. Washington, D.C.: Office of Opportunities in Science and American Association for the Advancement of Science.

Marshall, S. P. (1983). Sex differences in mathematical errors: An analysis of distractor choices. Journal for Research in Mathematics Education, 14(4), 325-336.

Marshall, S. P. (1984). Sex differences in children's mathematics achievement: Solving computations and story problems. Journal of Educational Psychology, 76(2), 194-204.

Matthews, W. (1984). Influences on the learning and participation of minorities in mathematics. Journal for Research in Mathematics Education, 15(2) 84-95.

McCormick, C. H., & Karabinus, R. A. (1976). Relationship of ethnic groups: Self-esteem and anxiety to school success. Educational and Psychological Measurement, 36(4),1093-1100.

McKelvey, B. (Cited in Education Daily, January 25, 1984), 17(17), p. 6.

Meehan, A. M. (1984). A meta-analysis of sex differences in formal operational thought. Child Development, 55(3), 1110-1124.

Miura, I. (1984). Processes contributing to individual differences in computer literacy. Unpublished doctoral dissertation, Stanford University.

Mokros, J. (personal communication, 1984)

Morine-Dershimer, G. (1983). Instructional strategy and the "creation" of classroom status. American Educational Research Journal, 20(4), 645-661.

Morse, L. W., & Handley, H. M. (1982). Relationships of significant others, parental and teacher influences to the development of self concept, science attitudes and achievement among adolescent girls (Grant No. NIE-G-79-0159). Washington, D.C.: National Institute of Education. (Eric Document Reproduction Service No. ED 238 902)

Moskowitz, J. M., Malvin, J. H., Schaeffer, G. A., & Schaps, E. (1983). Evaluation of a cooperative learning strategy. American Educational Research Journal, 20(4), 687-696.

Myers, D. E., & Milne, A. M. (1982). Achievement by gender and home language for elementary and secondary school children: A preliminary analysis. Prepared for Part C: Math and Language Minority Students Project administered by the National Institute of Education (Contract No. 300-80-0778) with the U. S. Department of Education.

Myers, D. E., & Milne, A. M. (1983, February). Mathematics achievement of language-minority students (Draft). Washington, DC: Decision Resources.

National Assessment of Educational Progress (1983). Third national mathematics assessment: Results, trends, and issues (NAEP Report No. 13-MA-01). Princeton, NJ: Educational Testing Service reprint. [Library of Congress Catalog Card Number: 72-183665]

National Assessment of Educational Progress (1984). [Student background questionnaire: Computer related experiences.] Unpublished raw data.

National Center for Education Statistics. (1978). Three National Assessments of Science: Changes in Achievement, 1969-1977. (Science Report No. 08-S-00) Denver, CO: National Assessment of Educational Progress.

National Science Board Commission on Precollege Education in Mathematics, Science and Technology (1983). Educating Americans for the 21st Century. Washington, DC: National Science Foundation.

Nelson, R. E. (1979). Sex differences in mathematics attitudes and related factors among Afro-American students. (Doctoral Dissertation, University of Tennessee, 1978.) Dissertation Abstracts International, 39, 4793-A - 4794-A.

Nelson, W., Knight, G. P., Kagan, S., & Gumbiner, J. (1980). Locus of control, self-esteem, and field independence as predictors of school achievement among Anglo-American and Mexican-American children. Hispanic Journal of Behavioral Sciences, 2(4), 323-335.

Newcombe, N., & Bandura, M. M. (1983). Effect of age at puberty on spatial ability of girls: A question of mechanism. Developmental Psychology, 19(2), 215-224.

Ng, K. M., & Tsang, S. (1980). Mathematical cognitive structures of Chinese-American, Euro-American and Hong Kong Chinese students. Paper presented at the Annual Meeting of the American Educational Research Association, Boston, MA.

Overton, W. F., & Meehan, A. M. (1982). Individual differences in formal operational thought: Sex role and learned helplessness. Child Development, 53(6), 1536-1543.

Paulsen, K., & Johnson, M. (1983). Sex role attitudes and mathematical ability in 4th, 8th, and 11th grade students from a high socioeconomic area. Developmental Psychology, 19(2), 210-214.

Payne, B. D., Smith, J. E., & Payne, D. A. (1983). Sex and ethnic differences in relationships of test anxiety of performance in science examinations by fourth and eighth grade students: Implications for valid interpretations of achievement test scores. Educational and Psychological Measurement, 43(1), 267-270.

Perez, E., & White, M. A. (1983). Student reports of motivational and educational attributes of mathematics microcomputer software versus classroom activity. (Electronic Learning Laboratory Report). New York: Teachers College, Columbia University.

Powers, S., Thompson, D., Azevedo, B., & Schaad, O. (1983). The predictive validity of the Stanford Mathematics Test across race and sex. Educational and Psychological Measurement, 43(2), 645-649.

Pulos, S., Stage, E. K., & Karplus, R. (1982). Setting effects in mathematical reasoning of early adolescents: Findings from three urban schools. Journal of Early Adolescence, 2(1), 39-59.

Revelle, G., Honey, M., Amsel, E., Schauble, L., & Levine, G. (1984). Sex differences in the use of computers. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.

Rosenthal, A. S., Baker, K., & Ginsburg, A. (1983). The effect of language backgound on achievement level and learning among elementary school students. Sociology of Education, 56(4), 157-169.

Rosenthal, R., & Rubin, D. B. (1982). Further meta-analytic procedures for assessing cognitive gender differences. Journal of Educational Psychology, 74(5), 708-712.

Ryman, D. (1977). Teaching methods, intelligence, and gender factors in pupil achievement on a classification task. Journal of Research in Science Teaching, 14(5), 401-409.

Sanchez, J. L. (1980). A comparison of achievement of Mexican and Mexican-American children in the areas of reading and mathematics when taught within a cooperative and competitive goal structure. (Doctoral dissertation, University of California, Santa Barbara, 1979.) Dissertation Abstracts International, 40(3), 1333-A.

Sanders, J. S. (1984). The computer: Male, female or androgynous? The Computing Teacher, 11(8), 31-34.

Sanders, J. S., & Stone, A. (in press). The Neuter Computer: Computers for Girls and Boys. New York: Neal Schuman Publishers.

Schofield, B., Murphy, P., Johnson, S., & Black, P. (1982). Science in schools. Age 13: Report No. 1. London, England: DES.

School Uses of Microcomputers. (April, 1983). (Report from a National Survey) Baltimore, MD.: Johns Hopkins University, Center for Social Organization of Schools, Issue No. 1.

Schubert, J. G., Wolman, J., DuBois, P., and Eaton, M. (1984). Ideas for Equitable Computer Learning. Palo Alto, CA: American Institute for Research.

Sharpley, A. M., Irvine, J. W., & Sharpley, C. F. (1983). An examination of the effectiveness of a cross-age tutoring program in mathematics for elementary school children. American Educational Research Journal, 20(1), 103-111.

Sherman, J. (1980). Mathematics, spatial visualization and related factors: Changes in girls and boys, grades 8-11. Journal of Educational Psychology, 72(4), 476-482.

Shymansky, J. A., Kyle, W. C., Jr., & Alport, J. M. (1983). The effects of new science curricula on student performance. Journal of Research in Science Teaching, 20(5), 387-404.

Slavin, R. E. (1985) Team assisted individualization: Combining cooperative learning and individualized instruction in mathematics. In R. Slavin, S. Sharan, S. Kagan, R. Hertz-Lazarowitz, C. Webb, & R. Schmuck (Eds.), Learning to Cooperate, Cooperating to Learn. New York: Plenum.

Slavin, R. E., & Karweit, N. L. (1985). Effects of whole class, ability grouped, and individualized instruction on mathematics achievement. American Educational Research Journal, 22, 351-367.

Stage, E. K., Kreinberg, N., Parsons, J. E., & Becker, J. R. (1982). Increasing the participation and achievement of girls and women in mathematics, science, and engineering. Manuscript submitted for publication.

Steinkamp, M. W., & Maehr, M. L. (1983). Affect, ability, and science achievement: A quantitative synthesis of correlational research. Review of Educational Reseach, 53(3), 369-396.

Steinkamp, M. W., & Maehr, M. L. (1984). Gender differences in motivational orientations toward achievement in school science: A quantitative synthesis. American Educational Research Journal, 21(1), 39-59.

Strauch, A. B. (1977). More on the sex and race interaction on cognitive measures. Journal of Educational Psychology, 69(2), 152-157.

Stodolsky, S. S. (1984). Frameworks for studying instructional processes in peer work-groups. In P. L. Peterson, L. C. Wilkinson, & M. Hallinan (Eds.), The social context of instruction: Group organization and group processes (pp. 107-122). San Diego: Academic Press.

Swadener, M., & Hannafin, M. (1984). Similarities and differences in sixth-grader's attitudes toward computers: An exploratory study. Unpublished manuscript.

Treagust, D. F. (1980). Gender-related differences in spatial representational thought. Journal of Research in Science Teaching, 17(2), 91-97.

Tsai, S., & Walberg, H. J. (1983). Mathematics achievement and attitude productivity in junior high school. Journal of Educational Research, 76(5), 267-272.

Tsang, S. L. (1976). The effects of the language factor and the cultural content factors of mathematics achievement test on Chinese and Chicano students (Doctoral dissertation, Stanford University, 1976). Dissertation Abstracts International, 37(2), 714-A.

Turrentine, S. H. (1982). The relationship between body mass and self concept in preadolescents and adolescents. (Doctoral dissertation, University of North Carolina at Chapel Hill, 1981) Dissertation Abstracts International, 42(6), 2313-B.

Webb, N. M. (1984). Sex differences in interaction and achievement in cooperative small groups. Journal of Educational Psychology, 76(1), 33-44.

Webb, N. M., & Cullian, L. K. (1983). Group interaction and achievement in small groups: Stability over time. American Educational Research Journal, 20(3), 411-423.

Webb, N. M., & Kenderski, C. M. (1984). Student interaction and learning in small-group and whole-class settings. In P. L. Peterson, L. C. Wilkinson, and M. Hallinan (Eds.), The social context of instruction: Group organization and group processes (p. 153-170). San Diego: Academic Press.

White, K. R. (1982). The relationship between SES and academic achievement. Psychological Bulletin, 91(3), 461-481.

Wilder, G., Mackie, D., & Cooper, J. (1985). Gender and computers: Two surveys of computer related attitudes. Sex Roles: A Journal of Research, 13(3/4), 215-228.

Wilder, G., Mackie, D., & Cooper, J. (1985). Gender, computers and computer generated games: Three empirical studies. Unpublished manuscript.

Willson, V. L. (1983). A meta-analysis of the relationship between science achievement and science attitude: Kindergarten through college. Journal of Research in Science Teaching, 20(9), 839-850.

Wise, K. C., & Okey, J. R. (1983). A meta-analysis of the effects of various science teaching strategies on achievement. Journal of Research in Science Teaching, 20(5), 419-435.

Wright, D. (personal communication, 1983)

Appendix A

Table of Meta-Analyses

META-ANALYSES

Factors	Outcome Measures	Mean Effects (number of studies)	Author & Year	Notes
Science program:	Science process	AB>NAB Δ = .52 (28)	Bredderman (1983)	-No significant sex effect. 12 of 57 studies were published since 1975 and included students in grades 4-8. The remaining studies were conducted from 1967-1977 and included students in grades K-8 and 10.
Activity-based science programs (AB)	Science content	Δ = .16 (14)		
Non-activity based programs (NAB)	Math achievement	Δ = .12 (7)		
	Intelligence	Δ = .48 (2)		
	Creativity	Δ = .42 (5)		
	Affective	Δ = .28 (15)		
Science program effect within SES	Aggregated program outcome	AB>NAB Δ = .65 disadvantaged students		-The effect of activity based science programs is greater for disadvantaged students than for average students or advantaged students for all outcomes except affective.
		Δ = .30 average students		
		Δ = .22 advantaged students		
Sex: male(M)/female(F)	Combined cognitive level	M>F Δ = .06 (36) elementary	Fleming & Malone (1983)	-Combined cognitive level refers to student ability to perform on written tasks at various taxonomic levels (i.e., Bloom, Piaget). 169 studies were analyzed. These studies were published from 1960-1981 and included students in grades K-12. Information on publication date and subjects' grade is not reported for individual studies.
		M>F Δ = .23 (22) middle		
	Science achievement	M>F Δ = .04 (16) elementary		
		M>F Δ = .32 (11) middle		
	Science attitude	M>F Δ = .18 (9) elementary		
		M>F Δ = .11 (7) middle		
Ethnic: (not controlling for SES) White (W)/Black(B)	Combined cognitive level	W>B Δ = .43 (11) elementary		
		W>B Δ = .42 (12) middle		
	Science achievement	W>B Δ = .34 (5) elementary		
		W>B Δ = .47 (5) middle		
	Science attitude	W>B Δ = .40 (3) elementary		
		W>B Δ = .02 (4) middle		
White(W)/Hispanic(H)	Combined cognitive level	W>H Δ = .35 (12) elementary		
		W>H Δ = .33 (10) middle		
	Science achievement	W>H Δ = .30 (5) elementary		
		W>H Δ = .30 (4) middle		
	Science attitude	W>H Δ = .08 (3) elementary		
		W>H Δ = .02 (4) middle		

Factors	Outcome Measures	Mean Effects (number of studies)	Author & Year	Notes
Sex: male(M)/female(F)	Quantitative ability Visual-spatial Field articulation (RFT, GEFT)	M>F d = .43 (16) ω^2 = .01 M>F d = .45 (10) ω^2 = .043 M>F d = .51 (20) ω^2 = .025	Hyde (1981)	-Studies previously analyzed by Maccoby and Jacklin (1974) plus a few additional studies. Only 1 visual-spatial study and 1 field articulation study were published since 1975 and included students in grades 4-8. The remaining 78 studies were conducted from 1955-1978 and included individuals 11-84 years of age.
Sex: male(M)/female(F)	Selected science cognitive outcomes: Knowledge Comprehension Application Higher processes	 M>F Δ = .05 elementary M>F Δ = .09 junior high M>F Δ = .16 elementary M>F Δ = .16 junior high M>F Δ = .17 elementary M>F Δ = .30 junior high F>M Δ = -.01 elementary M>F Δ = .16 junior high	Kahl, Malone, & Fleming (1982)	-169 studies published between 1960-1982 were analyzed for students in grades K-12. Information on publication date and subjects' grade is not provided for individual studies. Half of the studies examined sex differences.
Sex: male(M)/female(F)	Propositional logic (formulating and testing hypotheses) Combinations Proportional reasoning (volume displacement, equilibrium in hydrolic press and balance, hauling weight on inclined plane, etc.)	M>F Δ = .05 (64) M>F Δ = .05 (43) M>F Δ = .31 (53)	Meehan (1984)	-No age effect on observed sex differences. 21 of 53 studies were published from 1975 on and included students in grades 4-8. The remaining studies were conducted from 1961-1982 and included individuals from 5-79 years of age.

META-ANALYSES

Factors	Outcome Measures	Mean Effects (number of studies)	Author & Year	Notes
Elementary general science program: New science curricula (NSC) Traditional (T)	Achievement	NSC>T $\Delta = .35$	Shymansky, Kyle & Alport (1983)	-105 studies of students in grades K-12 were included in the analyses. Studies were published from 1955-1980. Information on publication date and subjects' grade is not provided for individual studies.
	Perceptions	NSC>T $\Delta = .32$		
	Process skills	NSC>T $\Delta = .59$		
	Analytic skills	NSC>T $\Delta = .06$		
	Related skills	NSC>T $\Delta = .27$		
Junior high life science program: New science curricula (NSC) Traditional (T)	Perceptions	NSC>T $\Delta = .66$		
	Analytic skills	NSC>T $\Delta = .01$		
Junior high physical science program: New science curricula (NSC) Traditional (T)	Achievement	NSC>T $\Delta = .31$		
	Perceptions	NSC>T $\Delta = .31$		
	Process skills	NSC>T $\Delta = .08$		
	Analytic skills	T>NSC $\Delta = -.10$		
Aggregated science program effect within sex grouping	Achievement	NSC>T $\Delta = .25$ male sample		-Only 19 effect sizes were calculated for predominantly female samples, while 123 were coded for predominantly male samples. When sample was greater than or equal to 75% male, it was coded as a male sample. Similarly, when sample was greater than or equal to 75% female, it was coded as a female sample.
		NSC>T $\Delta = .45$ mixed sample		
		NSC>T $\Delta = .55$ female sample		
	Perceptions	T>NSC $\Delta = -.02$ male sample		
		NSC>T $\Delta = .51$ mixed sample		
		NSC>T $\Delta = .32$ female sample		
	Process skills	NSC>T $\Delta = .16$ male sample		
		NSC>T $\Delta = .52$ mixed sample		
		NSC>T $\Delta = .29$ female sample		
	Analytic skills	NSC>T $\Delta = .30$ male sample		
		NSC>T $\Delta = .31$ mixed sample		
		T>NSC $\Delta = -.10$ female sample		
	Related skills	NSC>T $\Delta = .01$ male sample		
		NSC>T $\Delta = .30$ mixed sample		

META-ANALYSES

Factors	Outcome Measures	Mean Effects (number of studies)	Author & Year	Notes
Sex: male(M)/female(F)	Aggregated motivational orientation	M>F Δ = .29 large scale studies	Steinkamp & Maehr (1984)	-298 samples involving school-age students published between 1965-1981 were included in analysis. Information on samples were obtained from 83 articles, science test manuals and an unspecified number of large scale (national and international) studies. Information on publication date and subjects' grade is not provided for individual studies.
	Dimensions of motivational orientation:			
	Science important	M>F Δ = .13 total articles		
		F>M Δ =-.05 large scale studies		
	Enjoy science	M>F Δ = .04 total articles		
		M>F Δ = .35 large scale studies		
	Science and self	M>F Δ = .21 total articles		
		M>F Δ = .16 large scale studies		
	Not just for boys	F>M Δ =-.61 total articles		
		Not given large scale studies		
	Active involvement (extracurricular)	M>F Δ = .12 total articles		
		M>F Δ = .54 large scale studies		
Sex effect within SES	Motivational orientation	F>M Δ =-.22 disadvantaged		
		M>F Δ = .67 upper middle		
		F>M Δ =-.01 mixed		
		F>M ∧ =-.22 disadvantaged, total articles		
		M>F Δ = .67 upper middle, total articles		
		F>M Δ =-.01 mixed, total articles		
Teaching strategies:			Wise & Okey (1983)	-400 effect sizes were obtained from 160 studies published since 1949 and included students in grades 6 to college. 30% ot effect sizes were from studies published since 1975. No sex or ethnic effects were reported.
Experimental Science Teaching Strategies (EST)/Traditional Strategies (T)	Combined achievement measure including high and low cognitive outcomes, problem solving, critical thinking, creativity, logical thinking, and affective measures	EST>T Δ = .36 elementary EST>T Δ = .30 middle		

META-ANALYSES

Factor 1	Factor 2	Mean Correlations (number of studies)	Author & Year	Notes
Teacher age	Student cognitive outcome	r = .13	Druva & Anderson (1983)	-65 studies of students in grades K-12 were included in the analysis. Of these, 75% were conducted during 1966-1975. Information on publication date and subjects' grade is not provided for individual studies. Student sex or ethnicity effects were not examined. -Correlations of student cognitive outcomes and measures of teacher sex, personality, self, sociability, values as well as enthusiasm, efficiency and temperament fell below .1 and were, therefore, omitted from the table. Correlations of student affect and measures of teacher intellect, values, enthusiasm and attitudes were also omitted as r<.1.
Teacher science training	Student cognitive outcome	r = .19		
Teacher education and performance	Student cognitive outcome	r = .10		
Teacher intellectual	Student cognitive outcome	r = .15		
Teacher attitudes	Student cognitive outcome	r = .10		
Teacher age	Student affective outcome	r = .26		
Teacher science training	Student affective outcome	r = .18		
Teacher education and performance	Student affective outcome	r = .12		
Teacher self	Student affective outcome	r =-.12		
Teacher social	Student affective outcome	r =-.14		
Teacher efficiency	Student affective outcome	r =-.20		
Teacher temperament	Student affective outcome	r =-.10		

META-ANALYSES

Factor 1	Factor 2	Mean Correlations (number of studies)	Author & Year	Notes
General ability	Science achievement	r = .25 (9) elementary r = .59 (5) middle	Fleming & Malone (1983)	-169 studies involving students in grades K-12 published from 1960-1981 were included in the analysis. Information on publication date and subjects' grade is not provided for individual studies. -Correlations of sex with science attitude for both elementary and middle grade levels were omitted from the table as r<.1.
SES	Science achievement	r = .20 (9) elementary r = .26 (5) middle		

META-ANALYSES

Factor 1	Factor 2	Mean Correlations (number of studies)	Author & Year	Notes
Aggregated self terms	Math achievement	r = .20 (35)	Hansford & Hattie (1982)	-128 studies were analyzed for students in preschool to college. Information on publication date and subjects' grade not provided for individual studies. -No significant difference between mean correlations for sex [F(1,554) = 1.58, p = .21]. -Trend for low SES to have low positive relationship with self-achievement correlation but problems with defining and measuring SES. -Correlations between achievement/performance and 13 other self terms ≤.27. -Relationship of self-concept and achievement varied depending upon measure used. Mean correlations between measures of self-concept and achievement were greater for teacher ratings (r = .34) or GPA (r = .34) than for standardized measures (r<.21) of achievement.
Aggregated self terms	Science achievement	r = .24 (12)		
Aggregated self terms within grade level	Aggregated performance/ achievement	r = .20 (65) primary r = .27 (44) secondary		
Aggregated self terms within ethnicity	Aggregated performance/ achievement	r = .33 (28) Anglo r = .19 (17) Black r = .23 (4) Chicano		
Aggregated self terms within sex	Aggregated performance/ achievement	r = .26 (40) males r = .24 (39) females		
Aggregated self terms within SES	Aggregated performance/ achievement	r = .13 (18) low r = .25 (15) middle r = .22 (6) high		
Self-concept of ability	Aggregated performance/ achievement	r = .42 (20)		
Self expectation	Aggregated performance/ achievement	r = .53 (1)		

META-ANALYSES

Factor 1	Factor 2	Mean Correlations (number of studies)	Author & Year	Notes
Student age	Student cognitive outcome	r = .30 (16) elementary r = .42 (7) junior high	Kahl, Malone, & Fleming (1982)	-169 studies published between 1960-1981 were analyzed for students in grades K-12. Information on publication date and subjects' grade is not provided for individual studies. Half of the studies examined sex differences.
Student race (White/Black)	Student cognitive outcome	r = .17 (13) elementary r = .19 (12) junior high		
Student race (White/Hispanic)	Student cognitive outcome	r = .13 (12) elementary		
Student SES	Student cognitive outcome	r = .30 (19) elementary r = .29 (13) junior high		
Student attitude/motivation (school/science)	Student cognitive outcome	r = .31 (4) elementary r = .19 (3) junior high		
Student self-concept	Student cognitive outcome	r = .35 (4) junior high		
Student internality	Student cognitive outcome	r = .43 (2) elementary r = .62 (1) junior high		
Student math ability/performance	Student cognitive outcome	r = .46 (8) elementary r = .52 (3) junior high		
Student IQ	Student cognitive outcome	r = .42 (27) elementary r = .43 (14) junior high		
Student age	Student affective outcome	r = .15 (2) elementary r = .15 (1) junior high		
Student sex	Student affective outcome	r = .10 (11) elementary		
Student math ability/performance	Student affective outcome	r = -.16 (1) junior high		
Student IQ	Student affective outcome	r = .19 (3) elementary r = .12 (5) junior high		
Affect within sex	Science achievement	r = .19 males r = .18 females	Steinkamp & Maehr (1983)	-22 of 66 studies were published since 1975 and included students in grades 4-8. The remaining studies were conducted from 1966 and included students from 3 years to college age. -Correlation of cognitive ability with affect was omitted from the table as r<.1.
Cognitive abilities within sex	Science achievement	r = .36 males r = .32 females		

META-ANALYSES

Factor 1	Factor 2	Mean Correlations (number of studies)	Author & Year	Notes
Individual SES	Mathematics achievement	r = .25	White (1982)	-5 out of 101 studies analyzed were conducted since 1975. The remaining studies were published from 1918-1974. Information on publication date and subjects' grades is not provided for individual studies.
School SES	Mathematics achievement	r = .70		
Attitude within grade level	Science achievement	r = .18 elementary r = .14 junior high	Willson (1983)	-43 studies involving students from grades 3 to college were included in the an[illegible] Information on publication date and subjects' grades is not provided for total sample or individual studies.
Attitude within sex grouping	Science achievement	r = .30 all male r = .15 all female r = .14 mixed		

Appendix B

List of Meta-Analyses

Appendix B

List of Meta-Analyses

Bredderman, T. (1983). Effects of activity-based elementary science on student outcomes: A quantitative synthesis. Review of Educational Research, 53(4), 499-518.

Druva, C. A., & Anderson, R. D. (1983). Science teacher characteristics by teacher behavior and by student outcome: A meta-analysis of research. Journal of Research in Science Teaching, 20(5), 467-479.

Fleming, M. L., & Malone, M. R. (1983). The relationship of student characteristics and student performance in science as viewed by meta-analysis research. Journal of Research in Science Teaching, 20(5), 481-495.

Hansford, B. C., & Hattie, J. A. (1982). The relationship between self and achievement/performance measures. Review of Educational Research, 52(1), 123-142.

Hyde, J. S. (1981). How large are cognitive gender differences? A meta-analysis using w^2 and d. American Psychologist, 36(8), 892-901.

Kahl, S. R., Malone, M. R., & Fleming, M. L. (1982). Sex-related differences in pre-college science: Findings of the science meta-analysis project. Paper presented at the annual meeting of the American Educational Research Association, New York.

Linn, M. C., & Petersen, A. C. (in press). A meta-analysis of gender differences in spatial ability: Implications for mathematics and science achievement. In J. Hyde & M. C. Linn (Eds.), The psychology of gender: Advances through meta-analysis. Baltimore: Johns Hopkins University Press.

Meehan, A. M. (1984). A meta-analysis of sex differences in formal operational thought. Child Development, 55, 1110-1124.

Rosenthal, R., & Rubin, D. B. (1982). Further meta-analytic procedures for assessing cognitive gender differences. Journal of Educational Psychology, 74(5), 708-712.

Shymansky, J. A., Kyle, W. C., Jr., & Alport, J. M. (1983). The effects of new science curricula on student performance. Journal of Research in Science Teaching, 20(5), 387-404.

Steinkamp, M. W., & Maehr, M. L. (1983). Affect, ability, and science achievement: A quantitative synthesis of correlational research. Review of Educational Research, 53(3), 369-396.

Steinkamp, M. W., & Maehr, M. L. (1984). Gender differences in motivational orientations toward achievement in school science: A quantitative synthesis. American Educational Research Journal, 21(1), 39-59.

White, K. R. (1982). The relation between socioeconomic status and academic achievement. Psychological Bulletin, 91(3), 461-481.

Willson, V. L. (1983). A meta-analysis of the relationship between science achievement and science attitude: Kindergarten through college. Journal of Research in Science Teaching, 20(9), 839-850.

Wise, K. C., & Okey, J. R. (1983). A meta-analysis of the effects of various science teaching strategies on achievement. Journal of Research in Science Teaching, 20(5), 419-435.

Appendix C

Directory of Intervention Programs

Appendix C

Directory of Intervention Programs

Programs For Minority Students:

American Indian Science and Engineering Society (AISES)
Education Director, Ann Card
1320 College Avenue
Suite 1220
Boulder, Colorado 80303
(303) 492-8658

Blacks and Mathematics (BAM), A Visiting School Lecturer Program sponsored by the Mathematical Association of America (MAA)
Director, Professor John W. Alexander, Jr.
Department of Mathematics
Wentworth Institute of Technology
Boston, Massachusetts 02115
(617) 442-9010

Finding Out/Descubrimiento
Director, Elizabeth B. Cohen, Professor
Program for Complex Instruction
Center for Educational Research at Stanford (CERAS)
Stanford University, Stanford, California 94305
(415) 495-3983

Mathematics, Engineering, Science Achievement Program (MESA)
Executive Director, (Interim), Richard T. Santee
MESA Junior High School Program
Director, Julian Zaragoza
Lawrence Hall of Science
University of California
Berkeley, California 94720
(415) 642-5064

Math Bridge Program
Director, Don Birmingham
University of Minnesota
117 Pleasant Street, S.E.
Minneapolis, Minnesota 55455
(612) 373-2673

National Action Council for Minorities in Engineering (NACME)
Director, Bob Finnell
3 West 35th Street
New York, New York 10001
(212) 279-2626

PRIME, INC.
Executive Director, Alexander Tobin
1831 Chestnut Street, Suite 6B
Philadelphia, Pennsylvania 19103
(215) 563-1718

Program for Rochester to Interest Students in Science and Math (PRISM)
Program Director, Constance Mitchell
Rochester Public Schools
12 Mortimer Street
Rochester, New York 14614
(716) 325-5139

Project SEED (Special Elementary Education for the Disadvantaged)
Director, William F. Johntz
2336-A McKinley Avenue
Berkeley, California 94703
(415) 644-3422

Saturday Academy
Director, Nellouise D. Watkins
Bennett College
900 East Washington Street
Greensboro, North Carolina 27401-3239
(919) 370-8648

Saturday Science Academy
Director, Melvin Webb
Center for Science and Engineering (RCSE)
Atlanta University
223 Chestnut Street, S.W.
Atlanta, Georgia 30314
(404) 681-0393

Southeast Consortium for Minorities in Engineering (SECME)
Executive Director, Carolyn C. Chesnutt
Assistant Director, Ann Wilson
Georgia Institute of Technology
Mail Code 0270
Atlanta, Georgia 30332
(404) 894-3314

Programs for Girls:

Computer Equity Training Project*
Director, Jo Shuchat Sanders
Women's Action Alliance, Inc.
370 Lexington Avenue
New York, New York 10017
(212) 523-8330

*Though the project is no longer operating a product is available describing strategies used.

Expanding Your Horizons in Math and Science
Math/Science Network
Math/Science Resource Center
Director, Jan MacDonald
Mills College
Oakland, California 94613
(415) 430-2230

Math for Girls Project
Director, Nancy Krienberg
Lawrence Hall of Science
University of California
Berkeley, California 94720
(415) 642-1823

Women and Mathematics: Visiting Lecture program, sponsored by the Mathematics Association of America
National Director, Dr. Carole Lacampagne
Department of Mathematics
University of Michigan - Flint
Flint, Michigan 48503
(313) 762-3244

<u>Programs for Educational Personnel and Parents</u>

EQUALS
Lawrence Hall of Science
Director, Nancy Krienberg
University of California
Berkeley, California 94720
(415) 642-1823

Family Math Program
Director, Virginia Thompson
Lawrence Hall of Science
University of California
Berkeley, California 94720
(415) 642-1823

Ideas for Equitable Computer Learning*
Jane G. Schubert
Principal Research Scientist
American Institute for Research (AIR)
P. O. Box 1113
Palo Alto, California 94302
(415) 493-3550

*Though the project is no longer operating a product is available describing strategies used.

Appendix D

Bibliography

Bibliography

Aiken, L. R., Jr. (1972). Language factors in learning mathematics. Review of Educational Research, 42(3), 359-385.

Akers, G. D. (1980). The effect of behavioral objectives on student achievement in introductory physical science (IPS). (Doctoral Dissertation, University of Maryland, 1979.) Dissertation Abstracts International, 40(9), 4983-A.

Alexander, K. L. & Pallas, A. M. (1983). Reply to Benbow and Stanley. American Educational Research Journal, 20(4), 475-477.

Alexander, S. J. (1977). Locus of control and sex role expectations in black and white, female and male children. Dissertation Abstracts International, 38(2), 957-B.

Anderson, J. G., & Evans, F. B. (1976). Family socialization and educational achievement in two cultures: Mexican-American and Anglo-American. Sociometry, 39(3), 209-222.

Anick, C.M., Carpenter, T. P., & Smith, C. (1981). Minorities and mathematics: Results from the National Assessment of Educational Progress. Mathematics Teacher, 73, 560-566.

Armstrong, J. M. (1980). Achievement and participation in mathematics: An overview. Report of a two-year study (Grant No.NIE-G-77-0061). Washington, D.C.: National Institute of Education.

Armstrong, J. M. (1981). Achievement and participation of women in mathematics: Results of two national surveys. Journal for Research in Mathematics Education, 12(5), 356-372.

Arzi, Y. & Amir, Y. (1977). Intellectual and academic achievements of underprivileged children in homogeneous and heterogeneous classrooms. Child Development, 48(2), 726-729.

Banks, J. A. (1982). Educating minority youth: An inventory of current theory. Education and Urban Society, 15(1), 88-103.

Banks, J. A. (1984). Black youths in predominantly white suburbs: An exploratory study of their attitudes and self concepts. Journal of Negro Education, 53(1), 3-17.

Becker, H. J. (1982). Microcomputers in the classroom - Dreams and realities (Report No. 319). (Eric Document Reproduction Service No. ED 217 872)

Becker, J. R. (1981). Differential treatment of females and males in mathematics classes. Journal for Research in Mathematics Education, 12(1), 40-53.

Benbow, C. P. & Stanley, J. (1983). Sex differences in mathematical reasoning ability: More facts. Science, 222(4627), 1029-1031.

Berndt, T. J. (1982). The features and effects of friendship in early adolescence. *Child Development*, *53*(6), 1447-1460.

Bernreuter, J. D., III. (1981). A study of self concept and achievement of inner city Black seventh grade students as influenced by values clarifications lessons in science. (Doctoral dissertation, University of Northern Colorado, 1980.) *Dissertation Abstracts International*, *41*(9), 3937-A.

Bin Abdullah, K., & Lowell, W. E. (1981). The ability of children to generalize selected science concepts. *Journal of Research in Science Teaching*, *18*(6), 547-555.

Blosser, P. E. (1983). Teaching science to middle school students, Part I. *Journal of School Science and Mathematics*, *83*(6), 516-523.

Blyth, D.A., Simmons, R. G., & Ford, S. C. (1983). The adjustment of early adolescents to school transitions. *Journal of Early Adolescence*, *3*(1&2), 105-120.

Bookman, A. B., & Iwanicki, E. F. (1983). The effects of test preparation on standardized mathematics achievement test performance. *Journal of Research and Development in Education*, *16*(4), 46-51.

Bossert, S. T., Barnett, B. G., & Filby, N. N. (1984). Grouping and instructional organization. In P. L. Peterson, L. C. Wilkinson, & M. Hallinan (Eds.), *The social context of instruction: Group organization and group processes* (pp. 39-51). San Diego: Academic Press.

Boswell, S. I., & Katz, P. A. (1980). *Nice girls don't study mathematics* (Grant No. NIE-G-79-0023). Washington, D.C.: National Institute of Education. (Eric Document Reproduction Service No. ED 188 888)

Boykin, A. W. (1983). The academic performance of Afro-American children. In J. T. Spence (Ed.), *Achievement and achievement motives* (pp. 322-371). San Francisco: W. H. Freeman and Company.

Bredderman, T. (1983). Effects of activity-based elementary science on student outcomes: A quantitative synthesis. *Review of Educational Research*, *53*(4), 499-518.

Bridgeman, B., & Shipman, V. C. (1978). Preschool measures of self-esteem and achievement motivation as predictors of third-grade achievement. *Journal of Educational Psychology*, *70*(1), 17-28.

Brod, R. L. (1979). *Choctaw education*. Box Elder, MT.: LPS & Associates. (Eric Document Reproduction Service No. ED 197 920)

Brophy, J. (in press). Interactions of male and female students and male and female teachers. In L. C. Wilkinson & C. B. Marrett (Eds.), *Gender related differences in the classroom*. Academic Press.

Brown, C. D. (1980). The effects of individualized instruction, locus of control and sex on student achievement and attitude. *Dissertation Abstracts International*, *41*(2), 590-A.

Brown,R. L., Fournier, J. F., & Moyer, R. H. (1977). A cross-cultural study of Piagetian concrete reasoning and science concepts among rural fifth-grade Mexican- and Anglo-American students. Journal of Research in Science Teaching, 14(4), 329-334.

Brush, L. (1980). Encouraging girls in mathematics: The problem and the solution. Cambridge, MA: Abt Books.

Burial, R. (1983). Teacher-student interactions and their relationship to student achievement: A comparison of Mexican-American and Anglo-American children. Journal of Educational Psychology, 75(6), 889-897.

Burns, R. B. (1979). The self concept in theory, measurement, development and behavior. New York: Longmans, Inc.

Bush, H. L. (1976). An investigation of eighth grade pupils' understanding of quantitative concepts from United States history textbooks. (Doctoral dissertation, University of the Pacific, 1976). Dissertation Abstracts International, 37(4), 2104-A.

California Assessment Program, State Department of Education. (1982). Student achievement in California schools: 1981-1982 annual report. Sacramento, CA: Author.

Campbell, P. B. (1984). Girls, boys and too few computers. Manuscript submitted for publication.

Carpenter, T. P., Corbitt, M. K., Kepner, H. S., Jr., Lindquist, M. M., & Reep, R. E. (1980). NAEP Note: Problem solving. (Reprinted from Mathematics Teacher, 73, 427-433.)

Castenell, L. A. (1983). Achievement motivation: An investigation of adolescents' achievement patterns. American Educational Research Journal, 20(4), 503-510.

Cazden, C. B. (1984). Effective instructional practices in bilingual education. Draft written at the request of the National Institute of Education as one of a series of reports to Congress, under contract with E. H. White & Company.

Cazden, C. B., John, V. P., & Hymes, D. (Eds.) (1972). Functions of language in the classroom. New York: Teachers College Press, Columbia University.

Chan, K. S. (1983). Limited English speaking, handicapped, and poor: Triple threat in childhood. In M. Chu-Chang & V.Rodriguez (Eds.), Asian- and Pacific-American perspectives in bilingual education: Comparative research (pp. 153-171). New York: Teachers College Press, Columbia University.

Chan, K. S., & So, A. Y. (1983). The impact of language instruction on the educational achievement of hispanic students. Draft paper. National Center for Bilingual Research, Los Alamitos, CA.

Chu-Chang, M. (Ed.) (1983). Asian and Pacific-American perspectives in bilingual education: Comparative research. New York: Teachers College Press, Columbia University.

Choat, E. (1983). Reflections on the Cockcroft report. Primary school mathematics. Mathematics in School, 29-32.

Christensen, R., Witthuhn, J., & Robertson, C., Jr. (1982). American Indian women and mathematics: An annotated bibliography of selected resources. (Eric Document Reproduction Service No. ED 234 970) (Cover title: "American Women in Mathematics.")

Ciesla, J. L. (1976). Comment on "Sex differences in problem-solving ability." Journal of Research in Science Teaching, 13(6), 573-574.

Clifton, R. A. (1981). Ethnicity, teachers' expectations, and the academic achievement process in Canada. Sociology of Education, 54(4), 291-301.

Cohen, E. G. (1984). Talking and working together: Status, interaction, and learning. In P. L. Peterson, L. C. Wilkinson, & M. Hallinan (Eds.), The social context of instruction: Group organization and group processes (pp. 171-187). San Diego: Academic Press.

Cohen, E. G. (personal communication, 1984)

Cohen, J. (1969). Statistical power analysis for the behavioral sciences. New York: Academic Press.

Collier, M. (1983). Nonverbal factors in the education of Chinese American children: A film study. A report on research conducted with the assistance of National Institute of Education Grant NIE-G-81-0115. Asian American Studies, San Francisco State University.

Collis, D. A. (1984). The development of an instrument to measure atftitudes of secondary school males and females toward computers. Unpublished doctoral dissertation, University of Victoria.

Conway, P. D. C. (1977). A longitudinal analysis of intellectual ability and educational achievement of children from different social class and cultural groups. (Doctoral dissertation, University of Nebraska, 1976). Dissertation Abstracts International, 37(7), 4223-A.

Cooper, B. (1982). Differential experience and degree of selection: A comment on "Schooling and sex roles: The case of GCE 'O' level mathematics." British Journal of Sociology of Education, 3(1), 77-78.

Covington, M., & Omelich, C. (1979). Are causal attributions causal? A path analysis of the cognitive model of achievement motivation. Journal of Personality and Social Psychology, 37(9), 1487-1504.

Crandall, V. C. (1969). Sex differences in expectancy of intellectual and academic reinforcement. In C. P. Smith (Ed.), Achievement-related behaviors in children. New York: Russell Sage.

Creswell, J. L. (1980). A study of sex-related differences in mathematics: Achievement of Black, Chicano, and Anglo adolescents. (Eric Document Reproduction Service No. ED 189 029)

Creswell, J. L., & Exezidis, R. H. (1982). Research brief - Sex and ethnic differences in mathematics achievement of Black and Mexican-American adolescents. Texas Technical Journal of Education, 9(3), 219-222.

Creswell, J. L., & Houston, G. M. (1980). Sex related differences in mathematics achievement of Black, Chicano, and Anglo adolescents. Paper presented at the Annual Meeting of the American Educational Research Association, Boston. (Eric Document Reproduction Service No. ED 198 073)

Crosswhite, F. J., Dossey, J. A., & Swafford, J. O. (April, 1984). Second study of mathematics: Interim summary report -- United States. Champaign, IL: International Association for the Evaluation of Educational Achievement, U.S. National Coordinating Center, University of Illinois.

Cuevas, G. J. (1983). Microcomputers in bilingual classrooms: Ideas for in-service teacher training. Bilingual Journal, 22-24.

Cummins, J. (1979). Linguistic interdependence and the educational development of bilingual children. Review of Educational Research, 49(2), 222-251.

Deaux, K. (1984). From individual differences to social categories: Analysis of a decade's research on gender. American Psychologist, 39(2), 105-116.

DeBold, J. F., & Luria, Z. (1983). Gender identity, interactionism and politics: A reply to Rogers and Walsh. Sex Roles: A Journal of Research, 9(11), 1101-1108.

Demarest, M., & McKenzie, J. (1984). Probing the computer gender gap. Unpublished manuscript.

Denno, D. (1982). Sex differences in cognition: A review and critique of the longitudinal evidence. Adolescence, 17(68), 779-788.

Dillon, J. T. (1981). Male-female similarities in class participation. Journal of Educational Research, 75(1), 350-353.

Dornbusch, S. M. (1974). To try or not to try. Stanford Magazine, 2, 51-54.

Dorsey, O. L., & Burleson, J. (1982). Automated learning, individual instruction and computers in the small school classroom. (Eric Document Reproduction Service No. ED 228 003)

Druva, C. A., & Anderson, R. D. (1983). Science teacher characeristics by teacher behavior and by student outcome: A meta-analysis of research. Journal of Research in Science Teaching, 20(5), 467-479.

Dumont, R. V., Jr. (1972). Learning English and how to be silent: Studies in Sioux and Cherokee classrooms. In C. B. Cazden, V. P. John, & D. Hymes (Eds.), Functions of language in the classroom (pp. 344-369). New York: Teachers College Press, Columbia University.

Dweck, C. S., & Bush, E. (1976). Sex differences in learned helplessness: I. Differential debilitation with peer and adult evaluations. Developmental Psychology, 12(2), 147-156.

Dweck, C. S., & Goetz, T. E. (1978). Attributions and learned helplessness. In J. H. Harvey, W. Ickes, & R. F. Kidd (Eds.), New directions in attribution research. Volume 2. Hillside, NJ: Lawrence Erlbaum.

Dweck, C. S., Goetz, T. E., & Strauss, N. L. (1980). Sex differences in learned helplessness: IV. An experimental and naturalistic study of failure generalization and its mediators. Journal of Personality and Social Psychology, 38(3), 441-452.

Eccles, J. (Parsons) (1983). Achievement and achievement motives. In J. T. Spence (Ed.), Expectancies, values, and academic behaviors (pp. 75-146). San Francisco: W. H. Freeman & Company.

Ehindero, O. J. (1982). Correlates of sex-related differences in logical reasoning. Journal of Research in Science Teaching, 19(7), 553-557.

Entwistle, D. R. & Hayduk, L. A. (1982). Early Schooling: Cognitive and Affective Outcomes. Baltimore, MD: The Johns Hopkins University Press.

Erb, T. O. (1983). Career preferences of early adolescents: Age and sex differences. Journal of Early Adolescence, 3(4), 349-359.

Feldman, D. (1973). Problems in analysis of ability patterns. Child Development, 44, 12-18.

Fendrich-Salowey, G., Buchanan, M., & Drew, C. J. (1982). Mathematics, quantitative, and attitudinal measures for elementary school boys and girls. Psychological Reports, 51(1), 155-162.

Fennema, E. (1976). Influences of selected cognitive, affective, and educational variables on sex-related differences in mathematics learning and studying (Grant No. P-76-0274). Washington, D.C.: National Institute of Education.

Fennema, E. (1981). Attribution theory and achievement in mathematics. In S. R. Yussen (Ed.), The development of reflection. New York: Academic Press.

Fennema, E., & Carpenter, T. P. (1981). Sex-related differences in mathematics: Results from national assessment. Mathematics Teacher, 73, 555-559.

Fennema, E., & Sherman, J. (1977). Sex-related differences in mathematics achievement, spatial visualization and sociocultural factors. American Educational Research Journal, 14(1), 51-71.

Fennema, E., & Sherman, J. (1978). Sex-related differences in mathematics achievement and related factors: A further study. Journal for Research in Mathematics Education, 9(3), 189-203.

Fennema, E., Wolleat, P. L., Becker, A. D., & Pedro, D. (1981). Increasing women's participation in mathematics: An intervention study. Journal for Research in Mathematics Education, 12(1), 3-14.

Fernandez, C., Espinosa, R. W., & Dornbusch, S. M. (1975). Factors perpetuating the low academic status of Chicano high school students. (Research and Development Memorandum No. 138). Stanford, CA.: Stanford Center for Research and Development in Teaching. (Eric Document Reproduction Service No. ED 110 241)

Fetler, M. (1985). Computer literacy in California schools. Sex Roles: A Journal of Research, 13(3/4), 181-192.

Fleming, M. L., & Malone, M. R. (1983). The relationship of student characteristics and student performance in science as viewed by meta-analysis research. Journal of Research in Science Teaching, 20(5), 481-495.

Fox, L. H. (1976). The Effects of Sex Role Socialization on Mathematics Participation and Achievement (Contract No. FN17-400-76-0114). Washington, D.C.: National Institute of Education.

Freed, N. H. (Private Practice, Palo Alto, Ca.) (1983). Foreseeably equivalent math skills of men and women. Pyschological Reports, 52(1), 334.

Frieze, I. H., Fisher, J., Hanusa, B., McHugh, M., & Valle, V. (1978). Attributing the causes of success and failure: Internal and external barriers to achievement in women. In J. Sherman & F. Denmark (Eds.), Psychology of women: Future directions of research. New York: Psychological Dimensions.

Garwood, S. G., & Allen, L. (1979). Self-concept and identified problem differences between pre- and postmenarcheal adolescents. Journal of Clinical Psychology, 35(3), 528-537.

Good, T. L. & Findley, M. J. (1982). Sex role expectations and achievement. Unpublished manuscript.

Gottfredson. L. S. (1978). Race and sex differences in occupational aspirations: Their development and consequences for occupational segregation (Report No. 254). Baltimore, MD.: Johns Hopkins University, Center for Social Organization of Schools.

Graybill, L. (1975). Sex differences in problem-solving ability. Journal of Research in Science Teaching, 12(4), 341-346.

Green, R. (1978). Math avoidance: A barrier to American Indian science education and science careers. In R. Green, J. W. Brown, & R.Long (Eds.), Report and recommendations: Conference on mathematics in American education. Washington, D.C.: Educational Foundation of America and American Association for the Advancement of Science. (Eric Document Reproduction Service No. ED 170 084)

Green, R., Brown, J. W., & Long, R. (1978). Report and recommendations: Conference on mathematics in American Indian education. Washington, D.C.: Educational Foundation of America and American Association for the Advancement of Science.

Greif, E. B., & Ulman, K. J. (1982). The psychological impact of Menarche on early adolescent females: A review of the literature. Child Development, 53(6), 1413-1430.

Gross, R. T., Dexter, K., & McCormick, S. (1982). Patterns of maturation: Their effects on behavior and development. The Symposium on Middle Childhood: Developmental Variations and Dysfunction Between Six and Fourteen Years, January 15-17.

Hannafin, M. J. (1983). Fruits and fallacies of instructional systems: Effects of an instructional systems approach on the concept attainment of Anglo and Hispanic students. American Educational Research Journal, 20(2), 237-249.

Hansell, S., & Slavin, R. E. (1981). Cooperative learning and the structure of interracial friendships. Sociology of Education, 54(2), 98-106.

Hansford, B. C., & Hattie, J. A. (1982). Relationship between sex and achievement/performance measures. Review of Educational Research, 52(1), 123-142.

Hare, B. R. (1979). Black girls: A comparative analysis of self-perception and achievement by race, sex, and socioeconomic background (Report No. 271). Baltimore, MD: Johns Hopkins University, Center for Social Oranization of Schools.

Hare, B. R. (1980). Self-perceptions and academic achievement: Variations in a desegregated setting. American Journal of Psychiatry, 137(6), 683-689.

Harlen, W., Black, P., Johnson, S., & Palacio, D. (1983). Science in Schools. Age 11: Report No. 2. London, England: DES.

Heller, K. A., & Parsons, J. E. (1981). Sex differences in teachers' evaluative feedback and students' expectancies for success in mathematics. Child Development, 52(3), 1015-1019.

Hernandez, N. G. (in preparation). A model for mathematics teaching effectiveness for Mexican-American students.

Hess, R. D., & Miura, I. (1985). Gender differences in enrollment in computer camps and classes: The extra curricular acquisition of computer training. Sex Roles: A Journal of Research, 13(3/4), 193-203.

Hess, R. D., & Miura, I. (1983). Sex and class affect summer-camp enrollment. Info World, 5(17), 52-55.

Hiebert, J., Carpenter, T. P., & Moser, J. M. (1983). Cognitive skills and arithmetic performance: A reply to Steffee and Cobb. Journal for Research in Mathematics Education, 14(1), 77-79.

Hill, J. P., & Lynch, M. E. (1983). The intensification of gender-related role expectations during early adolescence. In J. Brooks-Gunn & P. L. Peterson (Eds.), Girls at Puberty (pp. 201-228). New York: Plenum Press.

Hollinger, C. L. (1983). Self-perception and the career aspirations of mathematically talented female adolescents. Journal of Vocational Behavior, 22(1), 49-62.

Holmes, B. J. (1982). Black students' performance in the national assessments of science and mathematics. Journal of Negro Education, 51(4), 392-405.

Holtan, B. (1982). Attribute-treatment-interaction research in mathematics education. School Science and Mathematics, 82(7), 593-602.

Howe, A. C., & Shayer, M. (1981). Sex-related differences on a task of volume and density. Journal of Research in Science Teaching, 18(2), 169-175.

Howe, A. C., Hall, V., Stanback, B., & Seidman, S. (1983). Pupil behaviors and interactions in desegregated urban junior high activity-centered science classrooms. Journal of Educational Psychology, 75(1), 97-103.

Hsia, J. (1983). Cognitive assessment of Asian-Americans. In M. Chu-Chang & V. Rodriguez (Eds.), Asian- and Pacific-American perspectives in bilingual education: Comparative research (pp. 123-152). New York: Teachers College Press, Columbia University.

Hueftle, S. J., Rakow, S. J., & Welch, W. W. (1983). Images of science: A summary of results from the 1981-1982 National Assessment in Science. Minneapolis, MN: Minnesota Research and Evaluation Center, University of Minnesota.

Humphreys, L. G., & Taber, T. C. (1973). Ability factors as a function of advantaged and disadvantaged groups. Journal of Educational Measurement, 10(2), 107-115.

Hyde, J. (1981). How large are cognitive gender differences? A meta-analysis using w^2 + d. American Psychologist, 36(8), 892-901.

Inn, K. (1983). Assessment of self-concept: bilingual Asian-American children. In M. Chu-Chang & V. Rodriguez (Eds.), Asian- and Pacific-American perspectives in bilingual education: Comparative research (pp. 172-193). New York: Teachers College Press, Columbia University.

Jacobowitz, T. J. (1980). The relation of sex, achievement, and science self-concept to science career preference of Black students. Dissertation Abstracts International, 41(2), 597-A.

Jacobowitz, T. (1983). Relationship of sex, achievement and science self concept to the scientific career preferences of black students. Journal of Research in Science Teaching, 20(7), 621-628.

Johnson, J. P. (1982). Can computers close the educational equity gap? Civil Rights Quarterly Perspectives.

Johnson, R. C. (1981). Psychosocial influences on the math attitudes and interests of Black junior high school students. Unpublished manuscript.

Johnstone, W. G. (1981). Ethnic group differences on the ITBS. A standard analysis in grades 3 through 8. Paper presented at the Annual Meeting of the Southwest Educational Research Association, Dallas, TX.

Jones, L. V., Burton, N. W., & Davenport, E. C., Jr. (1982). Mathematics achievement levels of black and white youth (Report No. 165). Chapel Hill: University of North Carolina, L. L. Thurstone Psychometric Laboratory.

Jordan, C., Hu-Pei Au, K., & Joesting, A. K. (1983). Patterns of classroom interaction with Pacific islands children: The importance of cultural differences. In M. Chu-Chang & V. Rodriguez (Eds.), Asian- and Pacific-American perspectives in bilingual education: Comparative research (pp. 217-242). New York: Teachers College Press, Columbia University.

Jourdane, J. R. (1970) A bilingual math-science learning center. (From: Reaching: Creative Approaches to Bilingual/Bicultural Education.) Washington, D.C.: Office of Education. (Eric Document Reproduction Service No. ED 051 716)

Juraschek, W. (1983). Piaget and middle school mathematics. School Science and Mathematics, 83(1), 4-13.

Kagan, S., & Zahn, G. L. (1975). Field dependence and the school achievement gap between Anglo-American and Mexican-American children. Journal of Educational Psychology, 67(5), 643-650.

Kagan, S., Zahn, L. G., & Gealy, J. (1977). Competition and school achievement among Anglo-American and Mexican-American children. Journal of Educational Psychology, 69(4), 432-441.

Kahl, S. R., Malone, M. R., & Fleming, M. L. (1982). Sex-related differences in pre-college science: Findings of the science meta-analysis project Paper presented at the Annual Meeting of the American Educational Research Association, New York. (Eric Document Reproduction Service No. ED 216 909)

Kahle, J. B., & Lakes, M. K. (1983). The myth of equality in science classrooms. Journal of Research in Science Teaching, 29(2), 131-140.

Kiesler, S., Sproull, L., & Eccles, J. S. (1983). (in press). Poolhalls, chips, and war games: Women in the culture of computing. Psychology of Women Quarterly.

Kelly, A. (1978). Feminism and research. Women's Studies International Quarterly, 1, 225-232.

Kelly, A. (1982). The missing half girls and science education. (Book review). Women's Studies International Quarterly, 5(5), 514-516.

Kirschner, V. (1982). What research says: Females and mathematics. School Science and Mathematics, 82(6), 511-513.

Koehler, M. S., & Fennema, E. (1982). Women and mathematics: Is there a problem? In S. Hill (Ed.), Education in the 80's (pp. 94-107). A National Education Association publication.

Korpi, M. C. (personal communication, 1984)

Kurshan, B., & Williams, J. (1984). The effect of the computer on problem solving skills - a comparison of junior high school boys and girls Manuscript submitted for publication.

Lane, W. K. (1976). The relationship between personality and differential academic achievement within a group of highly gifted and high achieving children. Dissertation Abstracts International, 37(5), 2746-A.

Langer, P., Kalk, J. M., & Searls, D. T. (1984). Age of admission and trends in achievement: A comparison of Blacks and Caucasians. American Educational Research Journal, 21(1), 61-78.

LaTorre, R. A., Yu, L., Fortin, L., & Marrache, M. (1983). Gender-role adoption and sex as academic and psychological risk factors. Sex Roles: A Journal of Research, 9(11), 1127-1136.

Lazarowitz, R. (1981). Correlations of junior high school students' age, gender, and intelligence with ability in construct classification in biology. Journal of Research in Science Teaching, 18(1), 15-22.

Leinhardt, G., Seewald, A. M., & Engel, M. (1979). Learning what's taught: Sex differences in instruction. Journal of Educational Psychology, 71(4), 432-439.

Leiter, J. (1983). Classroom composition and achievement gains. Sociology of Education, 56(3), 126-132.

Lerner, J. W. (1976). Children with learning disabilities. Boston, MA: Houghton Mifflin Company.

Lerner, R. M., & Lerner, J. V. (1977). Effects of age, sex and physical attractiveness on child-peer relations, academic performance, and elementary school adjustment. Developmental Psychology, 13(6), 585-590.

Lesser, G. S. (1973). Problems in the analysis of patterns of abilities: A reply. Child Development, 44, 19-20.

Lesgold, A. M., & Reif, F. (1982). Computers in education: Realizing the potential. (Report of a Research Conference). Pittsburgh, PA.: U. S. Department of Education and Office of Educational Research and Improvement.

Levine, D. U., & Ornstein, A. C. (1983). Sex differences in ability and achievement. Journal of Research and Development in Education, 16(2), 66-72.

Lindquist, M. M., Carpenter, T. P, Silver, E. A., & Matthews, W. (1983). The Third National Mathematics Assessment: Results and implications for elementary and middle schools. Arithmetic Teacher, 31(4), 14-25.

Linn, M. C. (1983). Content, context and process in reasoning during adolescence: Selecting a model. Journal of Early Adolescence, 3(1&2), 63-82.

Linn, M. C., & Petersen, A. C. (in press). A meta-analysis of gender differences in spatial ability: Implications for mathematics and science achievement. In J. S. Hyde & M. Linn (Eds.), The Psychology of Gender: Advances Through Meta-Analysis, Baltimore, MD: Johns Hopkins University Press.

Linn, M. C., & Pulos, S. (1983). Male-female differences in predicting displaced volume: Strategy usage, aptitude relationships and experience influences. Journal of Educational Psychology, 75(1), 86-96.

Linn, M. C., & Pulos, S. (1983). Aptitude and experience influences on proportional reasoning during adolescence: Focus on male-female differences. Journal for Research in Mathematics Education, 14(1), 30-46.

Llabre, M. M., & Cueves, G. (1983). The effects of test language and mathematical skills assessed on the scores of bilingual Hispanic students. Journal for Research in Mathematics Education, 14(4), 318-324.

Lockheed, M. E. (1982). Sex equity in classroom interaction research: An analysis of behavior chains. Paper presented at the Annual Meeting of the American Educational Research Association, New York.

Lockheed, M. E. (1984). Evaluation of the Women's Action Alliance Computer Equity Training Project (Grant No. G0083-02954). Princeton, NJ: Educational Testing Service and Department of Education (Women's Educational Equity Act Program), Washington.

Lockheed, M. E., & Harris, A. M. (1984). A study of sex equity in classroom interaction: Final Report. Volume 1. (Contract #NIE 400-80-0032). Princeton, NJ: Educational Testing Service and National Institute of Education, Washington.

Lockheed, M. E., & Harris, A. M. (1984). Cross-sex collaborative learning in elementary classrooms. American Educational Research Journal, 21(2), 275-294.

Lockheed, M. E., Harris, A. M., & Nemceff, W. (1983). Sex and social influence: Does sex function as a status characteristic in mixed-sex groups of children? Journal of Educational Psychology, 75(6), 877-888.

Lovett, C. J. (1980). Bilingual education: What role for mathematics teaching? Arithmetic Teacher, 27(8), 14-17.

Lynch, P. P., & Paterson, R. E. (1980). An examination of gender differences in respect to pupils' recognition of science concept definitions. Journal of Research in Science Teaching, 17(4), 307-314.

MacCorquodale, P. (July, 1980). Psycho-social influences on the accomplishments of Mexican-American students. Paper presented at the meeting of the American Association of School Administrators, Chicago, IL. (Eric Document Reproduction Service No. ED 200 355)

MacCorquodale, P. (1984). Self-image science and math: Does the image of the "scientist" keep girls and minorities from pursuing science and math? Paper presented at the 79th Annual Meeting of the American Sociological Association, San Antonio, TX.

Malcom, S. (1983). An assessment of programs that facilitate increased access and achievement of females and minorities in K-12 mathematics and science education. A study conducted for the NSB commission on pre-college education in mathematics, science, and technology. Washington, D.C.: Office of Opportunities in Science and American Association for the Advancement of Science.

Marshall, S. P. (1983). Sex differences in mathematical errors: An analysis of distractor choices. Journal for Research in Mathematics Education, 14(4), 325-336.

Marshall, S. P. (1984). Sex differences in children's mathematics achievement: Solving computations and story problems. Journal of Educational Psychology, 76(2), 194-204.

Matthews, W. (1983). Coloring the equation: Minorities and mathematics. Journal for Research in Mathematics Education, 14(1), 70-72.

Matthews, W. (1984). Influences on the learning and participation of minorities in mathematics. Journal for Research in Mathematics Education, 15(2) 84-95.

Matthews, W. (1980). Salient issues in mathematics education research for minorities: Proceedings from an NIE sponsored meeting. Washington, D.C.: National Institute of Education. (Eric Document Reproduction Service No. ED 191 699)

Matthews, W., Carpenter, T. P., Lindquist, M. M., & Silver, E. A. (1984). The third national assessment: Minorities and mathematics. Journal for Research in Mathematics Education, 15(2), 165-171.

McCormick, C. H., & Karabinus, R. A. (1976). Relationship of ethnic groups: Self-esteem and anxiety to school success. Educational and Psychological Measurement, 36(4),1093-1100.

McGee, M. G. (1979). Human spatial abilities: Psychonomic studies and environmental, genetic, hormonal and neurological influences. Psychological Bulletin, 86(5), 889-918.

McKelvey, B. (Cited in Education Daily, January 25, 1984), 17(17), p. 6.

Meece, J. L., Parsons, J. E., Kaczala, C. M., Goff, S. B., & Futterman, R. (1982). Sex differences in mathematics achievement: Toward a model of academic choice. Psychological Bulletin, 91(2), 324-348.

Meehan, A. M. (1984). A meta-analysis of sex differences in formal operational thought. Child Development, 55(3), 1110-1124.

Meeker, M., & Meeker, R. (1973). Strategies for assessing intellectual patterns in Blacks, Anglo and Mexican-American boys - or any other children - and implications for education. Journal of School Psychology, 11(4), 341-350.

Milne, A., Moskowitz, J., & Myers, D. (1983). Policy issues related to educational achievement of language minority children (Contract No. 300-80-0778). Washington, D.C.: U. S. Department of Education.

Milwaukee ESEA Title VII Bilingual/bicultural Education Program. Milwaukee Public Schools. (Eric Document Reproduction Service No. ED 151 409)

Miura, I. (1984). Processes contributing to individual differences in computer literacy. Unpublished doctoral dissertation, Stanford University.

Mokros, J. (personal communication, 1984)

Moore, C. G. (1982). The Navajo culture and the learning of mathematics. Washington, D.C.: National Institute of Education. (Eric Document Reproduction No. ED 214 708)

Morello, V. J., Turner, R. R., & Reed, N. (1977). Problem-solving strategies on a partial reinforcement task: Effects of socioeconomic status and cognitive level. Journal of Experimental Child Psychology, 24(74), 74-85.

Morine-Dershimer, G. (1983). Instructional strategy and the "creation" of classroom status. American Educational Research Journal, 20(4), 645-661.

Morse, L. W. (1982). Classroom interaction as related to junior high school students' achievement in science. Paper presented at the Annual Meeting of the American Educational Research Association, New York.

Morse, L. W., & Handley, H. M. (1982). Relationships of significant others, parental and teacher influences to the development of self concept, science attitudes and achievement among adolescent girls (Grant No. NIE-G-79-0159). Washington, D.C.: National Institute of Education. (Eric Document Reproduction Service No. ED 238 902)

Moskowitz, J. M., Malvin, J. H., Schaeffer, G. A., & Schaps, E. (1983). Evaluation of a cooperative learning strategy. American Educational Research Journal, 20(4), 687-696.

Murray, R. B. (1979). Piagetian logical operations comprehension and achievement test analysis in elementary, junior, and senior high school. Dissertation Abstracts International, 39(9), 5417-A.

Myers, D. E., & Milne, A. M. (1982). Achievement by gender and home language for elementary and secondary school children: A preliminary analysis. Prepared for Part C: Math and Language Minority Students Project administered by the National Institute of Education (Contract No. 300-80-0778) with the U. S. Department of Education.

Myers, D. E., & Milne, A. M. (1983, February). Mathematics achievement of language-minority students (Draft). Washington, DC: Decision Resources.

National Assessment of Educational Progress (1983). Third national mathematics assessment: Results, trends, and issues (NAEP Report No. 13-MA-01). Princeton, NJ: Educational Testing Service reprint. [Library of Congress Catalog Card Number: 72-183665]

National Assessment of Educational Progress (1984). [Student background questionnaire: Computer related experiences.] Unpublished raw data.

National Center for Education Statistics. (1978). Three National Assessments of Science: Changes in Achievement, 1969-1977. (Science Report No. 08-S-00) Denver, CO: National Assessment of Educational Progress.

National Center for Education Statistics. (1982). Instructional use of computers in public schools. Fast response survey system. Washington, D.C.: U. S. Department of Education.

National Science Board Commission on Precollege Education in Mathematics, Science and Technology (1983). Educating Americans for the 21st Century. Washington, DC: National Science Foundation.

Nelson, R. E. (1979). Sex differences in mathematics attitudes and related factors among Afro-American students. (Doctoral Dissertation, University of Tennessee, 1978.) Dissertation Abstracts International, 39, 4793-A - 4794-A.

Nelson, W., Knight, G. P., Kagan, S., & Gumbiner, J. (1980). Locus of control, self-esteem, and field independence as predictors of school achievement among Anglo-American and Mexican-American children. Hispanic Journal of Behavioral Sciences, 2(4), 323-335.

New goals for mathematical science education (1983, November). The report of a conference sponsored by The Conference Board of the Mathematical Sciences.

Newcombe, N. (1982). Sex-related differences in spatial ability: Problems and gaps in current approaches. In M. Potegal (Ed.), Spatial abilities: Development and physiological foundations (pp. 223-250). New York: Academic Press.

Newcombe, N., & Bandura, M. M. (1983). Effect of age at puberty on spatial ability of girls: A question of mechanism. Developmental Psychology, 19(2), 215-224.

Newcombe, N., Bandura, M. M., & Taylor, D. G. (1983). Sex differences in spatial ability and spatial activities. Sex Roles: A Journal of Research, 9(3), 377-386.

Ng, K. M., & Tsang, S. (1980). Mathematical cognitive structures of Chinese-American, Euro-American and Hong Kong Chinese students. Paper presented at the Annual Meeting of the American Educational Research Association, Boston, MA.

Niyekawa, A. M. (1983). Biliteracy acquisition and its sociocultural effects. In M. Chu-Chang & V. Rodriguez (Eds.), Asian- and Pacific-American perspectives in bilingual education: Comparative research (pp. 97-119). New York: Teachers College Press, Columbia University.

Olstad, R. G., Juarez, J. R., Davenport, L. J., & Haury, D. L. (1981). Initiators to achievement in science and mathematics by ethnic minorities. Washington, D.C.: U.S. Department of Education. (Eric Document Reproduction Service No. ED 223 404)

Overton, W. F., & Meehan, A. M. (1982). Individual differences in formal operational thought: Sex role and learned helplessness. Child Development, 53(6), 1536-1543.

Parsons, J. E. (1983). Attributional processes as mediators of sex differences in achievement. Journal of Educational Equity and Leadership, 3(1), 19-27.

Parsons, J. E., Ruble, D. N., Hodges, K. L., & Small, A. W. (1976). Cognitive-developmental factors in emerging sex differences in achievement-related expectancies. Journal of Social Issues, 32(3), 47-61.

Parsons, J. E., & Ruble, D. N. (1977). The development of achievement-related expectancies. Child Development, 48, 1075-1079.

Parsons, J. E., Adler, T. F., & Kaczala, C. M. (1982). Socialization of achievement attitudes and beliefs: Parental influences. Child Development, 53(2), 310-321.

Parsons, J. E., Kaczala, C. M., & Meece, J. L. (1982). Socialization of achievement attitudes and beliefs: Classroom influences. Child Development, 53(2), 322-339.

Parsons, J. E., Meece, J. L., Adler, T. F., & Kaczala, C. M. (1982). Sex differences in attributions and learned helplessness. Sex Roles: A Journal of Research, 8(4), 421-432.

Paulsen, K., & Johnson, M. (1983). Sex role attitudes and mathematical ability in 4th, 8th, and 11th grade students from a high socioeconomic area. Developmental Psychology, 19(2), 210-214.

Payne, B. D., Smith, J. E., & Payne, D. A. (1983). Sex and ethnic differences in relationships of test anxiety of performance in science examinations by fourth and eighth grade students: Implications for valid interpretations of achievement test scores. Educational and Psychological Measurement, 43(1), 267-270.

Perez, E., & White, M. A. (1983). Student reports of motivational and educational attributes of mathematics microcomputer software versus classroom activity. (Electronic Learning Laboratory Report). New York: Teachers College, Columbia University.

Peterson, A. C., Richards, M. T., & Boxer, A. (1983). Puberty: Its measurement and its meaning. Journal of Early Adolescence, 3(1&2), 47-62.

Pogrow, S. (1983). Education in the computer age: Issues of policy and reform. Beverly Hills, CA.: Sage Publications.

Potter, E. F. (1984). Impact of developmental factors on motivating the school achievement of young adolescents: Theory and implications for practice. Journal of Early Adolescence, 4(1), 1-10.

Powers, S., Thompson, D., Azevedo, B., & Schaad, O. (1983). The predictive validity of the Stanford Mathematics Test across race and sex. Educational and Psychological Measurement, 43(2), 645-649.

Pulos, S., Stage, E. K., & Karplus, R. (1982). Setting effects in mathematical reasoning of early adolescents: Findings from three urban schools. Journal of Early Adolescence, 2(1), 39-59.

Ramirez, M., & Casteneda, A. (1974). Cultural democracy, bicognitive development, and education. New York: Academic Press.

Ramist, L., & Arbeiter, S. (1984). Profiles, college-bound seniors, 1983. New York: College Entrance Examination Board.

Randhawa, B. S. (1983). Verbal interaction o students and their teachers in junior high classrooms. American Educational Research Journal, 20(4), 671-686.

Revelle, G., Honey, M., Amsel, E., Schauble, L., & Levine, G. (1984). Sex differences in the use of computers. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.

Reynolds, C. R., & Jensen, A. R. (1983). WISC-R subscale patterns of abilities of Blacks and Whites matched on full scale IQ. Journal of Educational Psychology, 75(2), 207-214.

Rogers, L. J. (1983). Hormonal theories for sex differences - politics disguised as science: A reply to DeBold and Luria. Sex Roles: A Journal of Research, 9(11), 1109-1113.

Rosenholtz, S. J., & Rosenholtz, S. H. (1981). Classroom organization and the perception of ability. Sociology of Education, 54(2), 132-140.

Rosenholtz, S. J., & Simpson, C. (1984). The formation of ability conceptions: Developmental trend or social construction? Review of Educational Research, 54(1), 31-63.

Rosenthal, A. S., Baker, K., & Ginsburg, A. (1983). The effect of language backgound on achievement level and learning among elementary school students. Sociology of Education, 56(4), 157-169.

Rosenthal, R., & Rubin, D. B. (1982). Further meta-analytic procedures for assessing cognitive gender differences. Journal of Educational Psychology, 74(5), 708-712.

Rothschild, S. J., & Lichtman, M. (1980). Factors related to White, Black and Hispanic women's mathematics attainments: A descriptive study. (Eric Document Reproduction Service No. ED 195 570)

Rowe, M. B. (1983). What research says. Science ability and achievement - helping girls make the connection. Science and Children, 42-43.

Ruble, D. N., & Frey, K. S. (1982). Self evaluation and social comparison in the classroom: A naturalistic study of peer interaction. Paper presented in the Symposium on Social Comparison: Implications for education of the American Educational Research Association, New York.

Russo, N. F. (1981). Mathematics and sex: The 19th Century Revisited. National Forum (formerly Phi Kappa Phi Journal).

Ryman, D. (1977). Teaching methods, intelligence, and gender factors in pupil achievement on a classification task. Journal of Research in Science Teaching, 14(5), 401-409.

St. George, A. (1983). Teacher expectations and perceptions of polynesian and pakeha pupils and the relationship to classroom behavior and school achievement. British Journal of Educational Psychology, 53(1), 48-59.

Sadker, D., & Sadker, M. (1984). Teacher reactions to classroom responses of male and female students. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.

Sanchez, J. L. (1980). A comparison of achievement of Mexican and Mexican-American children in the areas of reading and mathematics when taught within a cooperative and competitive goal structure. (Doctoral dissertation, University of California, Santa Barbara, 1979.) Dissertation Abstracts International, 40(3), 1333-A.

Sanders, B., Soares, M. P., & D'Aquila, J. M. (1982). The sex differences on one test of spatial visualization: A national difference. Child Development, 53(4), 1106-1110.

Sanders, J. S. (1984). The computer: Male, female or androgynous? The Computing Teacher, 11(8), 31-34.

Sanders, J. S., & Stone, A. (in press). The Neuter Computer: Computers for Girls and Boys. New York: Neal Schuman Publishers.

Satterly, D. J. (1976). Cognitive styles, spatial ability, and school achievement. Journal of Educational Psychology, 68(1), 36-42.

Schildkamp-Kundiger, E. (1982). International review of gender and mathematics. Washington, D.C.: National Institute of Education. (Eric Document Reproduction Service No. ED 222 326)

Schneider, W., & Treiber, B. (1984). Classroom differences in the determination of achievement changes. American Educational Research Journal, 21(1), 195-211.

Schofield, B., Murphy, P., Johnson, S., & Black, P. (1982). Science in schools. Age 13: Report No. 1. London, England: DES.

Schonberger, A. K. (1980). Sex-related issues in mathematics education. In M. M. Lindquist (Ed.), Selected Issues in Mathematics Education (pp. 185-198). Berkeley, CA: McCutchan Publishing Corporation.

School Uses of Microcomputers. (April, 1983). (Report from a National Survey) Baltimore, MD.: Johns Hopkins University, Center for Social Organization of Schools, Issue No. 1.

Schubert, J. G., Wolman, J., DuBois, P., & Eaton, M. (1984). Ideas for Equitable Computer Learning. Palo Alto, CA: American Institute for Research.

Segalowitz, S. J. (1983). Two sides of the brain: Brain lateralization explored. Englewood Cliffs, N.J.: Prentice-Hall, Inc.

Sells, L. W. (1980). The mathematics filter and the education of women and minorities. In L. H. Fox, L. Brody, & D. Tobin (Eds.), Women and the mathematical mystique (pp. 66-74). Baltimore, MD: Johns Hopkins University Press.

Shade, B. (1982). Afro-American cognitive style: A variable in school success. Review of Educational Research, 52(2), 219-244.

Sharan S. (1980). Cooperative learning in small groups: Recent methods and effects on achievement, attitudes and ethnic relations. Review of Educational Research, 50(2), 241-272.

Sharpley, A. M., Irvine, J. W., & Sharpley, C. F. (1983). An examination of the effectiveness of a cross-age tutoring program in mathematics for elementary school children. American Educational Research Journal, 20(1), 103-111.

Sharma, S., & Meighan, R. (1980). Schooling and sex roles: The case of GCE 'O' level mathematics. British Journal of Sociology of Education, 1(2), 193-205.

Shaughnessy, J., Haladyna, T., & Shaughnessy, J. M. (1983). Relations of student, teacher, and learning environment variables to attitude toward mathematics. Journal of School Science and Mathematics, 83(1), 21-36.

Sheehan, D. S., & Marcus, M. (1977). The effects of teacher race and student race on vocabulary and mathematics achievement. Journal of Educational Research, 70(1), 123-126.

Sheridan, E. M., & Fizdale, B. (1981). Cultural factors and sex differences in reading and mathematics. (Eric Document Reproduction Service No. ED 205 936)

Sherman, J. (1977). Summary of effects of biological factors on sex-related differences in mathematics achievement. (Eric Document Reproduction Service No. ED 145 312)

Sherman, J. (1980). Women and mathematics: Summary of research from 1977-1979 (Contract No. G-77-0063). Washington, D.C.: National Institute of Education. (Final Report) (Eric Document Reproduction Service No. ED 145 312)

Sherman, J. (1980). Mathematics, spatial visualization and related factors: Changes in girls and boys, grades 8-11. Journal of Educational Psychology, 72(4), 476-482.

Sherman, J. (1981). Girls and boys enrollment in theoretical math courses: A longitudinal study. Psychology of Women Quarterly, 5(5), 681-689.

Sherman, J. (1982). Mathematics the critical filter: A look at some residues. Psychology of Women Quarterly, 6(4), 428-444. (Eric Document Reproduction Service No. ED 269-511)

Shymansky, J. A., Kyle, W. C., Jr., & Alport, J. M. (1983). The effects of new science curricula on student performance. Journal of Research in Science Teaching, 20(5), 387-404.

Simmons, R. G., Blyth, D. A., Van Cleave, E. F., & Bush, D. M. (1979). Entry into early adolescence: The impact of school structure, puberty and early dating on self-esteem. American Sociological Review, 44(6), 948-967.

Simpson, A. W., & Erickson, M. T. (1983). Teachers' verbal and nonverbal communication patterns as a function of teacher race, student gender, and student race. American Educational Research Journal, 20(2), 183-198.

Skaalvik, E. M. (1983). Academic achievement, self-esteem and valuing of the school - some sex differences. British Journal of Educational Psychology, 53(3), 299-306.

Slavin, R. E. (1985) Team assisted individualization: Combining cooperative learning and individualized instruction in mathematics. In R. Slavin, S. Sharan, S. Kagan, R. Hertz-Lazarowitz, C. Webb, & R. Schmuck (Eds.), Learning to Cooperate, Cooperating to Learn. New York: Plenum.

Slavin, R. E. (1980). Cooperative learning. Review of Educational Research, 5(20), 315-342.

Slavin, R. E., & Karweit, N. L. (1985). Effects of whole class, ability grouped, and individualized instruction on mathematics achievement. American Educational Research Journal, 22, 351-367.

Smith, E. J. (1982). The black female adolescent: A review of the educational, career and psychological literature. Psychology of Women Quarterly, 6(2), 261-288.

Stage, E. K., Kreinberg, N., Parsons, J. E., & Becker, J. R. (1982). Increasing the participation and achievement of girls and women in mathematics, science, and engineering. Manuscript submitted for publication.

Stahl, J. M. (1983). Research on factors influencing the achievement of women and minorities in science, engineering, and mathematics: A bibliography. Psychological Documents, 13(2), 29-30.

Stake, J. E., & Katz, J. F. (1982). Teacher-pupil relationships in the elementary school classroom: Teacher-gender and pupil-gender differerences. American Educational Research Journal, 19(3), 465-471.

Stanley, J. C., & Benbow, C. P. (1982). Consequences in high school and college of sex differences in mathematical reasoning ability: A longitudinal perspective. American Educational Research Journal, 19(4), 598-622.

Stanley, J. C., & Benbow, C. P. (1982). Huge sex ratios at upper end. American Psychologist, 37(8), 972.

Stanley, S. O., & Greenwood, C. R. (1983). How much "opportunity to respond" does the minority student receive in school? Exceptional Children, 49(4), 370-373.

Steefe, L. P., & Cobb, P. (1983). Cognitive development and children's solutions to verbal arithmetic problems: A critique. Journal for Research in Mathematics Education, 14(1), 74-76.

Steinkamp, M. W., & Maehr, M. L. (1983). Affect, ability, and science achievement: A quantitative synthesis of correlational research. Review of Educational Reseach, 53(3), 369-396.

Steinkamp, M. W., & Maehr, M. L. (1984). Gender differences in motivational orientations toward achievement in school science: A quantitative synthesis. American Educational Research Journal, 21(1), 39-59.

Strauch, A. B. (1977). More on the sex and race interaction on cognitive measures. Journal of Educational Psychology, 69(2), 152-157.

Stodolsky, S. S. (1984). Frameworks for studying instructional processes in peer work-groups. In P. L. Peterson, L. C. Wilkinson, & M. Hallinan (Eds.), The social context of instruction: Group organization and group processes (pp. 107-122). San Diego: Academic Press.

Swadener, M., & Hannafin, M. (1984). Similarities and differences in sixth-grader's attitudes toward computers: An exploratory study. Unpublished manuscript.

Suydam, M. N. (1983). Research on mathematics education - Reported in 1982. Journal of Research in Mathematics Education, 14(4), 227-295.

Talmage, H., Pascarella, E. T., & Ford, S. (1984). The influence of cooperative learning strategies on teacher practices, student perceptions of the learning environment, and academic achievement. American Educational Research Journal, 21(1), 163-179.

Taylor, B. R. (1983). Equity in mathematics: A case study. The Mathematics Teacher, 76(1), 12-17.

Thornburg, H. D., & Jones, R. M. (1982). Social characteristics of early adolescents: Age versus grade. Journal of Early Adolescence, 2(3), 229-240.

Treagust, D. F. (1980). Gender-related differences in spatial representational thought. Journal of Research in Science Teaching, 17(2), 91-97.

Tsai, S., & Walberg, H. J. (1983). Mathematics achievement and attitude productivity in junior high school. Journal of Educational Research, 76(5), 267-272.

Tsang, C. (1983). Code-switching strategies in bilingual instruction settings. In Chu-Chang & V. Rodriguez (Eds.), Asian- and Pacific-American perspectives in bilingual education: Comparative research (pp. 197-215). New York: Teachers College Press, Columbia University.

Tsang, S. L. (1976). The effects of the language factor and the cultural content factors of mathematics achievement test on Chinese and Chicano students (Doctoral dissertation, Stanford University, 1976). Dissertation Abstracts International, 37(2), 714-A.

Tsang, S. L. (1980). Critical review of research on mathematics education of Chinese American students. Paper presented at the National Council of Teachers of Mathematics, Seattle, WA. (Eric Document Reproduction Service No. ED 191 699)

Turrentine, S. H. (1982). The relationship between body mass and self concept in preadolescents and adolescents. (Doctoral dissertation, University of North Carolina at Chapel Hill, 1981) Dissertation Abstracts International, 42(6), 2313-B.

Valadez, C. (1983). Overview. In M. Chu-Chang & V. Rodriguez (Eds.), Asian- and Pacific-American perspectives in bilingual education: Comparative research (p. 195). New York: Teachers College Press, Columbia University.

Vasquez, J. A. (1981). Factors that affect learning among minority youth: A partial bibliography. Washington, D.C.: Office of Bilingual Education and Minority Language. (Eric Document Reproduction Service No. ED 244 660)

Wahrman, R., & Puh, M. D. (1973). Sex, nonconformity and influence. Sociometry, 37(1), 137-147.

Webb, N. M. (1982). Peer interaction and learning in cooperative small groups. Journal of Educational Psychology, 74(5), 642-655.

Webb, N. M. (1982). Sex differences in interaction and achievement in cooperative small groups. Paper presented at the Annual Meetiong of the International Association for the Study of Cooperation in Education, Provo, Utah.

Webb, N. M. (1982). Student interaction and learning in small groups. Review of Educational Research, 52(3), 421-445.

Webb, N. M. (1984). Sex differences in interaction and achievement in cooperative small groups. Journal of Educational Psychology, 76(1), 33-44.

Webb, N. M., & Cullian, L. K. (1983). Group interaction and achievement in small groups: Stability over time. American Educational Research Journal, 20(3), 411-423.

Webb, N. M., & Kenderski, C. M. (1984). Student interaction and learning in small-group and whole-class settings. In P. L. Peterson, L. C. Wilkinson, and M. Hallinan (Eds.), The social context of instruction: Group organization and group processes (p. 153-170). San Diego: Academic Press.

Webster, M., Jr. (1977). Equating characteristics and social interaction: Two experiments. Sociometry, 40(1), 41-50.

Webster, M., Jr., & Driskell, J. E., Jr. (1978). Status generalization: A review and some new data. American Sociological Review, 43, 220-236.

Weiner, B., Frieze, I., Kukla, A., Reed, L., Rest, S., & Rosenbaum, R. M. (1971). Perceiving the causes of success and failure. Morristown, NJ: General Learning Press.

Welch, W. W., Andersson, R. E., & Harris, L. J. (1982). Effects of schooling on mathematics achievement. American Educational Research Journal, 19(1), 145-153.

West, C. K., Fish, J. A., & Stevens, R. J. (1980). General self-concept, self-concept of academic ability and school achievement: Implications for "causes" of self-concept. Australian Journal of Education, 24(2), 194-213.

White, K. R. (1982). The relationship between SES and academic achievement. Psychological Bulletin, 91(3), 461-481.

Wilder, G., Mackie, D., & Cooper, J. (1985). Gender and computers: Two surveys of computer related attitudes. Sex Roles: A Journal of Research, 13(3/4), 215-228.

Wilder, G., Mackie, D., & Cooper, J. (1985). Gender, computers and computer generated games: Three empirical studies. Unpublished manuscript.

Wilkinson, L. C., & Spinelli, F. (1983). Using requests effectively in peer-directed instructional groups. American Educational Research Journal, 20(4), 479-501.

Willig, A. C., Harnisch, D. L., Hill, K. T., & Maehr, M. L. (1978). Sociocultural and educational correlates of success failure attributions and evaluation anxiety in the school setting for Black, Hispanic and Anglo children. American Educational Research Journal, 20(3), 385-410.

Willson, V. L. (1983). A meta-analysis of the relationship between science achievement and science attitude: Kindergarten through college. Journal of Research in Science Teaching, 20(9), 839-850.

Wise, K. C., & Okey, J. R. (1983). A meta-analysis of the effects of various science teaching strategies on achievement. Journal of Research in Science Teaching, 20(5), 419-435.

Wollfolk, A. E. (1978). Student learning and performance under varying conditions of teacher verbal and nonverbal evaluative communication. *Journal of Educational Psychology*, *70*(1), 87-94.

Wright, D. (personal communication, 1983)

Wylie, R. (1979). *The self-concept: Theory and research on selected topics (Volume 2)*. Lincoln, NE: University of Nebraska Press.