DECLINES IN STUDENT ACHIEVEMENT IN SCIENCE--IMPLICATIONS FOR PUBLIC EDUCATION

by

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ABSTRACT

During the 1960s and 1970s, major innovative science curricula were introduced into public schools in the United States, and federal funds were used to improve the quality of science teachers. Nevertheless, student achievement in science has generally declined since 1963. This research focused on changes in four of the key variables related to science achievement--teachers, students, curricula, and school goals. The research examined (a) meta-analyses of the effectiveness of the innovative science curricula on student achievement, (b) research on changes in teacher and student characteristics during the last 30 years, (c) educational literature on changes in the goals of public education during this same period, and (d) changes in student achievement.

The results of this research suggest that the recent declines in science achievement are related to changes in student motivation, school goals, and school autonomy. The data indicate that contrary to the claims of some recent education commission reports, teachers and curricula have improved steadily over the last three decades. The conclusions developed from this research suggest that a number of the current educational reforms such as teacher competency testing, merit pay, curricular reform, student competency testing, and year-round schools should have little positive effect on student achievement. The research also suggests that parental

involvement in education could have a negative influence on science achievement. The findings do suggest that schools of choice, corporate educational partnerships, and teacher empowerment could significantly improve student science achievement.

To my wife Rosemary for her love and support

Ubi coniciebamur pollicitus eram semper flores--

Ver jam appetet

ACKNOWLEDGEMENT

To Dr. Nannette McLain

An anonymous Soviet poet wrote:

While yet there is time
Look out upon the world; devour it with your eyes
And, if your spirit demands more
add at least one stone to the edifice being built
So that when you are gone everyone will know
that where you once were a great emptiness now yawns.

Thank you for adding this small stone. Without your unerring guidance and untiring patience, this dissertation would still be an intention. And thank you for your wonderful sense of humor. It helped to make this effort fun.

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CHAPTER 1

INTRODUCTION

Following World War II, the United States was thrust into the *age of technology*. Scientific discoveries and technological advances stimulated by the war effort, as well as the transition to a peace-time economy, created a demand for new goods and services. Within the span of a few years, Americans were introduced to television, jet planes, and a whole assortment of labor-saving devices. Within the American home, scrub tubs were replaced by washing machines, clothes lines yielded to electric dryers, and coal bins disappeared as they were replaced by oil tanks.

During this same period, the Korean War and the "Cold War" demonstrated the importance of developing new military technology to keep the world "safe for democracy." Americans came to believe that technological innovation was essential to keep ahead of the Soviets.

The country was enamored with science and technology. After all it had helped to win the war, made the United States the dominant world leader, and promised to eliminate world hunger and poverty. Science and technology held the promise of offering a standard of living undreamed of by previous generations. The American public came to believe that today's dreams were tomorrow's inventions.

And why not? Submarines and rockets, the fare of earlier fiction writers, were the reality of the mid-1900s.

The combination of the peace-time economy, the military threat, and the American love affair with science and technology created a sudden demand for scientific talent--a demand that public schools could not meet. The last element in this chain of events leading to a major reform of science education in the United States was the launching of Sputnik in 1957. The idea that the Soviet Union could threaten our national security from space, as well as the national embarrassment that their German scientists were better than ours, pressed the United States into a national race for space.

The reform of science education had begun during the early years of the Eisenhower administration. However, when Sputnik was launched, more funds were dedicated to public elementary and secondary education. Federal funds were used to provide science teachers with additional training. Between 1959 and 1972, the National Science Foundation (NSF), a federal agency established by Congress in 1950, allocated approximately two-thirds of its budget for the creation of innovative science curricula in grades 7 to 12 (Weinstein, Boulanger, & Walberg, 1982). The educational reforms led to new methods of instruction and major innovative science curricula were introduced into public schools in the United States during the 1960s and 1970s.

Nevertheless, in spite of the massive educational funding effort, student achievement and interest in science generally declined between 1963 and 1980. The report *High School and Beyond: A National Longitudinal Study for the 1980s* (1985) began as follows:

> Over the last 20 years, the United States has witnessed a widespread decline in the quality of education. This decline has been especially pronounced with respect to mathematics and science, as evidenced by lowered enrollments and achievement scores, a diminishing teacher pool, and increased numbers of students on a general education track. (p. xiii)

During the 1980s, a national concern for declining student achievement led to nationwide educational reforms. Despite these reforms, national and international indicators of science and mathematics performance of students in the United States still showed little improvement (National Science Board, 1990).

This research investigated the effects of changes in the focus of educational reforms, societal changes, and changes in the American family on teacher quality, curricula, student characteristics, and school goals. The research then investigated which of these factors--curricula, teacher quality, student characteristics, or school goals--were most closely linked to changes in student achievement in science between 1957 and 1990. Based upon these findings, some implications for public education are discussed. The report also discusses the expected effectiveness of some of the recent educational reform proposals. Finally, some recommendations are proposed for educational reforms that could possibly improve student achievement.

Background

The launching of Sputnik in 1957 jolted the American public into a willingness to provide federal funding for educational reforms to train skilled scientists and engineers. The results of these reforms were soon evident. By 1963 the Scholastic Aptitude Test Mathematics scores (SAT-Ms) reached their highest level, and in 1969 the United States placed men on the moon.

Yet, in the 1970s sharp declines in science achievement, which were part of a broader pattern of decline in overall achievement levels, led educators to once again voice concerns about the quality of public education in the United States. By 1980 these concerns were replaced by warnings of a crisis in education (Yager, 1980); and in 1983 the condition of the nation's public schools became a national concern when the National Commission on Excellence in Education released the report, *A Nation at Risk: The Imperative for Reform, A Report to the Nation*.

The report declared that schools were failing in their efforts to educate students. According to the report, "We are raising a new generation of Americans that is scientifically and technologically illiterate." (p. 10) The widely published report instigated a national effort to reform public education. This effort, however, was not the first, but the fourth, national effort begun within 30 years to reform public education in the United States.

A series of reports including *A Place Called School (1984), Educating Americans for the 21st Century: A Plan of Action for Improving Mathematics, Science, and Technology Education for all American Elementary and Secondary Students so that their Achievement is the Best in the World by 1995* (1983), *High School* (1983) *The Paideia Proposal* (1982), and *Horace's Compromise* (1984) confirmed the fears of educators and the public that public schools were not providing quality education, especially in science and mathematics. Appendix B contains a listing of major educational reports on the state of public education between 1975 and 1990.

More recent studies have questioned the science ability of American students compared with students in other countries. Six countries--Canada, Ireland, Korea, the United Kingdom, the United States, and Spain--participated in the International Assessment of Educational Progress (1989). In this study, selected questions from the 1986 National Assessment of Educational Progress test were used to test 13-year-olds' science and mathematics achievement. On this test, students in the United States performed poorly, ranking behind students in Spain, Canada, the United Kingdom, and Korea.

Recent surveys indicate that the crisis in science education is twofold--not only do American students rank poorly in science achievement compared to their peers in other countries, but also American students are not interested in choosing careers in science and engineering. According to the National Science Board report, *Science and Engineering Indicators--1989*, 20% of United States graduates received science and engineering degrees in 1986, compared to 27% in Japan and 34% in West Germany, 40% in the United Kingdom, and 48% in France. Tifft (1989) reported that in 1988, one third of all United States Ph.D.s in natural science and engineering were earned by foreign students, that less than 1% of college freshmen reported that they intended to major in either mathematics or physics, and that, by the year 2000, the United States will face shortages of between 450,000 and 750,000 scientists and engineers.

Recent studies, such as the National Science Board report, *Educating Americans for the 21st Century*; the 1984 National Academy of Science report, *High School and the Changing Workplace: The Employer's View*; and the 1983 Education Commission of the States report, *Action for Excellence: Task Force on Education for Economic Growth* point out the serious problems faced by public schools.

Significance of the Decline in Science Achievement

Today's world economy is driven by technological innovation, and those countries with the best scientists and engineers will most likely control this economy (Welborn, 1984; Altbach, 1985). The National Center for Education Statistics 1989 report, *Education Indicators*, opens:

> Since the early 1980s, the country has become increasingly aware of the range of critical issues facing its schools. These issues are nationwide and include problems of declining academic performance, concerns about teacher qualifications and availability, and use of drugs and violence in the schools. The issues have serious implications, not only for effective operation of the schools, but for the future of individual workers, U.S. economic competitiveness, and ultimately for the structure and cohesiveness of American society. (p. 3)

The economic competitiveness of the United States has been challenged by foreign nations. According to Dentzer (1990), in the last 20 years the percentage of American-produced home electronics purchased in the United States has dropped from nearly 100% to a mere 5%. Japan threatens to monopolize the production of advanced computer chips and is a world leader in robotics. As of 1986 the United

States was replaced by Japan as the leading exporter of high-technology products (*National Science Board, 1989*). Korea has constructed state-of-the-art computer-driven steel mills that turn out higher quality, cheaper steel than can be produced in American mills. German manufacturers continue to capture increasingly larger shares of the high technology American market.

Unless American schools improve the quality of science education and increase the numbers of scientists and engineers, European and Asian countries may continue to increase their share of world economic markets at the expense of the United States. At the present time, projected shortages of trained scientists and engineers by the year 2000 could threaten not only the nation's economy but also our national security (*A Nation at Risk*, 1983; Weiss, 1985).

In the 1990s and beyond, not only must the United States produce highly trained scientists and engineers, but also blue- and white-collar workers who understand the principles of science. In a *U.S. News & WORLD REPORT* article (Dentzer, 1990), Robert Reich, who teaches public policy at Harvard, said, "I've heard officials of foreign firms say, 'Don't quote me, but we have to simplify our machinery and dumb down our training and orientation programs for workers in the U.S.'" Dentzer added:

> New production techniques require decision making by even the lowliest worker, while modern quality control demands a knowledge of statistics common among Japanese high-school graduates but rare among many U.S. college students. (p. 26)

It is not enough, however, for the United States to develop skilled scientists and engineers and scientifically educated workers in the United States. Our continued economic and social growth depends upon public science literacy (*National Science Board*, 1989; Lapointe, Mead, & Phillips, 1989). Only a scientifically competent citizenry can make responsible decisions on issues related to nuclear energy, global warming, extinction of species, and acid rain, as well as ethical questions surrounding certain medical advances in genetics and the prolongation of life.

The Lack of Consensus

There is no consensus on the nature of or the solution to the current educational problems. The various groups of educational reformers have been unable to identify a common set of factors related to the declines in science achievement. For example, Tifft (1989) reported that the solution to the current educational problems is to increase funding dramatically and to improve science teaching methods. National educational reports such as *Action for Excellence: Task Force on Education for Economic Growth* (1983), *A Nation at Risk* (1983), and *Making the Grade: Report of the Twentieth Century Fund Task Force on Federal Elementary and Secondary Education Policy* (1983) by the Twentieth Century Fund assert that teacher salaries are the key to teacher performance and therefore to student achievement.

According to many of these reports, by attaching salary incentives to teaching performance, teachers will strive to excel in their teaching. Kelly (1985) sums up the rationale behind higher salaries and merit pay, stating that "more intelligent individuals will be attracted to the profession, and the problem of excellence will thereby be resolved."

Other educational critics claim that the solution involves greater emphasis on teaching higher order thinking skills, especially critical thinking, in place of memorization (Arter, 1987; Elman & Lynton, 1985). Still others, such as United States Secretary of Energy James D. Watkins and American Federation of Teachers President Albert Shanker, argue that funding is not the issue. Instead, they claim that better curricula are needed and that teachers and teacher organizations know what curriculum is most effective (Tifft, 1989). In contrast, the report, *A Nation at Risk* (1983) cited teacher incompetence. According to the report, half of the nation's science teachers were not qualified to teach their subjects.

Altbach (1985) offers a very different explanation of the current crisis in education. Altbach argues "Thus, the crisis in education is caused directly by social policy and public opinion." (p. 15)

The variety and range of proposed solutions have grown as the inability of schools to restore science achievement has become more evident. More modest reforms include longer school days, an increased school year, testing of students and teachers, and increased graduation requirements, which include more courses in mathematics and science. More extreme solutions include year-round schooling, magnet schools, and schools of choice, as well as proposals to completely restructure schools (Sizer, 1983; Chubb & Moe, 1990). One recent experiment has turned over the control of public schools in Chicago to local citizen committees (Tifft, 1990).

The Need for Answers

One of the effects of the declines in student achievement in the 1960s and 1970s was that schools and teachers came to be viewed by the public and legislators as the likely cause of the problem. Consequently, many of the educational reforms have been directed at teachers.

But what if the declines in student achievement in science are not related to changes in teacher quality? Some reports have cited changes in the attitudes, motivation, and behavior of students as a cause of the decline in science achievement (Lapointe, Mead, & Phillips, 1989; Carnegie Foundation for the Advancement of Teaching, 1990)). Other reports (Applebee, Langer, & Mullis, 1989) have stressed the need to redefine school goals.

All parties involved in education--teachers, administrators, parents, school boards, and state and federal governments--need to understand the causes for the current crisis in science education in order to find solutions (Kavale, 1988). The proposed educational solutions vary greatly depending upon which of these factors is perceived as being the cause of the declines in science achievement. Unless the principal factors responsible for declining science achievement are isolated, time, effort, and large amounts of money may be wasted trying to implement illusionary solutions. But more importantly, the nation is at a critical juncture, and the road taken into the next century will depend upon the quality of our science programs in public schools.

Focus of Research

There is an unanswered question concerning educational reform and science achievement. Why is it that tougher standards for teachers and students, longer school days, a longer school year, and more science and mathematics courses required for graduation have not produced the expected gains in science achievement? How is it that competency testing, compensatory education, innovative science curricula and instructional strategies, computer-based instruction, and increased funding for schools have not enabled students in the United States to do well in international tests of science achievement?

This research report describes possible causes of the declines in student science achievement between 1963 and 1990. The delineation of causes provides a framework for developing a hypothesis as to why the nationwide educational reforms of the 1980s produced only small gains in science achievement.

Since student science achievement is, to a great extent, the product of the interaction between the student, the teacher, curricula, and school goals, this research focused on changes in these four variables over the last three decades. Implications of the findings for educators and policy makers, as well as some proposed solutions to improve student science achievement are presented.

CHAPTER 2

RESEARCH APPROACH

The basic proposition of this research is that student achievement in science is primarily determined by four factors--the teacher, the student, the curriculum, and the school goals (Figure 1). In this research, *curriculum* is defined to be what is taught and what is intended to be learned, as well as methods of instruction, instructional technology, and teaching aids.

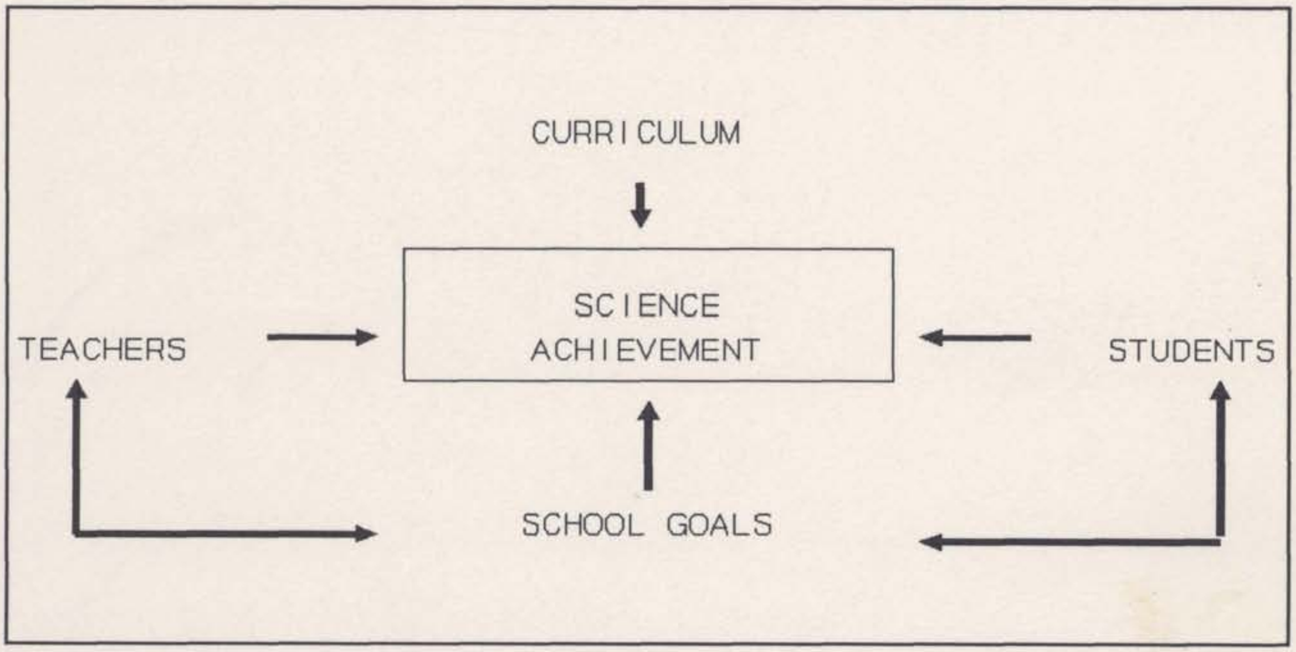

Figure 1. Determinants of Science Achievement

Research Premise

The premise of this research is that changes in curricula, teachers, students, or school goals must be related to the changes in student achievement after 1963. The research examines how changes in these variables could be related to the declines in student achievement in science after 1963 and the modest recovery in student science achievement during the 1980s. By examining changes in each of these factors between 1957 and 1990, it should be possible to identify which of these four factors is most closely linked to the observed changes in student achievement in science.

If we assume, for example, that during the last 30 years all of the factors except teacher characteristics were nearly unchanged, then the changes in science achievement must be related to changes in teacher characteristics. Similarly, if all the factors were unchanged except the curricula, then the innovative curricula of this period should be associated with the changes in science achievement.

Research Approach

The research approach was to (a) analyze trends in student achievement in science between 1957 and 1990; (b) describe and evaluate the curricula changes during this period; (c) describe changes in teacher and student characteristics, changes in requirements for teachers and students, and changes in school goals that relate to changes in science achievement; (d) relate changes in each of these factors to changes in student science achievement and to societal changes; (e) discuss implications of the findings for national educational reforms and for public education;

and (f) suggest some proposals that could be expected to improve science achievement.

Chapter Outline

Trends in student achievement in science between 1957 and 1990 are described in Chapter 3. This chapter includes the results of the National Assessment of Educational Progress on student science achievement, as well as the results of international studies of science achievement.

Chapter 3 also describes the SAT-M trend over the last three decades. The predictive validity of the SAT-M for various groups of students in engineering and science is well documented (The College Board Technical Handbook, 1984). In a recent, yet unpublished, study by the Educational Testing Service (ETS), student achievement in a total of 810 courses in the physical sciences and biology at 35 colleges was examined. The correlation between science achievement and SAT-M score was found to be between 0.5-0.6, which makes the SAT-M as good a predictor of science achievement as the high school grade point average (J. Braswell, Educational Testing Service, personal communication, July 9, 1990).

The SAT-M was selected instead of the SAT Science Achievement Tests, because only a small percentage of the students, who take the SAT-M also take Achievement tests (18% in 1990). Furthermore the percentage of students taking individual science tests is even smaller. For example, in 1990 less than 4% of the students taking the SAT also took the Biology Achievement test. Slightly less than 3% took the Chemistry Achievement test; and less than 2% took the Physics

Achievement test (College Entrance Examination Board, 1990). A second reason for not using the Achievement tests is that the students taking these tests are not representative of the test takers as a whole. For example, in 1990 the students who took the Achievement tests had an average SAT-M of 585, nearly 100 points higher than the overall student mean.

Curricula changes in public schools since 1957 are discussed in Chapter 4. In this chapter, the major innovative curricula and instructional strategies are described and evaluated.

In chapter 5, changes in teacher and student characteristics are examined and evaluated. Chapter 6 relates changes in curricula, teachers, students, and school goals to major societal changes that have influenced public schools since 1957. The chapter also discusses the increasing involvement of the Federal Government in education, the effects of the major social movements, and some changes in the American family that have influenced public education.

The changes in science achievement, which were described in Chapter 3, are re-examined in Chapter 7 within the context of the sweeping changes in the American culture during the 1960s, 1970s, and 1980s. In this chapter, an alternative hypothesis is presented to explain the changes in science achievement. This hypothesis relates changes in science achievement since 1957 to changes in school goals and student characteristics.

Based on the analysis and discussions presented in Chapters 3 to 7, implications for schools and policy makers are presented in Chapter 8. The chapter discusses the expected effectiveness of some of the major educational reforms based upon the findings of this research. The chapter concludes with a some proposals for raising student science achievement, as well as some conclusions about the state of public education in the United States.

Meta-analytical Research on Science Achievement

The traditional method for reporting the collective results of studies in education has been narrative reviews. Narrative reviews, however, are qualitative, tend to be subjective (Light & Pillemer, 1982), and do not have systematic procedures for integrating studies and forming conclusions across studies (Cooper & Rosenthal, 1980; Light & Smith, 1971). Consequently, narrative reviews are vulnerable to reviewer bias (Slavin, 1984) and seldom are able to develop general conclusions from the studies (Hedges & Olkin, 1985).

In the last decade, meta-analysis has become a frequently used statistical method to combine the results of studies. The term meta-analysis, or analysis of analyses, was first introduced into the literature by Glass (1976), who defined it as "the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings." (p. 3) Meta-analysis is a method for integrating reviews to form generalizations from a collection of studies (Bangert-Drowns, 1986).

The meta-analytic method is particularly well suited for this study because the research on the effect of the innovative science curricula and instructional methodologies is so extensive. Because so many studies have been conducted on this topic in recent decades, the task of integrating these findings is enormous and would be beyond the capability of any individual researcher. Fortunately, during the last 15 years a number of meta-analyses have focused on these topics.

For example, the Science Meta-Analysis Project (Anderson, Kahl, Glass, & Smith, 1983) was a multi-university effort that examined broad questions concerning science education. In the same year, Wilson (1983) did a meta-analysis of the relationship between science attitude and science achievement. Becker (1989) and Lynch and Paterson (1980) used meta-analysis to investigate gender differences in pre-college science achievement. In 1985 Tamir reported a meta-analysis on cognitive preferences in learning. The results of meta-analyses such as these were used to evaluate the effectiveness of the innovative science curricula and instructional methods on student achievement in science.

Research Rationale

A historical analytic approach was selected for this dissertation principally because this approach is the most appropriate technique for tracing social changes over time and for comparing these changes across cultures (Babbie, 1986; Bybee, 1982). However, there was another reason. The social sciences in general and education research in particular have been criticized for the proliferation of unrelated experimental studies that have added little to the overall theoretical body of knowledge. This view was summarized by Hunter, Schmidt, and Jackson (1982) who said:

> "At one time in the history of psychology and the social sciences, the pressing need was for more empirical studies examining the problem in question. In many areas of research, the need today is not additional empirical data but some means of making sense out of the vast amounts of data that have accumulated." (p. 26)

On the same topic, Glass, McGaw, and Smith (1981) added:

> "The house of social science research is sadly dilapidated. It is strewn among the scree of a hundred journals and lies about in the unsightly rubble of a million dissertations. Even if it cannot be built into a science, the rubble ought to be sifted and culled for whatever consistency there is in it." (p. 11)

This author preferred to sift, rather than to add to the scree.

Research Limitations

Historical research has certain limitations. One limitation is the inability to confirm that one factor causes another to change. In this research in particular, although certain changes can be associated with declining student science achievement, no proof of effect can be empirically established. Certainly, alternative interpretations of the data can be made, and the existence of intervening variables cannot be ruled out.

A second limitation of the study is personal values or biases that can influence selection and interpretation of historical sources (Borg, 1989; Longman, 1983). While this threat to validity applies to any type of research, it is particularly important in historical research. In this type of research, a researcher's bias may unintentionally skew the selection and interpretation of research, tending to favor those studies that support the research. Although the author attempted to be objective, the reader is cautioned that personal biases of the author inevitably may influence both the selection and the interpretation of the data.

Definitions

Certain terms have been defined for use in this research. These terms are:

Curriculum: what is taught and what is intended to be learned, as well as methods of instruction, instructional technology, and teaching aids.

Involvement: federal legislation, court rulings, funding restrictions, and administrative guidelines pertaining to public education.

School goals: the long-range, school outcomes as determined by the school district (Posner & Rudnitsky, 1986; Zais, 1976). School goals are the guiding principles, which help to set the tone for the classroom learning climate.

Societal factors: federal and state involvement in public education, societal movements, and changes the American family and community that altered school goals in public schools.

CHAPTER 3

TRENDS IN SCIENCE ACHIEVEMENT

The 1985 report, *High School and Beyond: A National Longitudinal Study for the 1980s* (West, Miller,& Diodato, 1985), opened:

> Over the last 20 years, the United States has witnessed a widespread decline in the quality of education. This decline has been especially pronounced with respect to mathematics and science, as evidenced by lowered enrollments and achievement scores, a diminishing teacher pool, and increased numbers of students on a general education track. (p. xiii)

The state of science education in public schools had been summarized previously in *A Nation at Risk* (1983), which reported that the "average achievement of high school students on most standardized tests was lower in 1983 than in 1957 when Sputnik was launched." Thus, the science dilemma was twofold: students in the United States were lacking both in aptitude and interest in science.

The declines in science achievement resulted in widespread education reforms in the 1980s. However, as this chapter shows, the reforms did not produce the expected gains in science achievement scores. According to the National Science Board (1989), "National and international indicators of U.S. school mathematics and science performance show little improvement, despite continuing major reform efforts." (p. 2) The Board reported that fewer college freshmen were selecting majors in science or engineering and that the rate of increase of enrollment in graduate science or engineering programs was slowing. At the same time, the percentage of foreign students receiving Ph.D.s in science and engineering at American universities continued to increase, while the percentage of native United States students decreased.

In this chapter, trends in science achievement are documented by examining the results of national assessments of science achievement and international tests of science achievement, as well as trends in the SAT-M.

National Tests of Science Achievement

The National Assessment for Educational Progress (NAEP) measured the science achievement of 13- and 17-year-old American students in 1970, 1973, 1977, 1982, and 1986. These results for 13-year-olds and 17-year-olds are shown respectively in Tables 1 and 2.

As shown in Table 1, the overall student science scores for 13-year-olds declined by 7 points between 1970 and 1977. The scores then increased from a low point of 247 in 1977, reaching 251 in 1986. Despite these modest gains, the 1986 scores for 13-year-olds were still lower than in 1970. These trends are shown in Figure 2. As the figure shows, males consistently outscored females on the test. This phenomenon was consistent with trends found on the SAT-M (Figure 12).

TABLE 1

NAEP ASSESSMENT OF SCIENCE PROFICIENCY FOR 13-YEAR-OLDS: 1970-1986

STUDENT CHARACTERISTICS	YEAR				
	1970	1973	1977	1982	1986
All Students	254.9	249.5	247.4	250.2	251.4
Male	256.8	251.7	251.1	255.7	256.1
Female	253.0	247.1	243.8	245.0	246.9
White	263.4	258.6	256.1	257.3	259.2
Black	214.9	205.3	208.1	217.2	221.6
Hispanic	-----	-----	213.4	225.5	226.1
Source: Mullis & Jenkins, (1988)					

TABLE 2

NAEP ASSESSMENT OF SCIENCE PROFICIENCY FOR 17-YEAR-OLDS: 1970-1986

STUDENT CHARACTERISTICS	YEAR				
	1970	1973	1977	1982	1986
All Students	304.8	295.6	289.6	283.3	288.5
Male	313.8	304.3	297.1	291.9	294.9
Female	296.7	288.3	282.3	275.2	282.3
White	311.8	303.9	297.7	293.2	297.5
Black	257.8	250.4	240.3	234.8	252.8
Hispanic	-----	-----	262.3	248.7	259.3
Source: Mullis & Jenkins, (1988)					

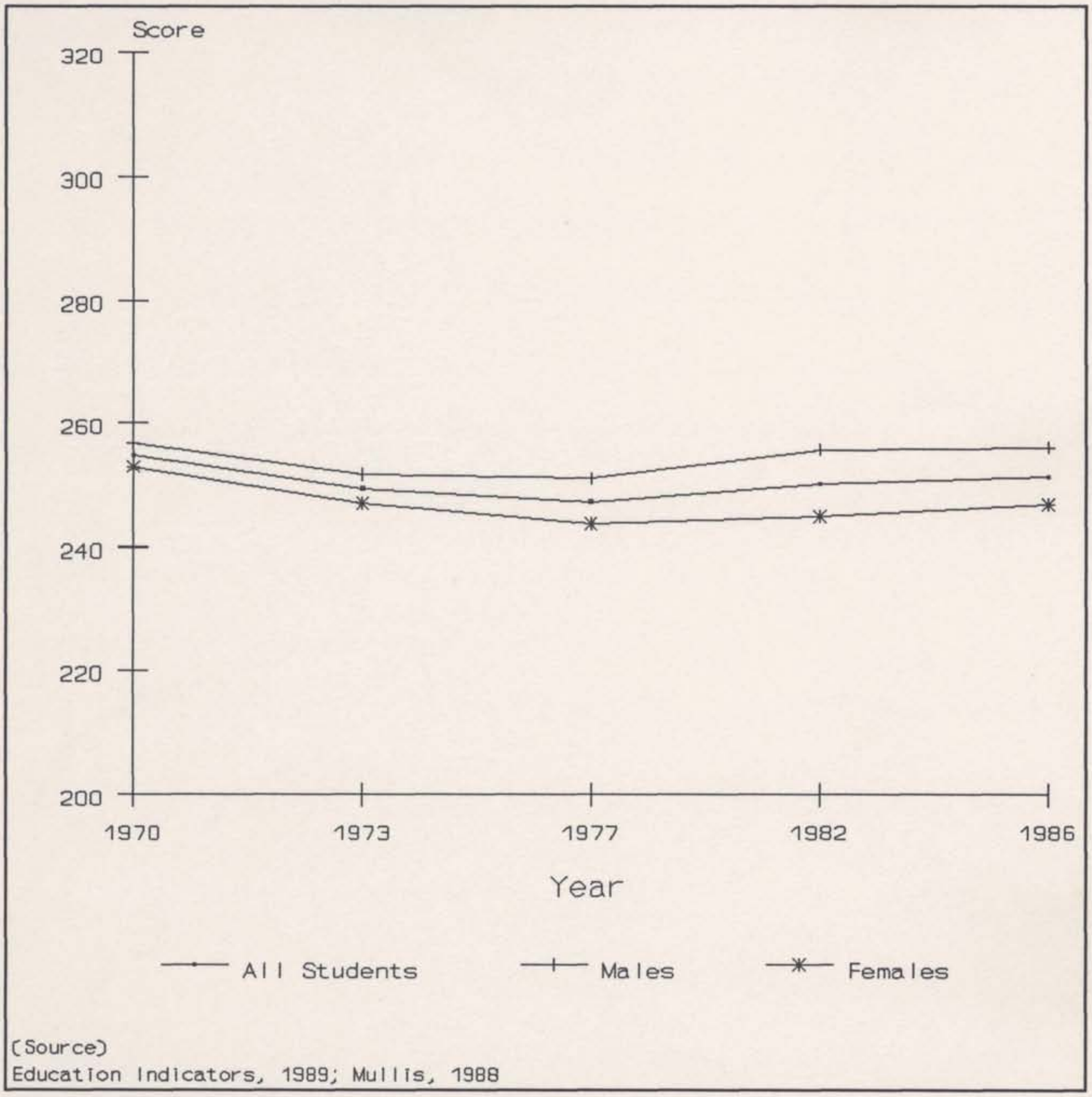

Figure 2. NAEP Scores for 13-Year-Olds (By Gender)

The trend was similar for 17-year-olds, including the gap between male and female scores (Figure 3). In this age group, achievement scores declined by 21 points between 1970 and 1982 (Table 2). The scores then increased in 1986, but like the scores for the 13-year-olds, the gains for 17-year-olds did not offset the previous declines, so that the 1986 student scores were still 16 points lower than in 1970.

When the achievement scores were broken down by racial group (Figure 4 and Figure 5), several interesting differences became apparent. Between 1970 and 1986, the achievement scores of 13-year-old White students declined by 4 points. The decline was much more severe for 17-year-old White students, dropping 14 points. In contrast, achievement scores for 13-year-old Black students rose nearly 7 points between 1970 and 1986. For 17-year-old Black students, scores declined, but only by 5 points during the same period. The trends indicate that the test score declines were greater for White students than for Black students.

The different trends for Black students in comparison to White students were even more apparent between 1977 and 1986--the eras of the "Back-to-Basics" and "Excellence" educational reforms. (The "Excellence" reforms [1983-] were in response to the report, *A Nation at Risk*, 1983). During this time, achievement scores for 13-year-old Black students rose nearly 14 points; for 17-year-old Black students by nearly 18 points. In comparison, achievement scores for 13-year-old White students rose only 3 points during the same period, while scores for 17-year-olds remained nearly unchanged. It would appear that the educational reforms during the 1970s and 1980s may have been more beneficial for Black students than for White students.

The trends for 13-year-old Hispanic students were similar to the trends for 13-year-old Black students, with achievement scores for 13-year-old Hispanic students increasing by nearly 13 points between 1977 and 1986. However, gains made by 13-